The European Union's Approach to Artificial Intelligence and the Challenge of Financial Systemic Risk

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Abstract This piece examines the EU's 'Proposal for a Regulation of the European Parliament and of the Council Laying Down Harmonised Rules on Artificial Intelligence' ('AI Act') with a view to determining the extent to which it addresses the systemic risk created by AI FinTech. Ultimately, it is argued that the notion of 'high risk' at the centre of the AI Act leaves out financial systemic risk. This exclusion can neither be justified by reasons of technology neutrality, nor by reasons of proportionality: neither is AI-driven financial systemic risk already covered by existing (or proposed) macroprudential frameworks and tools, nor can its omission from the AI Act be justified by the prioritisation of other types of risk. Moving forward, it is suggested that the EU's AI Act would have benefited from a broader definition of 'high risk'. It is also hoped that EU policy makers will soon begin to strengthen existing macroprudential toolkits to address the financial systemic risk created by AI.

1 Introduction[1]

Technology and finance have become inextricably linked. Incumbent banks, insurance companies and other traditional financial institutions are increasingly dependent on technology, numerous new companies now specialise in offering

[1] This chapter only takes into account developments until February 2023.

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technology-fuelled financial applications and platforms, and even the world's largest information technology companies (the so-called 'BigTechs') have begun to tap into the financial services industry. 'FinTech'—a term often used to describe the innovative use of modern technologies in the provision of financial services[2]—is seemingly everywhere.[3]

With its promised ability to radically improve information seeking and processing, Artificial Intelligence ('AI') stands to revolutionise FinTech.[4] But if AI brings significant promise to the financial services industry, it also presents important perils. Most obviously, AI-fuelled FinTech—like most other types of FinTech—creates operational and cyber risk. More significantly, the use of AI in financial services gives rise to new challenges specifically inherent in current AI technology paradigms like knowledge representation, natural language processing and machine-learning (Expert Group on Regulatory Obstacles to Financial Innovation 2019). Crucially, it is increasingly apparent that AI FinTech specifically poses a singular threat to market stability in the form of financial systemic risk.

It is little wonder then that AI has become such a focal point of interest for policymakers around the world, having already attracted over 700 policy initiatives across more than 60 different jurisdictions.[5] In the European Union ('EU'), these policy initiatives have included, in particular, the General Data Protection Regulation,[6] the Digital Services Act Package which comprises both a proposal for a Digital Services Act (European Commission 2020a) and a proposal for Digital Markets Act (European Commission 2020b)—and, recently, an AI Legislative Package—which includes an ambitious Proposal for a Regulation on a European approach

[2] The term 'FinTech' can also be employed to describe the new players in the financial system (often start-ups) whose core business involves using technology in the provision of financial services. Such services can include online lending and deposits ('Neobanking'), as well as the provision of payment solutions, investment services, wealth and asset management services, and insurance services ('InsurTech'). For a discussion, see *inter alia* Jackson (2020), p. 9.

[3] The average adoption rate of Fintech among the markets of Australia, Canada, Hong Kong, United Kingdom, and United States was 60% in 2019, while in 2015 it was just 16%, according to a recent report by Ernerst & Young (2019). A similar trend is found in the European Union; see Schmitz (2019).

[4] Typically, AI refers to the technological developments that allow computer systems to behave autonomously and emulate human intelligence, to the point that human input is significantly reduced or even eliminated. For a discussion of the challenges of defining AI, see Russell and Norvig (2010), pp. 1–27; Casey and Lemley (2020), pp. 287–362; Magnusson (2020), p. 337; and Bringsjord and Govindarajulu (2018).

[5] See the report by OECD AI Policy Observatory (2022). Importantly, the OECD AI Policy Observatory has also produced a set of principles promoting the use of AI that is innovative and trustworthy and that respects human rights and democratic value, available at OECD AI Policy Observatory (2019).

[6] Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data and repealing Directive 95/46/EC (General Data Protection Regulation), OJ 2016 L 119/1.

for AI (the 'AI Act') (European Commission 2021g).[7] This act is effectively a set of horizontal rules that will govern not just the growing use of AI in the financial services industry, but all uses of AI more broadly. Still, its potential for addressing the risks specifically created by AI FinTech has been noted by the EU.[8]

This piece examines the EU's proposed AI Act with a view to determining the extent to which it addresses the systemic risk created by AI FinTech. Ultimately, it is argued that the notion of 'high risk' at the centre of the AI Act leaves out financial systemic risk. This exclusion can neither be justified by reasons of technology neutrality, nor by reasons of proportionality: neither is AI-driven financial systemic risk already covered by existing (or proposed) macroprudential frameworks and tools, nor can its omission from the AI Act be justified by the prioritisation of other types of risk. Moving forward, it is suggested that the EU's AI Act would have benefited from a broader definition of 'high risk'. It is also hoped that EU policy makers will soon begin to strengthen existing macroprudential toolkits to address the financial systemic risk created by AI.

Our work is organised as follows: Section 2 determines the extent to which the use of AI technology in the financial sector can amplify systemic risk; Section 3 outlines the basic features of the EU's AI Act and evaluates its ability to specifically capture the systemic risk created by AI FinTech; Section 4 concludes by making recommendations for further regulatory and supervisory developments in this area.

2 AI Uses in Finance and Systemic Risk

2.1 The Opportunities and Risks of AI FinTech

Recent years have witnessed an increasing adoption of high-end technologies by the financial sector, with AI sitting firmly at the heart of the FinTech (r)evolution.

Broadly, AI is used both in front-office operations (comprising procedures vis-a-vis consumers, customers, and supervisory entities) and back-office operations (involving procedures within the organizational framework of the company or institution). Examples of AI-powered FinTech include chatbots for answering

[7] More recently still, the EU has also proposed a new AI Liability Directive: see Directive of the European Parliament and of the Council on adapting non-contractual civil liability rules to artificial intelligence (AI Liability Directive), COM(2022) 496 final, Brussels, 28.09.2022.

[8] Namely, the Explanatory Memorandum for the AI Act notes that its provisions apply to 'AI systems provided or used by regulated credit institutions' (see Explanatory Memorandum, 1.2). More broadly, the AI Act is set to apply to all providers placing on the market or putting into service AI systems in the Union, irrespective of whether those providers are established within the Union or in a third country, to all users of AI systems located within the Union, and to all providers and users of AI systems that are located in a third country, where the output produced by the system is used in the Union—including when those AI systems are applied in connection to the provision of financial services (see AI Act, Article 2).

client queries, trading platforms hosting or using advanced algorithmic trading mechanisms, the provision of deposits and lending services supported by smart contracts running on blockchain protocols, and the automated submission of regulatory reports by supervised entities. In particular, AI enables financial actors to collect and parse through large amounts of data—which may then be put to multiple uses, from calculating credit and investment ratings, to detecting fraudulent and illicit practices. AI can also be used to improve connectivity between agents in the financial system[9]—and AI-fuelled RegTech and SupTech could radically change compliance, regulatory and supervisory procedures.[10]

These uses of AI in finance create significant opportunities for improving efficiency, fairness, and inclusiveness across the financial system, but they also bring important challenges. Indeed, it has long become clear that many modern technological applications are vulnerable to cyber and operational risks, create data privacy concerns, or can become channels for algorithmic bias—and particular features of AI could exacerbate these risks.[11] More recently, specific concerns have emerged regarding the impact of AI FinTech on financial systemic risk.

