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Artificial Intelligence (AI): prospects for financial services and policy approach

Executive Summary

AI trends, benefits and challenges

- Artificial Intelligence (AI) involves the training and the use of algorithms to mimic human intelligence and is mostly data-driven.
- AI is considered as the new technology with the highest potential to transform the financial sector in the near future, due to its capacity to add value to practically every step of the value chain, both in terms of productivity (performance improvement, smart decision-making) and revenue generation (personalisation, new data based services or offerings). AI can also be used to support financial supervision and cyber-resilience efforts.
- AI developments are widespread in the financial sector and many firms have passed the initial experimentation phase, but only a limited number of financial institutions apart from fintechs currently use AI at scale for a wide range of activities. Predictions made before the Covid-19 crisis were that AI would have a major impact on the financial sector in the coming 5 years, with most financial institutions putting a high emphasis on AI in their development objectives and incumbents aspiring to catch up with fintechs. It is likely that this trend will continue and possibly intensify post-crisis with an increased pressure on costs, the search for new sources of revenue and the need to optimize risk management in an uncertain environment and also a general acceleration of digitalisation.
- Europe is generally behind the curve compared to the US and China in terms of AI development, with significantly lower levels of R&D investment and a fragmented approach across Member States. Europe appears also out of touch at present with the US and China in terms of retail digital platforms and related data volumes and variety, and also of cloud providers. European players benefit from the services provided by non-EU platforms but this situation raises questions about the technological sovereignty of the EU in the future and whether access to data will be sufficient for EU businesses to leverage the potential of AI. Technologies are nevertheless quickly evolving and the EU is well positioned according to the Commission to leverage the opportunities offered in particular by non-personal data and the "next digital wave" that includes the Internet of Things (IoT), smart connected device data and edge computing, although the implications of these developments for financial services are still to be determined. Efforts are also being made to encourage the development of a digital ecosystem in the EU based on European standards.
- In the financial sector, access to appropriate data sets in terms of quality, volume and variety and the capacity and skills to handle large amounts of different data are considered to be the main potential barriers to the wider uptake of AI. These issues are reinforced by obstacles to the sharing of data such as data standardisation issues or inconsistencies of data regimes, and also the persistence of legacy IT systems that were not built with the data management systems needed for AI. Other challenges concern access to AI software and appropriate hardware capacity (e.g. specific chips, high performance computers) and also the capacity to deploy operationally AI models.
- Some of these issues may be addressed with open-source and cloud-based solutions. However, fully leveraging the capacities of AI also requires changes in the business and IT models of financial firms in order to put data at their centre. A transformation of skills and working processes is also needed, as well as an implementation of AI in combination with other technologies such as cloud services and also developing cross-ecosystem data collaborations.
- Some risks associated with an increase in AI use have been identified by regulators, including accountability and explainability issues, possible bias in the data sets used and increased exposure to data privacy issues. Operational solutions to address these issues exist, notably making AI systems more understandable, but they are not systematically implemented at present. A wide-spread development of AI could also raise some financial stability questions in the future, according to the FSB, with the possible development of new forms of interconnectedness and pro-cyclicality and higher third-party dependencies.

Existing and proposed EU policy frameworks

- Currently there are few EU frameworks that were developed with AI in mind, except GDPR and the non-legislative fintech action plan, which also applies to AI developments.
- The use of AI in the financial sector is therefore largely governed by existing financial regulations and general principles that apply to fintech developments such as technology-neutrality. How to address the development of AI in the financial sector and enhance data sharing is currently being evaluated as part of the assessments that the Commission is conducting in the perspective of the new Digital Finance Strategy for Europe, due to be proposed towards the end of 2020.
- The Commission is also drawing up two key AI and data horizontal policies, with the objective to facilitate and encourage the uptake of AI by businesses and public institutions, manage the risks associated with the use of AI and also ensure that EU firms can access a wide and suitable enough pool of data. There is also a strong focus in these initiatives on fostering a European approach to digital development, likely to ensure high privacy, security, safety and ethical standards, building on previous initiatives such as GDPR. Finally encouraging the development of the European data economy is another objective of these proposals.
- In its White paper on AI currently under consultation, the Commission is proposing to step up AI investments and skills in the EU and increase efforts to coordinate

R&D. A new proportionate framework is also due to be put forward at the end of 2020, aiming to increase trust in AI technology. AI applications would be subject to mandatory requirements and prior conformity assessments (concerning training data sets or human oversight for example) when they are employed in high-risk sectors and a voluntary labelling system would be proposed for other sectors. At this stage, the classification of financial services has not yet been specified.