2.2 *The Impact of AI on the Cross-Sectional and Time Dimensions of Systemic Risk*

The traditional classification of financial systemic risk refers to two dimensions. The first is the 'cross-sectional (or structural) dimension' that relates to how risk is distributed within the financial system at a given point in time. To monitor this dimension, macroprudential authorities must address interconnectedness and common exposures in financial markets. The second is the 'time dimension' which relates to the procyclicality of the financial system and is concerned with how aggregate risks and vulnerabilities build up over time and are amplified by interactions within the financial system and feedback between the financial system and the real economy. Financial firms and individuals alike tend to assume excessive risks in the upswing (boom phase) and become risk-averse in the downswing (bust phase). These hidden and under-priced risks normally unfold dramatically, potentially leading to the materialisation of systemic risk (Danielson 2017).

As the use of AI in finance becomes increasingly pervasive, a key question is whether AI-driven technology can amplify these two dimensions of systemic risk.

Regarding the cross-sectional dimension, interconnectedness is a rather intuitive concept to understand and apply in this context. The financial system is a network of interconnected financial institutions and interlinked markets. In normal times, these interconnections facilitate risk-sharing across financial institutions. However, during

[9] See the report by EBA (2019).

[10] See the examples provided in the report by the FSB (2020), pp. 37–60.

[11] For an overview of opportunities and risks see Boukherouaa et al. (2021).

a period of stress, the same interconnections can easily facilitate the propagation of shocks and result in a 'domino effect'. A shock hitting one market, or one institution can quickly spread to other markets and institutions that are connected to it and impact a large part of the financial system, or even the system as a whole. Similarly, greater reliance on technology across a broad array of interconnected platforms, firms and third-party partners increases interconnectedness and concentration.

Financial institutions largely outsource the use of AI technologies to a small number of third-party technology and service providers. It is indeed the 'famous five' —Amazon, Google, Microsoft, Facebook, and Apple—and their counterparts in China that dominate the AI market partly by applying a strong strategy of acquisitions and complementary dominance in providing cloud computing services.[12] As noted previously, AI services stands to improve the efficiency of the financial markets. Nonetheless, similar to cloud computing providers, AI providers, such as dominant BigTechs, can become systemically important given their interconnectedness with financial institutions and the lack of readily available substitutes for the services they provide.[13] In principle, AI service providers, much like financial market infrastructures, can be said to act as the 'plumbing of the financial system'[14] in light of their provision of infrastructure and platform AI services to financial markets.[15] Unfortunately, at present, the notion of 'systemically important financial institution' is almost exclusively applied, in practice, to traditional financial institutions such as banks and insurance companies (Carstens 2021). Similarly, the notion of 'systemically important financial market utility' is applied to market infrastructures (Carstens et al. 2021, p. 7). Even where domestic macroprudential authorities have a designation power that can be applied to specific legal entities, such as AI providers, within a BigTech group,[16] it is often met with practical and legal barriers and limitations (Keller 2020, p. 138). This challenge is magnified by the existing concerns of market dominance and systemic footprint of BigTechs in light of their collection of user data and their ability to exploit natural network effects.[17]

[12] See CB (2019). On acquisitions see Alcantara et al. (2021). See also, Chakravorti (2021).

[13] According to the FSB-IMF-BIS the three key criteria that are helpful in identifying the systemic importance of markets and institutions are: 'size (the volume of financial services provided by the individual component of the financial system), substitutability (the extent to which other components of the system can provide the same services in the event of a failure) and interconnectedness (linkages with other components of the system).'

[14] Press Release, US Department Treasury, Financial Stability Oversight Council Makes First Designations in Effort to Protect Against Future Financial Crises (18 July 2012).

[15] *Ibid.*

[16] For instance, the FSOC has the power to designate nonbank financial institutions and financial market utilities as systemically important and subject them to heightened supervision and prudential standards. See Dodd-Frank Act ss 113, 804.

[17] On the Data, Network and Activity business model of BigTechs see the report of BIS (2019), p. 62.

In a concentrated environment and without direct regulatory oversight, reliance of financial institutions on third-party AI-providers for their core services could amplify idiosyncratic risks, potentially leading to system-wide disruptions. For instance, if a major provider of AI is exposed to a severe operational disruption, such as a cyber threat, information technology lapses, internal process, or control breakdowns,[18] this could lead to a simultaneous system-wide operational disruption. In an extreme case, market concentration in AI providers could also result in a 'lock-in', where financial institutions are excessively dependent upon a specific AI provider and unable to easily replace its services due to a lack of feasible alternative providers[19] and/or lack of interoperability of the service (Lins et al. 2021, p. 441). AI-providers may themselves depend on the use and services of cloud computing providers, another disruptive sector which could pose risks to the stability of financial systems (FSB 2019, p. 5; Bank of England 2021). Global cloud-computing service providers, such as Amazon and Microsoft, often also provide AI-products and services known as Artificial Intelligence as a Service ('AIaaS').[20] The growth of the AIaaS is exponential and is expected to increase by 41% during 2021–2025.[21] The combination of AI with cloud computing services and the concentration of the providers intensify risks inherent in both disruptive technologies—particularly since these AI providers are often outside the regulatory reach and, therefore, are not subject to micro-prudential regulations that ensure their safety and soundness. Furthermore, the data available to macroprudential authorities on exposures of financial institutions to third-party providers is incomplete. The regulatory perimeter may not yet enable macroprudential authorities to collect timely, comprehensive, and comparable data that can be aggregated for macroprudential analysis. This opacity supports adopting comprehensive and cross-border regulatory frameworks, as noted in Sect. 4 below.

In the cross-sectional dimension of systemic risk, shocks could also propagate via common exposures i.e., exposures of financial institutions towards the same sources of risk. For instance, financial institutions or other companies which provide financial services can be exposed to similar risk factors and risk management practices or models. These common exposures arise because of similarities and homogeneity

[18] See Request for Information and Comment on Financial Institutions' Use of Artificial Intelligence, Including Machine Learning A Notice by the Comptroller of the Currency, the Federal Reserve System, the Federal Deposit Insurance Corporation, the Consumer Financial Protection Bureau, and the National Credit Union Administration on 31 March 2021, available at https://www.federalregister.gov/documents/2021/03/31/2021-06607/request-for-information-and-comment-on-financial-institutions-use-of-artificial-intelligence (accessed 15 March 2022).

[19] Similar to the risk of cloud services. See FSB (2019). See also FINRA (2021).

[20] Lins et al. (2021), p. 6, define it as 'cloud-based systems providing on-demand services to organizations and individuals to deploy, develop, train, and manage AI models'. See the World Bank Group report from 2019 available at https://documents1.worldbank.org/curated/en/954851578602363164/pdf/Prudential-Regulatory-and-Supervisory-Practices-for-Fintech-Payments-Credit-and-Deposits.pdf (accessed 15 March 2022).

[21] See ReportLinker (2021).

across financial institutions that create the possibility of joint simultaneous failures. As such, reliance on standardised AI models or algorithms, which are trained on similar data streams, could produce herding and uniformity of predictions and behaviour in financial markets.[22] This is particularly worrisome since financial institutions already use AI systems for asset pricing, credit risk modelling and monitoring of risks[23] and will increasingly rely on these, not as complementary systems but as substitutes to existing, human-monitored ones. Moreover, adopting AI-tailored regulation and supervisory systems could inadvertently lead to common characteristics to AI systems, homogeneity, and model uniformity (Calzolari 2021, p. 33). This is not a theoretical concern as common exposures to similar risk management practices and models have proved to be disastrous in the run-up to the 2007–2009 financial crisis, when the Basel Committee standards of minimum capital for international banks heavily relied on the risk assessment of credit rating agencies. In hindsight, it became clear that these agencies had incentives to inflate credit scoring and their models failed to assess risks accurately (Rivlin and Soroushian 2017).

The use of AI systems could also provide a fertile ground for the build-up of endogenous imbalances in the financial system propagated and reinforced through a feedback loop between data and algorithms. In this scenario, the AI system will generate algorithms' decisions and data which will then be used to update models. These models will generate more data and will adapt their decisions and predictions based on that data in a dynamic and autonomous feedback loop. This unpredictable cycle, in its nature, could be dangerous and amplify risks that are already present in financial markets.

The concern of the feedback loop between data and algorithms is particularly acute for three key reasons. First, research on the effects of the feedback loop is still in its infancy,[24] making it difficult to monitor, let alone control it. This fits in well within a broader concern of scarcity of experts and the challenge of financial institutions and regulatory and supervisory authorities to hire and retain highly skilled personnel (Chui and Malhotra 2018). Second, AI service providers use 'alternative data' such as unstructured data, synthetic data and aggregated data (Bank of England and the Financial Conduct Authority 2021). Processing 'alternative data' and using it to inform policy decisions is, in practice, far from easy. Unstructured data must go through a cleaning process to remove errors and inconsistencies and ensure its effective use; synthetic data must capture and

[22] See Gensler and Bailey (2020). On herding results when AI systems perform similar calculations simultaneously, see Buckley et al. (2021), p. 51.

[23] FSB (2017b); and Institute of International Finance (2019), highlighting the lack of understanding from supervisors as a key challenge to implementing Machine Learning in credit risk modelling. See also the EBA (2021) and, in particular, see on p. 66 analysis and case studies of RegTech solutions to creditworthiness assessments.

[24] Malik (2020) shows that the feedback loop between data and money laundering algorithm creates a 'self-fulfilling prophecy' where the ML system overestimates its prediction accuracy, and its (human) users over-rely on the system predictions.

accurately represent the original real data[25] whereas aggregated data must be validated, at times, without knowing its granular structure (Rankin et al. 2020). The absence of tailored-data quality standards for AI further exacerbates the unpredictability of the data-algorithms feedback loop. Third, AI systems are trained on past events. Initial outputs, patterns and indicators set by regulators are shaped by humans who may naturally have narrow and backward-looking views of systemic risk. There is, therefore, a real risk that 'overtraining' on past events will result in new types of risks being left 'off screen'. This concern led economists to warn of the danger that AI systems '. . . will focus on the least important type of risk, those that are readily measured while missing out on the more dangerous endogenous risk. In effect, it will automate and reinforce the adoption of mistaken assumptions that are already a central party of current crises. In doing so, it will make the resulting complacency even more likely to build up over time.'[26] While this risk may not be unique to AI, most AI systems applied in financial services are untested for an abrupt shock to market conditions, a financial crisis and other stress scenarios.[27] Where the parameters of input data are unfitting to these conditions, models may need retraining (Bank of England 2020). However, retraining is an expensive process and, therefore, financial institutions are likely to suffer from inaction bias and choose to delay it, at the expanse of erroneous methods. As we shall see in the next section, the need for macroprudential regulation (and a supporting legal framework) that can 'force' financial institutions as well as AI providers to internalise these negative externalities has not been addressed by the European Union's AI Act—nor is it currently addressed by any sectoral legislation—and remains vital and urgent.

Another key challenge of AI systems that is prevalent in academic discussion is the black-box problem. In AI-driven algorithmic systems, it is possible to observe input and output (incoming and outgoing) data, but their internal operations are not always very well understood.[28] By way of illustration, AI models are so complex that even their creators are often not able to grasp how decisions have been formulated or interpret the reasoning supporting a given output. (Black and Murray 2019, p. 196) Automated decision-making, therefore, raises a concern of

[25] There is evidence of decreases in accuracy in models trained with synthetic data compared with models trained with real data. See Rankin et al. (2020).

[26] Buckmann et al. (2021) therefore suggest that when it comes to predicting crises 'Humans' rich historical, contextual, and theoretical understanding helps us to deal with these unexpected situations.'

[27] European Commission (2021a). On the potential negative impact of a crisis on ML models see Bank of England (2020), The Impact of COVID on Machine Learning and Data Science in UK Banking, Quarterly Bulletin 2020 Q4 available at https://www.bankofengland.co.uk/quarterly-bulletin/2020/2020-q4/the-impact-of-covid-on-machine-learning-and-data-science-in-uk-banking (accessed 15 March 2022), suggesting that '. . . this is linked to the fact that ML models' performance can change or deteriorate under conditions different to those displayed in the data on which they were originally trained.'