- The Commission is also proposing a new data strategy aiming to create a single market for data in the EU that would facilitate the access to and the sharing of personal and non-personal data across the Union. The proposed strategy rests on 4 main pillars: (i) a cross-sectoral governance framework for defining rules regarding data access and use; (ii) the strengthening of Europe's data infrastructures and capabilities (federation of European clouds, cloud rulebook, etc.); (iii) investment in data literacy and the enhancement of individual data rights regarding IoT data; and (iv) the development of common European data spaces in several sectors including financial services.
- In addition, the new Digital Services Act that the Commission is currently preparing may also have some implications for data sharing, potentially with rules concerning large online platforms acting as gatekeepers and measures to make it easier for users to move their data across providers.

1. AI definitions and the state of progress of AI in the EU

1.1. AI definitions, categories and approaches

Artificial Intelligence (AI) is a field of computer science[1] dedicated to solving cognitive problems commonly associated with human intelligence, such as learning, problem solving, and pattern recognition. AI systems use software (algorithms or computer programmes) for performing these tasks[2] based on different types of mathematical models[3].

Current AI systems are mostly data-driven[4]. They are "trained" through the processing of large data sets[5] - instead of being programmed with rules reflecting human expertise - to recognize predetermined outcomes, visual or audio elements[6] understand speech or text or to identify patterns and links among data. AI algorithms are designed to continue to learn while in use in an adaptive way, based on the data they process. Thus the quality of AI outcomes may improve with experience. Outcomes are also dependent on the data used for the training of AI systems. AI is composed of different subsets[7] including:

- Machine Learning (ML) that refers to algorithms that autonomously improve their performance, training on vast amounts of data (historical data)[8]. ML is used for identity verification, fraud detection, robo-advisors, customer segmentation and personalisation for example. Different types of learning can be used depending on the problem to solve (e.g. supervised or unsupervised depending on whether the outcome is predetermined or not)[9] and

[1] There are multiple definitions of Artificial Intelligence (AI). This one is adapted from definitions given by Amazon and also C. Durodié in "Decoding AI in financial services" – 2019. Many definitions insist on the imitation of human intelligence, e.g. the Encyclopedia Britannica: "AI relies on the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings". The European Commission uses the following definition: "Artificial intelligence (AI) refers to systems that display intelligent behaviour by analysing their environment and taking actions – with some degree of autonomy – to achieve specific goals".(White paper on AI). A simpler definition: algorithms that mimic human intelligence (FT-11/05/20).

[2] The output may be in various forms, e.g. a yes/no answer, a probability distribution, a projected trajectory, clusters…

[3] Different classifications of AI applications for business purposes have been made. For example the WEF report of 2018 on "The new physics of financial services" proposes the following classification in five main types of AI application: (i) pattern detection – recognising (ir)regularities in data, (ii) foresight – determining the probability of future events, (iii) customisation – optimising outcomes for specific customer profiles, (iv) decision-making – recommending courses of action based on rules, and (v) interaction – communicating with humans through digital media.

[4] In a first wave of AI also known as 'symbolic AI' the decision-making process was closely aligned with how human experts make decisions. Any intelligence in the system came directly from human expertise manually inputted into it. This was the basis of expert systems used since the 80's. This approach was improved with so called "fuzzy logic"; by allowing variables to have a value between 0 and 1 these systems can capture a wider range of market conditions for example. The symbolic AI approach can however not easily capture more intuitive decisions made with expertise and a perception of the environment and is limited by the need to codify rules and exceptions in the system which is very difficult to achieve for complex problems. It is therefore only used for tackling repetitive problems in well-defined contexts.

[5] AI uses three main categories of data in a nominal and anonymised way: (i) hard data which can be checked and for which evidence can be provided i.e. address, phone number, date of birth, profession, etc. for a person or financial accounts for a business; (ii) activity data related to people's activities i.e. health data, shopping, transport…or the activities of a business; (iii) behavioural or perception data related to customers' online behaviour, facial recognition or gesture tracking for a person or e.g. online reviews of customer perception for a business. This data can be quantitative or qualitative and is more or less structured.