[28] Black and Murray (2019), referring to Pasquale (2015).

explainability[29] or, in other words, a concern that the internal behaviour of the model cannot be 'directly understood by humans (interpretability)' and its explanations (justifications) cannot 'be provided for the main factors that led to its output (EBA 2020).' AI systems also raise concerns of auditability since it is not always feasible to conduct an analytical and empirical evaluation of the algorithm.[30] These features can negatively affect the capacity of financial firms to monitor algorithmic performance and assure ongoing compliance with regulatory requirements.[31] This, in turn, could result in inaccurate credit decisions based on erroneous creditworthiness assessments and unsatisfactory credit and liquidity risk management. Lack of explainability also impinges on the ability of financial institutions to adjust their strategies in times of stress or poor performance (Organization for Economic Co-Operation and Development 2021), potentially leading to market volatility, liquidity shortages and even a gridlock during financial turmoil (Bathaee 2018, p. 889).

Without diminishing the importance of the black-box problem, another danger of AI that has been somewhat overlooked is the disparity and mismatch between expectations and targets, on the one hand and objectives and purposes, on the other. The potential disparity between regulatory aims and the operation of AI systems that are programmed to optimise processes should be acknowledged and monitored. The difficulty, however, to foresee this disparity was illustrated in Yuval Harari's book, Homo Deus:

> Even programming the system with seemingly benign gaols might backfire horribly. One popular scenario imagines a corporation designing the first artificial super-intelligence and giving it an innocent test, such as calculating pi. Before anyone realises what is happening, the AI takes over the planet, eliminates the human race, launches a campaign of conquest to the ends of the galaxy, and transforms the entire known universe into a gain super-computer that for billions upon billions of years calculates pi ever more accurately. After all. This is the divine mission its Creator gave it (Harari 2016).

While this scenario may seem more like science fiction than reality, the point to be made here is that regulatory goals, including stability of the financial system and the safety and soundness of financial institutions, may not be easily reconciled and controlled in AI systems.

Another type of disparity could emerge between the straightforward optimisation target of AI and its users' target. This is particularly the case with off-the-shelf AI service that offers to users AI models that are already trained by the provider or other parties and removes the need to set up, train and actively manage the product. This service offers users 'complexity abstraction' and is cost-effective, but it also

[29] See FSB (2017a), and Knight (2017).

[30] See the paper by the Banque De France (2020).

[31] This concern has been raised recently in the US: A Notice by the Comptroller of the Currency, the Federal Reserve System, the Federal Deposit Insurance Corporation, the National Credit Union Administration, and the Financial Crimes Enforcement Network on 4 December 2021, available at https://www.federalregister.gov/documents/2021/04/12/2021-07428/request-for-information-and-comment-extent-to-which-model-risk-management-principles-support (accessed 15 March 2022).

hands over the control and responsibility of the service to the AIaaS provider (Lins et al. 2021, p. 6; Pandl et al. 2021). As such, providers will not know much about the business model, practices and targets of the user and the user, in turn, will not know much (or not at all) about the setup and configuration of the AI system (Pandl et al. 2021). The 'veil' between AI providers and users increases the risk that target optimisation will not meet expectations and inhibit the ability to mould the service to the specific needs of the firm.

Finally, the use of AI can also affect regulators and the compliance of financial firms with regulations. As noted previously, AI systems are increasingly used in policymaking—and while this technology entails a great potential particularly in improving systemic risks surveillance by automating macroprudential analysis and data quality assurance, the use of AI to improve macroprudential analysis comes with a price.[32] Lack of explicability and auditability means that macroprudential authorities may not be able to understand how an AI model has arrived at its decisions or predictions, how undesired events occurred and how to respond and mitigate risks that have materialised or prevent risks from emerging in the future. Accordingly, macroprudential authorities may not be able to communicate to the public or parliament the reasons supporting their policy decisions and thus, their transparency and accountability may be diluted.[33] In addition, although AI can indeed be used by banks to maximise their regulatory compliance, for instance, for capital optimisation and improve their risk profile and safety and soundness,[34] assisting banks to 'game' the system more efficiently can ultimately subdue the effect of prudential regulatory standards. When accumulated, the strategic behaviour of financial institutions could result in negative externalities and destabilise the financial system. Most importantly, these 'gaming' techniques may relieve pressures for banks in the short term but may not necessarily be set with a view to longer-term changes that may yield more sustainable outcomes.

This is only the tip of the iceberg. In reality, the impact of the risks that should be of a concern to regulators go much beyond the financial system. Until now, the regulatory focus on the financial system-real economy nexus was limited to ensuring the continuation of efficient allocation of resources of the financial system in the face of shocks and preventing potential negative effects on the real economy. As AI systems will increasingly power not just the financial system but also energy, military and transport, a breakdown in those systems will be truly systemic and potentially devastating. Risks inherent in AI systems will originate from the real economy and ecosystems (Galaz et al. 2021), spilling over to other segments of the

[32] On the use of AI in supervision see Hertig (2022).

[33] Keller (2020), p. 177. Though see Danielsson et al. (2021) arguing that AI models can be more transparent than human regulators who can use strategic ambiguity in their communications.

[34] Though the use of Machine Learning is limited in regulatory areas such as capital requirements for credit risk and for Internal Rating Based approaches—they are largely used as a complementary system to the standard model used for capital calculation. To that effect, the European Banking Authority has published a Discussion Paper on Machine Learning for IRB Approaches, November 2021, EBA/DP/2021/04.

economy and the financial system. This, rather distant, danger has not gone under the radar of supervisors. The European Systemic Risk Board, for instance, observed that 'AI could be used to attack, manipulate, or otherwise harm an economy and threaten national security through its financial system directly and/or its impact on the wider economy. For instance, algorithms could be manipulated in an effort to transfer wealth to foreign powers, to undermine an economy's growth in an effort to create unrest, or to send wrong signals to trading units to seek to trigger a systemic crisis'[35]—a scenario that is truly a case of 'unknown unknowns'.

In truth, much is still unknown about the real extent of the impact of AI-driven FinTech—and while policymakers, industry players and experts appear alert to many of the risks created by AI, the potential of AI-driven technology for magnifying systemic risk has been receiving comparatively little attention. With the EU taking the lead in AI regulation, the time is ripe to assess whether its AI Act captures the financial systemic risk amplified by AI FinTech.

3 The EU's Approach to AI and the Challenge of Systemic Risk

3.1 One Approach, Two Pillars

The risks associated with the growth of AI technology and the development of an increasing variety of AI applications—in finance[36] and elsewhere[37]—have not gone unnoticed by the EU. Quite to the contrary: as the Union enters what it has dubbed as Europe's Digital Decade,[38] the desire to ensure that AI 'puts people first' sits firmly at the forefront of the EU agenda.

Indeed, the EU's recently published approach to AI expresses clear concerns over the unrestrained development of AI applications and their risks, and has elected 'trustworthy AI' as one of the key pillars of its AI policy.[39] At the same time, the

[35] See European Systemic Risk Board (2020); see also 'The Rise of Global Technology Risk' in Arner et al. (2019, p. 69) and Buckley et al. (2019).