[6] E.g. using trial and error tests, feedback from previous experience on a multitude of dimensions and data points.

[7] Other subsets of AI include Cognitive Computing which allows the retrieval, indexing and processing of large amounts of data gathered from various sources - used for algo / HFT trading, process automation or Ambient Computing which focuses more on sensors and connected devices. Another categorisation can be made depending on the nature of AI systems. AI-systems can be purely software based, acting in the virtual world (e.g. voice assistants, image analysis software, search engines, speech and face recognition systems…) or can be embedded in hardware devices (e.g. advanced robots, autonomous cars, drones, Internet of Things applications…).

[8] The Commission's definition: With machine learning techniques, algorithms are trained to infer certain patterns based on a set of data in order to determine the actions needed to achieve a given goal. (White paper on AI).

[9] For further detail you can read the following article https://machinelearningmastery.com/types-of-learning-in-machine-learning/. For solving a supervised learning problem, the ML system works on predetermined outcomes (used for e.g. image recognition or fraud detection) which means that humans must label and categorise the underlying training data, which can take up a huge amount of time, and limits datasets to those categorised by humans. For an unsupervised learning problem, the ML system makes predictions based on the patterns it finds with no predetermined outcome (used for e.g. customer segmentation and personalisation of services). For a reinforcement learning problem, the ML system learns from trial and error with experience based on feedback from the environment on whether a given action was good or bad (used e.g. for portfolio management).

different techniques are used also to tackle these problems including for example deep learning[10].

- Natural Language Processing (NLP) that seeks to enable machines to understand the way humans use text and speech in order to process written or audio elements, learn languages, and generate human-like writing or speech - used for chatbots, virtual assistants, AML
- Computer Vision that seeks to enable devices to understand their visual surroundings, collecting and analysing imagery (photos, videos) – used for identity verification, KYC, insurance claims management
- Robotics[11] that combine computers and sensors in order to process visual and sensory data from the surroundings - can be used for virtual assistants or programming physical robots.

The performance of existing AI systems is constantly improving in terms of the range and depth of data that can be processed, the capacity to take into account contextual knowledge and the analytical methods used for providing insights[12], but they remain focused at present on specific and predetermined domains or tasks and mainly process information from the past, which may be a limitation in evolving environments.

New phases of AI are currently being outlined (Artificial General Intelligence or Superintelligence) that aim to build a single system to solve a varied set of problem definitions, building on data and knowledge available in multiple sectors, disciplines and contexts, thus better reproducing human decision-making.

1.2. State of progress of AI in the EU

Generally, the development of AI in the EU is lagging behind the US and Asia[13] at present in terms of investments in the technology and access to data. The EU is indeed behind the curve compared to the US and Asia in terms of R&D investment in this field, which is primarily made by large tech companies at present[14]. China and the US have also put forward ambitious plans in this area for the coming years, with China aiming to be world leader in AI by 2030 and the US announcing a plan to double investment in AI R&D. It is fair to mention also that other factors such as different levels of data protection and the larger scale of the US and Chinese markets compared to EU fragmented markets also play a role in the speed of adoption of AI in these jurisdictions.

Europe seems moreover out of touch with the US and China currently in terms of retail digital platforms and related data volumes and variety[15], which are essential for reaping the full benefits of AI in the retail space. European players benefit from the services provided by non-EU platforms (e.g. in terms of cloud services, AI-as-a-service, etc…), but some observers consider that the current situation raises potential questions regarding the technological sovereignty (or non-dependence of the EU) and the access of European industry players to sufficient data, digital resources and skills. Tackling these issues is one of the key objectives of the new Commission, which has put forward plans for "shaping Europe's digital future" that include proposals for a stronger European AI strategy and data framework (see Section 4). The Commission has also expressed ambitions to seize the opportunities offered by the "next data wave", concerning Internet of Things (IoT) data generated by smart connected objects and also non-personal industrial and public data[16].

2. Main AI applications in the financial services sector and future evolutions

2.1. Existing applications of AI in the financial services sector

Most market observers consider that AI is the new technology that has the most potential to transform the financial sector due to its capacity to add value to practically every step of the value chain, both in terms of productivity and revenue generation. The financial services sector is also a natural candidate for this technology, since it is very much a data driven industry selling immaterial products[17] and with high compliance and reporting needs. Another factor is that although digitalisation is widely developed in the sector, manual processes subsist in many areas.

AI use is a reality in the financial services sector[18] and is generally progressing. Many companies have passed the initial experimentation phase and are deploying AI systems in different areas. There is already a wide range of applications of AI throughout the financial services value chain, in the front, middle and back offices and also to support administrative, regulatory and supervisory activities. AI use cases have been implemented in the different areas of finance i.e. banking, insurance, capital

[10] Deep Leaning is one of the techniques used by ML systems. It is powered by artificial neural networks (ANNs), modelling the way neurons interact in the human brain, and it uses learning approaches inspired from the human brain. Neural networks filter inputs through several layers of analysis or interpretation (analysing different dimensions of the data e.g. once an ANN learns what an object looks like it can recognize it in a new image) or use gradual steps of decision also known as back propagation or gradient descent (used e.g. in speech recognition or image processing).

[11] This is different from Robotic Process Automation (RPA) which has been used for many years and consists of the automation of repetitive manual tasks, but RPA does not learn from the data it uses or from the feedback given by humans, not does it provide insights or adapt.

[12] E.g. about how a person or animal moves for visual recognition or about how people write for text recognition.

[13] In 2018 83% of global investment in AI across M&A and VC / PE was in the US and China (APIS report). The Stanford University AI Index moreover shows that the US and China, together with the UK and Israel account for almost all AI investment, and for 85% of AI patent filings (Source FT 23/02/20).

[14] 3.2 Bio € invested in 2016 in the EU compared to 12.1 Bio in North America and 6.5 Bio in Asia – Source Commission White paper on AI. Internal investment by large corporations dominates. Tech giants and digital native companies such as Amazon, Apple, Baidu, and Google are investing billions of dollars in various AI technologies. Estimates are that this amounted to $18 billion to $27 billion in 2016; external investment (from VCs, PE firms, M&A, grants, and seed funding) was around $8 billion to $12 billion. The highest investments were on ML (5-7 Bio) and Computer Vision (2.5-3.5) well ahead of other subsets of AI. (Source McKinsey – AI the next digital frontier? June 2017).

[15] Source White paper on AI – EU Commission February 2020.

[16] According to the Commission, today 80% of data processing and analysis that takes place in the cloud occurs in data centres and centralised computing facilities, and 20% in smart connected objects, such as cars, home appliances or manufacturing robots, and in computing facilities close to the user ("edge computing"). By 2025 these proportions are set to change markedly. (Source AI White Paper on AI).

[17] Source Roland Berger "AI and financial services – How to tackle the big buzz?" June 2019.

[18] Financial services account for 19% of total IT spent on AI – Souce APIS report / IDC.

markets, payments and both for retail and wholesale business. In some cases AI is used to support employees of financial services companies, in others it is used in a more autonomous way. In terms of operating model, financial institutions are either developing AI capabilities in-house, partnering with fintechs specialised in AI or using cloud-based AI applications (AI-as-a-service).

Recent surveys show that currently about half of financial institutions at the international level have several functional AI solutions and up to 80% have some experience with its deployment at least on a small scale[19]. Some observers however claim that the percentage of firms actually using AI and ML solutions at scale for a number of financial activities is much more limited, except for fintechs[20]. In terms of sectors, investment managers and payment providers seem to be slightly ahead in their adoption.

Current AI applications in the financial sector can be grouped according to five main domains:

- New value propositions leveraging data analytics and alternative data to generate new insights, used notably for enhancing the services offered to customers (e.g. robo-advice), improving portfolio management (e.g. market research) and supporting financing proposals (e.g. loans)
- Risk management including fraud detection, trading surveillance and liquidity and counterparty risk evaluations
- Process reengineering of administrative tasks, reporting or regulatory compliance activities
- Customer acquisition and management with AI systems used for speeding up on-boarding and improving customer segmentation, cross-selling and personalisation
- Customer service with AI-enabled interaction to support existing communication channels (e.g. chatbots, virtual assistants) and allow advisors to focus on more added-value tasks.

Progress is underway in all these areas, but the most common areas of use of AI for financial firms seem to be the two first ones of risk management and the development of new value propositions, used by more than 50% of firms[21]. Only the more advanced financial companies in AI adoption are using AI at scale for customer service and acquisition. Process efficiency is another potential area for the use of AI (ML or NLP). However, at present robotic process automation (RPA) is the most widely used approach for automating repetitive manual tasks, which is usually not considered as true AI, since RPA systems are mostly rules-based and do not learn from or adapt with the data they use or the feedback they receive. How the AI component may add value in this context still remains to be clarified in many cases.