[36] In March 2018, an Expert Group on Regulatory Obstacles to Financial Innovation (ROFIEG) was appointed to assist the DG FISMA by providing expertise on FinTech, and its final report—dated 13 December 2019—alerted the European Commission to the fact that AI was set to 'become increasingly relevant for both FinTech and RegTech'. See ROFIEG (2019).

[37] The EU's concern with developing a clear AI strategy dates from as early as 2018, when 25 European countries adhered to a Declaration of cooperation on AI (see Declaration—Cooperation on Artificial Intelligence, 10 April 2018, available at https://digital-strategy.ec.europa.eu/en/news/eu-member-states-sign-cooperate-artificial-intelligence, (accessed 15 March 2022)) in what the EU describes as the first 'important milestone' in the road to a fully-fledged European approach to AI. See European Commission (2018).

[38] See European Commission (2021f) and European Commission (2021d)

[39] See European Commission (2022a).

EU has not failed to recognise the promises of AI, and its desire to create a safe environment for AI users, developers and deployers has come tempered by a sense of urgency in bolstering Europe's ability to compete in the global AI landscape.[40] In addition to 'trustworthy AI,' the EU's policy is to be supported by a second pillar of 'excellence in AI.'

The image used by the EU is evocative: pillars typically offer upright support for superstructures—and multiple pillars intuitively offer more support than one. In that sense, the goal of the EU is to 'build a resilient Europe for the Digital Decade' where, *at the same time,* 'people can enjoy the benefits of AI': in other words, the EU wants to become an AI powerhouse sustained by both innovation and safety. But, unlike most pillars, innovation, and safety are not always complementary: they are often at tension with each other and choices that make AI more trustworthy can come at the cost of AI excellence (and vice versa).[41]

Arguably, the complementarities and tensions at the nexus of the EU's approach to AI stand as powerful explanations for many of the regulatory choices that shape that approach—and namely, for the key option to address differently different types of risks created by AI, and some not at all. Under this framework, identifying and recognising the existence of certain risks—like the AI-driven systemic risk discussed in the previous section—is just the first step in policymaking, and a step that is not necessarily followed by regulatory action to mitigate those risks.

With that in mind, this article proceeds to introduce the EU's approach to AI, discussing the extent to which it captures the financial systemic risk amplified by AI.

3.2 The EU's Approach to AI

It has been noted that the EU's approach to AI rests on a dual notion of excellence and trustworthiness. The idea of excellence in AI has translated into concerns over the development and uptake of AI in Europe, the fostering of an environment where AI is able to thrive 'from the lab to the market,' the encouragement of AI as a force for good in society, and the building of strategic leadership in key sectors; the idea of trustworthy AI, on the other hand, reflects concerns over safety risks specific to AI technology, liability issues pertaining to AI, and the importance of updating sectoral safety legislation.[42]

[40] See European Commission (2022b).

[41] Indeed, Brummer and Yadav argue that 'when seeking to (i) provide clear rules, (ii) maintain market integrity, and (iii) encourage financial innovation, regulators can achieve, at best, two out of these three objectives'. See Brummer and Yadav (2019), p. 235.

[42] See European Commission —namely the sub-headings 'A European approach to excellence in AI' and 'A European approach to trust in AI,' respectively.

In practice, these concerns have led the European Commission to publish an AI package in April 2021 that includes a Communication on Fostering a European Approach to Artificial Intelligence' ('Communication') (European Commission 2021b), an (updated) Coordinated Plan with Member States ('Coordinated Plan') (European Commission 2021c), and the previously discussed AI Act—a compromise version of which has recently been approved by the European Commission.[43]

The Communication lays down the foundations for the EU's approach to AI—expanding upon the notion that AI carries both opportunities and risks and noting that 'certain characteristics of AI... pose specific and potentially high risks to the safety and fundamental rights that existing legislation is unable to address'—but ultimately offers very little detail into how the EU plans to deal with the so-called 'two sides' of AI.[44] By contrast, both the Coordinated Plan and the AI Act provide important insights into what the EU has in store for AI.

Broadly, the (updated) Coordinated Plan encapsulates the commitment to foster Europe's ability to compete in the global AI landscape,[45] provides an overview of what has already been done and proposes a plan for future action. Crucially, it notes the importance of developing a policy framework to ensure trust in AI systems—and highlights the publication of a White Paper (European Commission 2020c) proposing an EU Regulatory Framework on AI ('AI White Paper').[46] This regulatory framework is set to include a number of measures adapting the European liability framework to the challenges of new technologies (including AI),[47] several

[43] The current version of the proposed AI Act is now awaiting adoption by the European Parliament.

[44] See European Commission (2021d) —where the European Commission recognises both 'AI's potential' and the fact that 'the use of AI also creates risks that need to be addressed.'

[45] This Commitment had already been expressed in the original version of the EU's Coordinated Plan on AI. European Commission (2018).

[46] Other notable outputs include the Independent High-Level Expert Group on Artificial Intelligence's Ethics Guidelines for Trustworthy Artificial Intelligence and the Assessment List for Trustworthy AI produced by the High-Level Expert Group on AI'—available, respectively at https://digital-strategy.ec.europa.eu/en/library/ethics-guidelines-trustworthy-ai and at https://digital-strategy.ec.europa.eu/en/library/assessment-list-trustworthy-artificial-intelligence-altai-self-assessment (accessed 15 March 2022)—as well as the EU Cyber Security Strategy for the Digital Decade, produced by the Commission and the High Representative of the Union for Foreign Affairs and Security Policy, and available at https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=JOIN:2020:18:FIN (accessed 15 March 2022).

[47] The EU aimed to propose these measures sometime between the last quarter of 2021 and the first quarter of 2022 (see European Commission 2018) and it is likely that they will include a revision of the Product Liability Directive, as well as a specific proposal regarding the liability of certain AI systems. See European Commission (2021b).

revisions to existing sectoral safety legislation[48]—and, notably, the aforementioned AI Act.

It is this AI Act that offers the clearest glimpse into how AI is set to be regulated within the EU. At over 80-articles long it is meant to secure Europe 'a leading role in setting the global gold standard' for AI and sets itself to address the risks generated by specific uses of AI technology. Roughly, this is to be accomplished through a horizontal regulatory framework that lays down harmonised rules for introducing and using AI systems in the EU across industries and sectors.