AI is also developing in the EU financial sector, although it is difficult to have a precise view on the specific level of progress of AI in Europe compared to the rest of the world.

The Commission expert group on regulatory obstacles to financial innovation[22] considered in its report published in December 2019 for example that the overall impact of AI in the EU financial sector is still "limited" with many challenges remaining to be addressed. A wide range of applications can be identified but these are still implemented in a piecemeal fashion in most cases.

2.2. Main current drivers and barriers to AI adoption

Key prerequisites for an effective development of AI are not specific to financial services and concern: data issues (availability of appropriate data, access to data, AI software and data skills), access to appropriate hardware and operational ML capabilities[23].

In recent surveys conducted in the financial services sector[24], issues related to data appear to be the main obstacles at present[25].

A first challenge is the availability of appropriate data of sufficient quality for training AI systems[26] and the ability for AI users to process large amounts of different types of data, including unstructured ones. This is an issue in particular for non-tech companies that still need to put in place adequate data gathering and processing capacities to ensure that there is a constant flow of appropriate data. Data skills also need to be enhanced in many cases, although data analytic capacities can also be accessed via cloud services for example. A second challenge is the access to a wide enough range of data. This requires ensuring that there are no unjustified or unfair barriers to the access to and

[19] A survey conducted by the WEF at the end of 2019 shows that up to 80% of financial institutions globally have now implemented AI in some way (90% for fintechs) and that 90% of them expect to see AI implemented in 3 or more areas of their business in the coming 2 years, as opposed to 40% today (WEF survey: Transforming paradigms: A global AI in financial services survey January 2020). A KPMG survey conducted in 2020 in the US shows that 47% of financial institutions are moderately to fully operational with AI deployment (Living in an AI world 2020). This illustrates a strong increase over the last few years. A survey conducted in 2017 showed that only 20% of companies said they had adopted one or more AI-related technology at scale or in a core part of their business. 10% percent reported adopting more than two technologies (McKinsey AI: the next digital frontier? June 2017).

[20] For example some commentators consider that there is a certain degree of window-dressing in claims about the use of AI in the area of investment management, where traditional quantitative analyses are mostly used rather than ML and where the use of non-traditional data is quite limited – Source FT – Fund managers must embrace AI disruption (15/01/2020).

[21] These statistics are confirmed by a KPMG survey (2020) conducted in the US that shows that 85% of financial services respondents expect AI to play the strongest role in fraud detection (85%) and enhancing customer experience (45%).

[22] According to the Commission expert group on regulatory obstacles to financial innovation (ROFIEG) the actual impact of AI on the financial sector is still limited at EU sector level.

[23] The ability to safely deploy ML models into production at scale and monitor their performance properly.

[24] For example WEF survey: Transforming paradigms: A global AI in financial services survey January 2020.

[25] Some observers however point out that over time incremental progress due to algorithms will most likely diminish, while improvements in hardware may continue to be significant. Source FT Hardware revolution pushes AI to the mainstream (13 Dec 2019).

[26] For example historical data which may come in varied formats or may be incomplete and was not structured to be used by AI systems; difficulty to know whether real-time data feeds can be trusted to remain constant in terms of data definitions…

sharing of data and that data sharing is conducted in a way that preserves consumer rights and privacy. In the financial sector this raises specific questions about the type of data that may be shared and how to ensure a level playing field between financial institutions and non-financial players in a context where open finance concepts may develop[27]. Possible data standardisation and interoperability issues also need addressing[28], as well as making sure that appropriate data infrastructures are available to store and process the required data. The inconsistency of data regimes and policies is a further challenge at the international level and also within the EU, despite the implementation of the GDPR[29].

Other barriers to AI adoption include the access to AI software and to sufficient computing power. Open-source AI software or cloud-based solutions can nevertheless help companies that do not have the resources or time to build their own AI software or computing capacity to tackle some of these issues. Cloud-based AI-as-a-service platforms[30] for example provide tools that allow financial institutions to build or complete AI systems, upload and manage data and then train ML algorithms[31]. Advanced chips and high-performance computing power can also be rented through cloud-based platforms.

Technologies are nevertheless quickly evolving and this may shift the debate about drivers and barriers to AI adoption to a certain extent in the coming years. For example it is predicted that many AI processes will run in the future on devices such as smartphones, intelligent home or car devices (so-called edge devices) rather than on the cloud[32], although the implications of these evolutions for financial services still need to be further evaluated. It is also believed that new hardware developments such as AI-specific chips will possibly play a more important role in the development of AI in the future than AI algorithms, which may become more commoditised, at least for the most common applications.

2.3. Future prospects of AI development in the financial sector

The predictions made before the Covid-19 crisis were that AI would have a major impact on the financial sector in the coming 5 years[33], with most financial institutions[34] putting a high emphasis on AI in their development objectives and incumbents aspiring to catch up with fintechs[35]. It is likely that this trend will continue and possibly intensify post-crisis with an increased pressure on costs, the search for new sources of revenue and the need to optimize risk management in an uncertain environment. Another factor is a general acceleration of digitalisation. A majority of customers will have been using digital channels during the Covid outbreak and financial institutions have also been testing more broadly AI-based customer interaction such as chatbots and virtual assistants because of social distancing constraints.

It is however still uncertain whether traditional financial services companies will be able to have AI embedded in core products and processes and actually running in production in the coming years, according to many market observers.

In addition to the drivers and barriers mentioned above, several issues need to be considered, particularly by incumbent financial institutions, for accelerating the uptake of AI in the financial sector:

- Multiplying AI use-cases throughout the financial value chain - for revenue generation as well as productivity gains - in order to build sufficient experience with the technology throughout institutions and put in place an appropriate IT infrastructure and skill set
- Evolving towards more data and tech-centric business models that put digitalisation, data collection and processing efforts more at the centre of business strategies and operating models, also leading to a transformation of business culture and mindset
- Developing AI in combination with other new technologies such as cloud and DLT that are mutually beneficial. For example, cloud facilitates access to data, AI tools and computing capacity; etc...
- Enhancing cross-ecosystem collaborations on data and AI applications between incumbent financial institutions, fintechs, bigtechs and possibly other non-financial players, based on fair and transparent rules.

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[27] There is for example a debate around the Payment Services Directive (PSD 2 see Section 5) which provides access to bank account data to enable the development of new payment providers, but does not offer reciprocal access to non-financial data that may be necessary for the financial sector to develop AI capacities.

[28] e.g.to allow the combination of data from different sources.

[29] Progress has been made for personal data with the implementation of GDPR but further efforts are needed to achieve a coordinated approach to data policies across Member States, in order to benefit from a wide enough pool of data and potential economies of scale.

[30] They can be used for implementing specific components of a wider AI system (e.g. natural language processing, computer vision), to develop full ML solutions using pre-built development tools or to automate the training of AI systems.

[31] Specific AI-based solutions are also being developed on the cloud, such as fraud detection tools or tools to support customer interaction.

[32] According to the Commission, the volume of data is growing rapidly (due to be multiplied by 5 by 2025) and the way it is stored is also due to evolve (at present, 80% of data processing and analysis takes place in data centres and specialised computing facilities and 20% in smart connected objects such as cars, home appliances or manufacturing objects or in computer facilities close to the user (edge computing) – by 2025 these proportions are due to be inverted, which may also have the advantage of increasing the control individuals have on their personal data). At present the private sector, notably US and Chinese Big Techs, play a large role in the production and management of data, a significant part being retail data. The Commission believes that a large part of data in the future will come from industrial and professional applications, areas of public interest and IoT (internet-of-things) applications in everyday life where the EU has a strong position, thus opening new opportunities.

[33] For example a BCG model established that about 23% of China's financial sector jobs would be disrupted by AI before 2027 either in the form of job cuts, higher productivity or the creation of new types of jobs – Source The impact of AI on the financial job market – BCG 2018.

[34] A recent survey conducted by the Bank of England and FCA on ML adoption in the UK financial services sector confirms this trend. Two thirds of respondents having live ML applications in use and companies expecting their number of ML applications to more than double over the next three years. Deployment for a majority of respondents is nevertheless on a small or medium scale or still in the development phase. Source: ML in UK financial services – Bank of England and FCA – October 2019.

[35] AI is expected to turn into an essential business driver across the Financial Services industry in the short run, with 77% of all respondents anticipating AI to possess high or very high overall importance to their businesses within two years. While AI is currently perceived to have reached a higher strategic relevance to FinTechs, Incumbents are aspiring to catch up within two years. Source WEF survey Transforming paradigms January 2020.