Cross-sectoral horizontal rules are inherently ambitious, but the ambition behind the EU's proposal has come tempered with important concerns for balance. Such concerns are not misplaced; rather, they illustrate the inherent tension between the two pillars in the EU's approach to AI—excellence and trustworthiness—and, more broadly, the inherent tension between innovation and safety that so often underlies regulatory policy. However, it is worth determining whether the EU's AI Act resolves this tension satisfactorily, in a way that allows it to address the impact of AI on the financial system, namely by preventing or mitigating the financial systemic risk demonstrably amplified by AI.

3.3 Missing the Opportunity to Regulate the Systemic Risk Amplified by AI

The Regulatory Framework for AI proposed by the EU currently does very little to specifically address the impact of AI on the financial system. As it stands, the one proposal made by the EU within this framework—the AI Act—targets only one aspect of that impact: the risk of discrimination created by AI systems that evaluate the creditworthiness of natural persons ('algorithmic credit scoring').[49]

This is not necessarily an oversight. The impact of AI technology on the financial system has been expressly acknowledged by the EU on more than one occasion—and it does not necessarily follow that the EU must approve new rules to address that impact. It all comes back to the tension between excellence and trustworthiness—innovation and safety—which the AI Act resolves through two principles: technology neutrality and proportionality.

The idea of technology neutrality[50] is firmly present in the April 2021 Communication that laid down the foundations for the EU's approach to AI,[51] and reflects the

[48] The revisions of existing sectoral safety legislation were originally planned for the second quarter of 2021 (see European Commission (2022c)), and are likely to include adaptations of the Machinery Directive, of the General Product Safety Directive, of the Radio-Equipment Directive and of the product legislation that might follow the approval of the proposed AI Act (see European Commission (2021d)).

[49] AI Act, Recital (37) and Annex III, 5(b).

[50] For a discussion of the principle of 'technology neutrality,' *see,* ia, Greenberg (2016), p. 207.

[51] See European Commission (2021b).

notion that regulation should neither impose nor discriminate in favour of the use of any specific technology.[52] Any rules should focus on regulating the risks created by a particular technology, instead of on the technology itself. This means two things for the EU's approach to AI: first, that any regulatory approach approved by the EU to mitigate the risks created by AI technology should be risk-based (as opposed to technology-based); second, that new rules are only required if and to the extent that AI technology creates risks that are not already adequately addressed within the EU.

Accordingly, the AI Act endorses a risk-based regulatory approach to AI that limits regulatory intervention 'to the minimum necessary requirements to address the risks and problems linked to AI' and tailors it 'to those concrete situations where there is a justified cause for concern, or where such concern can reasonably be anticipated in the near future.'[53] Additionally, it is noted—both in the EU AI White Paper and in its AI Act—that there is currently 'an extensive body of existing EU . . . legislation, including sector-specific rules, further complemented by national legislation' that is 'relevant and potentially applicable to a number of emerging AI applications.' Such rules are fully applicable in these sectors, regardless of whether AI technology is involved, and will only require adjustments if—and only if—they cannot 'be enforced adequately to address the risks that AI systems create (European Commission 2020c).'

Likewise, the notion of proportionality is embedded across the various documents that comprise the EU's approach to AI[54]—culminating in Recital (14) of the AI Act, which underlines the need to introduce 'a proportionate and effective set of binding rules for AI systems.'[55] More broadly, the EU rejects solutions that are 'excessively prescriptive,'[56] or impose 'disproportionate burdens'[57] in favour of solutions that 'facilitate . . . innovation and thus enhance European competitiveness,'[58] namely by avoiding 'unnecessary restrictions to trade (European Commission 2021e).' Specifically, this proportionality is to be achieved by distinguishing between varying levels of risk, by regulating different AI applications

[52] The idea of 'technology neutrality' is not new, nor is it exclusive to the EU's approach to AI. For example, technology neutrality is one of the key principles of the European Regulatory Framework for Electronic Communications (see Directive 2002/21/EC of 7 March 2002, recital (31)).

[53] See chapter 1 of the European Commission's Explanatory Memorandum for the Proposal for a Regulation of the European Parliament and of the Council Laying Down Harmonised Rules on Artificial Intelligence (Artificial Intelligence Act) and Amending Certain Union Legislative Acts, 2021/0106(COD), available at https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1623335154975&uri=CELEX%3A52021PC0206 (accessed 15 March 2022).

[54] See, in particular, European Commission (2021b); and European Commission (2018).

[55] AI Act, recital (14).

[56] *Ibid.*

[57] *Ibid.*

[58] *Ibid.*

differently and according to their perceived level of risk—and, crucially, by leaving those AI applications perceived as less risky essentially unattended.[59]

At the end of the day, the ideas of technology neutrality and proportionality combine in the EU's AI Act to give rise to a 'risk-based approach' to AI that specifically focuses on 'high risk' applications.[60] In other words, even though the AI Act endorses an ambitious, cross-sectoral, horizontal regulatory approach, that approach is limited by the idea that only unregulated AI risk needs to be addressed—and, even then, only 'high' AI risk. The result is a regime that prohibits only a limited number of AI practices,[61] and that only imposes additional requirements and obligations on those AI systems that are considered by the EU to be 'high risk'[62] (and on participants in the production and distribution chains of those systems[63]—all the way down to final users).[64]

Does this 'high risk approach' to AI adequately address the change brought by AI to the financial system? As noted previously, only one aspect of the impact of AI on the financial system is currently covered by the EU's AI Act—the risk of discrimination created by algorithmic credit scoring systems[65]—but the generalised exclusion of the risks posed by other AI systems to the financial system and its players can only be deemed an oversight if it cannot be properly justified under the technology neutrality and proportionality principles that underlie the EU's high risk approach to AI regulation.

On the one hand, there is no question that the EU wants to create a regulatory environment encouraging of 'trustworthy AI;' on the other hand, there is no question either that overreaching laws and rules could come at the expense of the EU's ability to compete with countries like the United States and China for a place at the forefront of the global market for AI technology. And it could be argued that most risks posed by AI to the financial system and its players

[59] Notably, the AI Act includes a series of articles whereby the Commission and Member States undertake to encourage and facilitate the adoption of voluntary codes of conduct for the providers of non-high-risk AI (see AI Act, article 69). Also, non-high-risk AI systems may nevertheless be regulated by other rules within the broader EU and national regulatory frameworks—although most legal regimes currently in force in the EU fail to specifically address the risks newly created or enhanced by the development of AI applications.

[60] See the European Commission's White Paper, where the European Commission expressly states that 'to strike this balance [between achieving its regulatory objectives without being excessively prescriptive], the Commission is of the view that it should follow a risk-based approach' European Commission (2020c).

[61] AI Act, article 5.

[62] AI Act, articles 8–15.

[63] AI Act, articles 16–28.

[64] AI Act, article 52. Notably, additional requirements may apply to AI systems intended to interact with natural persons—which may be cumulatively subject to the requirements and obligations that pertain to 'high risk' AI systems (see AI Act, article 52(4)).