3. Benefits and risks associated with AI in the financial sector

3.1. Benefits of AI use in the financial services sector

AI applications have two main potential benefits for the providers of financial services: (i) productivity and efficiency enhancement and (ii) revenue generation through improved marketing and customer service.

Estimates of economic impacts are in the magnitude of tens to hundreds of billions of additional economic value for the financial services sector in the coming 10 to 20 years[36]. Some projections show that in the coming 10 years cost reduction will represent the highest impact of AI (about 60% of the total value) with process optimisations and a foreseen reduction of staff in certain activities (e.g. trading, fraud detection…). AI is also expected to support additional revenue generation with new services and products and smarter decision-making, representing approximately 40% of the total economic impact of AI[37].

These improvements may also benefit customers, providing for example easier and wider access to financial services, better value for money and a stronger personalisation of the services offered.

Productivity and efficiency enhancement

AI can help to improve the efficiency and productivity of existing financial, administrative and compliance activities in terms of cost, speed or precision in a number of ways: process optimisation (e.g. back office processes, customer on-boarding and management), performance improvement (e.g. trading or portfolio management activities, credit risk monitoring). AI systems can also help to better evaluate and manage risk with: an improved pricing of risk (e.g. accuracy of credit risk evaluation) and anticipation of defaults, a better detection and management of operational risks (e.g. cyber-risks) or frauds. More generally AI can also potentially support more effective planning, risk management and decision-making in all financial functions.

AI has a particular added value in areas where data is unstructured such as insurance claims (incorporating images or health data), investment management (using a wide range of market data and sentiment data sources) and lending (using alternative sources of information e.g. web based information, social media…). Another advantage of AI over traditional optimisation or reengineering efforts is that the improvement can be exponential if the AI system is trained to adapt to a wide range of data, including unstructured data, and if the system learns from its work, improving its performance on an on-going basis. AI moreover facilitates the digitalisation of financial activities in certain areas. For example, the digitalisation of customer relationships may generate numerous questions and requests by email or phone that can more easily be addressed with AI-based chatbots, virtual assistants and robo-advisors.

Revenue generation through improved marketing and customer service

AI facilitates client segmentation and customer preference prediction that can contribute to improving pricing, products and services (e.g. with more personalisation, capacity to price discriminate, or a more holistic approach). This can help financial institutions to attract new categories of clients (e.g. by expanding credit or insurance into new populations that were eliminated from traditional risk assessment or by building new value propositions) and also to retain existing clients by better anticipating their needs and providing them with new or better services. Data analytics can also help to provide access to added value information and advice on a wider scale, such as robo-advice and investment research, and can also allow advisors to focus on tasks with most added value. AI also helps to optimize cross-selling and customer relationship management, potentially increasing satisfaction.

Stability benefits

The FSB[38] has also underlined that AI may provide some stability benefits. The more efficient processing of information, for example in credit decisions, financial markets, insurance contracts, and customer interaction, may contribute to a more efficient financial system. The RegTech and SupTech applications of AI and machine learning can also help improve regulatory compliance and increase supervisory effectiveness, according to the FSB.

3.2. Risks associated with the use of AI

The use of AI in financial services poses a certain number of specific micro and macro-financial risks that need addressing in order to ensure sufficient trust from market stakeholders. Some issues are also potential obstacles for the appropriate supervision of AI systems. For incumbent financial institutions, AI also creates new competition challenges. Fintechs may be able to develop new offers with AI and provide certain financial services in a more effective way. Using alternative sources of information that can be processed with AI systems, fintechs may also challenge the current privileged access that banks or insurance companies have to their clients' financial and risk information.

Accountability and explainability: The first issue usually associated with AI is opaque decision making (the so called 'black-box' effect), which may create trust issues and make accountability[39] and auditing more complex to achieve. This perception is due in particular to the difficulty of relating input to the output of AI systems, to grasp the extent of the input when extensive and varied data sets are used and also to the fact that AI uses different models to process data rather than just one and that these may evolve over time. There are solutions to make AI systems more understandable by non-experts

[36] Autonomous / Next study 2018: total impacts across financial sectors is $ 1 trillion representing a 22% reduction of the traditional cost base with 490 Bio impact in front office (chatbots, voice assistants, authentication and biometrics), 350 Bio in middle office (fraud detection, KYC / AML, compliance workflows, monitoring of KPIs) and 200 Bio in back office (credit underwriting, insurance claims, investment management, smart contracts).