[65] AI Act, Recital (37) and Annex III, 5(b). Importantly, AI systems put into service by small scale providers for their own use are exempted from the regulation.

are already broadly captured by its existing financial regulation framework[66]—particularly following recent efforts to expand the scope of that framework.[67] For example, the most recent version of the EU's Markets in Financial Instruments Directive ('MiFID II') contains a series of requirements specifically applicable to firms, engaging in, facilitating, or hosting algorithmic trading,[68] and the 2014 EU Market Abuse Regulation includes express references to algorithmic-driven market manipulation[69]—showing a willingness to address algorithmic-driven (if not explicitly AI-driven) change.

Ultimately, a full discussion of whether the EU's high-risk approach to AI adequately addresses the impact of AI on the financial system far exceeds the scope of this piece. The scope of our enquiry is much narrower: does the high-risk approach to AI endorsed by the EU address the many ways in which AI-driven technology has amplified systemic risk and, if not, are any limitations in scope justified by technology neutrality or proportionality concerns?

Determining the extent to which the EU's approach to AI—and, namely, its AI Act—can address the new sources of systemic risk created by AI requires analysing the notion of 'high risk' at the centre of the AI Act. According to articles 6 and 7 of the AI Act, the classification of a particular type of AI system as 'high risk' depends essentially on its intended use (*see* article 6(1)(a) and 7(1)(a)) and on its potential for posing a 'risk of harm to the health and safety, or a risk of adverse impact on fundamental rights' of individuals (*see* article 7(1)(b))—with no regard for its potential for creating losses and contagion channels that can reach the wider system populated by those individuals. Indeed, this focus on the 'protection of... individuals' is made clear in Recital (10) of the AI Act and permeates most of its provisions.[70]

Some solace can perhaps be taken in the fact that article 7 (2)(d) of the AI Act suggests that 'risk assessments' conducive to updating the list of 'high risk' systems already identified by the European Commission[71] should take into account

[66] A discussion of the extent to which the EU financial regulation framework does a good job of capturing all the financial activity taking place within its Member States falls outside the scope of this article, although concerns over the system's ability to capture non-bank financial intermediation (sometimes known as 'shadow banking')—particularly as both small FinTech start-ups and larger technological companies ('BigTechs') increasingly position themselves as new entrants in the financial industry—are likely justified.

[67] For example, MiFID II expanded the scope of MiFID to capture proprietary traders that apply 'high frequency trading' techniques. For a discussion, see, ia, Gullifer and Payne (2020). Notably, the EU is in the process of reviewing its current algorithmic trading regime, but ESMA's final report on the matter fails to address the risks created by AI-driven algorithmic trading (see ESMA (2021))—although ESMA's more recent TRV Risk Analysis on Artificial Intelligence in EU Securities Markets does acknowledge the threat of 'possible systemic risks arising from the use of AI in algorithmic trading, as well as algorithmic bias and overfitting' (see ESMA (2023)).

[68] See, in particular, MiFID II, articles 17 and 48.

[69] EU Market Abuse Regulation, article 12(2)(c).

[70] AI Act, recital (10).

[71] AI Act, Annex III.

'the potential extent of [the harm or adverse impact to individuals] in terms of its intensity and its ability to affect a plurality of persons,' but even a broad interpretation of this formula fails to capture the true nature of systemic risk—which, as noted in the previous section, does not just include the risk that individual losses might affect a large number of agents at the same time, but, crucially, the risk that individual losses might propagate from just one individual agent and spread across an increasingly interconnected system—or that the use of similar models may result in common exposures that can facilitate the propagation of shocks.

It seems then that the AI Act struggles to capture the cross-sectional dimension of 'systemic risk' in its definition of 'high risk'—and, in that way, to address it. Given the significant propensity of AI for amplifying systemic risk discussed in the previous section, this could be seen as a significant overlook, but can this exclusion be justified under principles of technology neutrality or proportionality?

Technology neutrality requires regulators to adopt a risk-based—as opposed to technology-based—approach to regulation and intervene only when they identify risks that need mitigating. Now, the previous section has already covered the vast number of ways in which AI-driven technology amplifies financial systemic risk, and while some of these ways have been specifically addressed by recent regulation—namely, MiFID II when it comes to algorithmic trading[72]—others have not received the same regulatory attention.[73] It could, of course, be argued that AI-driven systemic risk is already covered by existing macroprudential frameworks, but the European Systemic Risk Board has recently acknowledged that technology-driven financial systemic risk (or 'systemic cyber risk') creates threats that 'require further work by macroprudential authorities (ESRB 2020).' And AI technology—as it evolves—can be a whole new ball game.

Alternatively, it could be argued that excluding systemic risk considerations from the definition of 'high risk' is justified by proportionality concerns and the relative lesser importance of this type of risk, but that would go against the growing consensus around the significance—and, indeed, the desirable prioritisation—of financial stability as a regulatory goal (Armour et al. 2016). From that perspective,

[72] MiFID II, articles 17 and 48.

[73] It is true that the Digital Services package also addresses concerns with AI and its impact on 'systemic risk'—but the Digital Services Act limits the idea of systemic risk to three main categories of risk that do not reflect the macroprudential concerns that underlie the narrower concept of 'financial systemic risk' used in this piece: a first category concerning 'the risks associated with the misuse of their service through the dissemination of illegal content, such as the dissemination of child sexual abuse material or illegal hate speech, and the conduct of illegal activities, such as the sale of products or services prohibited by Union or national law, including counterfeit products;' a second category concerning the impact of services 'on the exercise of fundamental rights, as protected by the Charter of Fundamental Rights, including the freedom of expression and information, the right to private life, the right to non-discrimination and the rights of the child;' and a third category concerning 'the intentional and, oftentimes, coordinated manipulation of the platform's service, with a foreseeable impact on health, civic discourse, electoral processes, public security and protection of minors' (see Proposed Digital Services Act, Recital (57)).

it is hard to understand why the EU has used its AI Act to address the AI-driven discrimination risks created by a phenomenon like algorithmic credit scoring, while leaving bigger picture systemic risk implications entirely unaddressed (including those that pertain to algorithmic credit scoring).[74]

Thus, it appears not only that the EU approach to AI, in general—and its new AI Act, in particular—fail to capture the systemic risk newly created by AI, but also that such failure is hard to justify under the principles of technology neutrality and proportionality that appear to guide such approach.

4 Conclusion

As the world of finance enters a new age of technological progress, regulators and supervisors across the globe have been brought to a crossroads: how can the financial system harness the benefits of AI while guarding against its risks? Answers are rarely obvious when it comes to algorithmic technology, but that has not stopped the EU from leading the way to shape the global regulatory agenda on AI.

The EU's regulatory aspirations go far beyond addressing the impact of AI on the financial system and its players: a bold new proposal for a horizontal AI Act targets high risk AI applications across industries and sectors. At the same time, the Union's ambitions have been moderated by concerns over its ability to compete in the global AI arena: AI trustworthiness and safety are important, but so are AI excellence and innovation. In the end, the EU's regulatory approach to AI readily acknowledges the impact of AI on the financial system—and, in particular, the risks created by algorithmic credit scoring systems—but leaves the financial systemic risk created by AI seemingly unaddressed.

This might be a significant overlook: this article has demonstrated that AI has been transforming both the financial system and the way in which that system is regulated and supervised, creating new—and still largely understudied—sources of systemic risk. And while the EU's decision to exclude systemic risk from the definition of 'high risk' that underpins its new AI Act could be justified by reasons of technology neutrality or proportionality, neither reason holds water. Neither are these new sources of systemic risk already addressed by existing macroprudential regulatory and supervisory approaches—as recently acknowledged by the EU's own

[74] As noted by Aggarwal, the fact that algorithmic credit scoring is a post-crisis phenomenon and the fact that algorithmic credit scoring systems have been trained in a benign macroeconomic environment is potentially worrisome. Relatedly, Aggarwal also expresses concerns over 'the impact of algorithmic credit scoring on the overall volume of household debt and the rate of credit expansion in the economy – particularly to vulnerable consumers for whom debt can quickly become unaffordable' (see Aggarwal (2021), pp. 42–73). The DNB, for instance, also acknowledges the systemic risk implications of AI-driven solutions and concentration of actors under the 'Soundness' principle included in its 'Principles for the Use of Artificial Intelligence in the Financial Sector'. See De Nederlandsche Bank (2019).

European Systemic Risk Board—nor is this type of risk less significant than the risks identified and covered by the AI Act.

It could be argued more convincingly that perhaps the EU's AI Act was not the right type of instrument for addressing this type of risk.[75] But it is nevertheless worrisome that horizontal rules that have the ambition of laying down harmonised AI rules across sectors and industries—and which even address the risks inherent in particular financial activities and services, like algorithmic credit scoring—entirely ignore the specific type of risk that most clearly conveys potential threats to the stability of that system. The tendency to focus on the micro—instead of on the macro—is not new, but episodes like the 2007–2009 financial crisis have taught us the importance of prioritising big picture considerations.

Additionally, it could be that the EU's AI Act actually does a disservice to the goal of mitigating the systemic risk created by AI. Most obviously, the AI Act could contribute to the false notion that the most significant risks created by AI have already been addressed—either in sectoral regulations, in the case of algorithmic trading, or in the AI Act itself, in the case of algorithmic credit scoring—at the same time that AI-driven systemic risk has actually escaped the regulator's radar. Second, the fact that the EU has chosen to address the risks created by AI by proposing a horizontal framework codified in a Regulation (instead of a Directive) ensures that similar regulatory requirements will apply to AI systems across sectors and across Member States, with very little room for variation. To the extent that such requirements may encourage the development of similar products subject to similar control and safety mechanisms, the AI Act could create a degree of uniformity and homogeneity that is itself a new source of systemic risk (Calzolari 2021).

In the end, the risk-based approach at the centre of the EU's approach to AI is an understandable attempt to address the technology neutrality and proportionality concerns that reflect existing tensions between the goals of 'excellence in AI' and 'trustworthy AI'—innovation and safety. But regulatory compromises and trade-offs require a clear understanding of the opportunities and risks that arise from the object of regulation. And underestimating or ignoring the potential of AI for amplifying systemic risk necessarily limits the EU's ability to strike the right balance when regulating AI.

Looking ahead, it is clear that more research is required into the systemic risk created by AI. It is also clear that the high-risk approach adopted by the EU in its AI Act could benefit from a broader definition of 'high risk': one that does not just focus on harm to individuals (or even many individuals) but also considers the broader structural and systemic impact of AI. Additionally, it is hoped that regulators and supervisors will soon begin work on strengthening existing macroprudential toolkits to ensure that they can handle the new systemic risk created by AI.[76] In this regard,

[75] See Whittlestone et al. (2021) noting that 'there is an open question as to whether systemic risks can be addressed via the same regulatory processes as more direct and easily identifiable harms'.

[76] See, in particular, the discussion in ESRB (2020).

some inspiration may be drawn from the EU's algorithmic trading regime and its requirements for stress testing and circuit breakers.[77]

Finally, it is worth underlining that systemic risk can easily travel across borders, and new regulatory and supervisory approaches looking to address the impact of AI on the financial system should acknowledge this international dimension of systemic risk (Keller 2020, pp. 295–296). It is therefore hoped that the EU's meritorious efforts to build a strategy for innovative and safe AI can eventually lead the conversation around the development of a more integrated cross-border approach to AI—and one that more readily acknowledges the important implications of AI for financial systemic risk.[78]

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[77] For a summary of the EU's algorithmic trading regime, see Conac (2017).

[78] *See* also, on Ethics, in this book P U Lima and A Paiva - Autonomous and Intelligent Robots - Social, Legal and Ethical Issues; A T Freitas - Data-driven approaches in healthcare - challenges and emerging trends; M C Patrão Neves and A B Almeida - Before and Beyond Artificial Intelligence - Opportunities and Challenges; E Magrani and P G F Silva - The Ethical and Legal Challenges of Recommender Systems Driven by Artificial Intelligence; M S Fernandes and J R Goldim - Artificial Intelligence and Decision Making in Health - Risks and Opportunities; M N Duffourc and D S Giovanniello - The Autonomous AI Physician - Medical Ethics and Legal Liability; and R Nogaroli and J L M Faleiros Júnior - Ethical challenges of artificial intelligence in medicine and the triple semantic dimensions of algorithmic opacity with its repercussions to patient consent and medical liability. *See* also, on the AI Act, in this book P U Lima and A Paiva - Autonomous and Intelligent Robots - Social, Legal and Ethical Issue; A T Fonseca, E V Sequeira and L B Xavier - Liability for AI Driven Systems; M N Duffourc and D S Giovanniello - The Autonomous AI Physician - Medical Ethics and Legal Liability; D Durães, P M Freitas and P Novais - The Relevance of Deepfakes in the Administration of Criminal Justice; and J C Abreu - The "Artificial Intelligence Act" Proposal on European e-Justice Domains Through the Lens of User-focused, User-friendly and Effective Judicial Protection Principles. *See* also, on Fintech, in this book K Yordanova and N Berterls - Regulating AI - Challenges and the Way Forward through Regulatory Sandboxes.

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