[37] According to a McKinsey Global Institute report on Modelling the impact of AI on the world economy (Sept 2018), automation of labour could add up to about 11 percent or around $9 trillion to global GDP by 2030 (i.e. 60% of total impacts) and Innovation in products and services could deliver up to about 7 percent or around $6 trillion of potential GDP by 2030.

[38] AI and ML in financial services. Market developments and financial stability implications. FSB November 2017.

[39] There may be accountability and potentially trust issues if results are difficult to explain and thus responsibilities and liabilities difficult to attribute.

(e.g. making efforts to retrofit explanations through reverse engineering or using a simpler more interpretable algorithm in the first place), but these are not easy to put in place in all circumstances, experts believe[40].

Bias and discrimination in decision-making: The way data is inputted and algorithms are built and trained may lead to the discrimination of certain customer segments or to bias in the outputs (e.g. eliminating certain profiles or increasing prices for them in an excessive way). This may diminish consumer trust in AI systems and create new legal risks and liabilities, unless decision criteria are sufficiently transparent.

Data privacy and possible misuse of AI: The volume of data required to develop AI effectively raises data privacy concerns if consumer data is increasingly shared without the possibility to ensure appropriate consent due to the sheer volume of data. In addition, consumers need to be informed of the ability of AI systems to analyse data and identify user preferences in an increasingly precise way in order to be able to provide consent in a sufficiently informed manner. AI may also create new privacy risks if it is misused, as illustrated by the debates around facial recognition.

Skills and change management: Many challenges need tackling in this area both for financial institutions and supervisors with: the need to adapt the workforce in terms of data and AI skills, to train staff to conduct certain activities with the support of AI systems (e.g. wealth management, loan provision, fraud detection…), to manage a potential reduction or reallocation of headcount in certain areas, to work in a more collaborative way with third-party providers…

Financial stability risks: According to the FSB[41], a widespread use of AI applications may also create some potential financial stability risks that need to be appropriately assessed and monitored. For example new and unexpected forms of interconnectedness between financial markets and institutions, based on the use by various institutions of previously unrelated data sources may emerge; a lack of interpretability or "auditability" of AI and ML methods may make risks more difficult to manage and supervise; herding or pro-cyclicality effects may increase with a wide-spread use of AI potentially using similar models and data sets e.g. for credit scoring, trading or investment decisions. The FSB also highlighted the risk of increasing third-party dependencies in the future for financial institutions with the development of AI.

4. Horizontal AI and data policies at the EU level

Making Europe "fit for the digital age" is a key objective of the political guidelines of the new Commission presented in 2019 and AI is at the centre of this ambition[42].

The Commission subsequently published in February 2020 a Communication on "Shaping Europe's digital future", which introduces an overall EU strategy to enable the data economy[43] and proposes actions in a wide range of areas: AI, data, cyber-security, digital skills and literacy, 5G and 6G, competition rules…

Two first proposals were made in February 2020 concerning the adoption of a European data strategy and a framework for AI. A first objective of these initiatives is to foster "a European way" to digital development (technology that works for people)[44] preserving high privacy, security, safety and ethical standards in a proportionate way in order to foster consumer trust and lead the way to a more human-centric approach to technology, following the example set by GDPR in the area of personal data. This involves managing the risks associated with the use of AI and encouraging an ethical use of AI, as well as defining adequate rules and incentives for the sharing of data. Encouraging the development of the EU data economy is a second objective, with actions proposed to step up EU investments and the coordination of Member State initiatives in AI R&D and data infrastructures in particular.

The Commission is also preparing a Digital Services Act with the launch of a public consultation in June 2020. This framework proposes to modernise the existing e-Commerce Directive taking into account in particular the development of large online platforms, in order to ensure the safety of users online and allow innovative digital businesses to grow. It focuses on two main sets of rules: (i) rules framing the responsibilities of digital platforms in order to address potential risks faced by users and facilitate a supervision of platforms and (ii) ex ante rules to ensure that large online platforms acting as gatekeepers behave fairly and can be challenged by new entrants and existing competitors. This latter set of rules may have some implications for data sharing, since measures are proposed to force large platforms to share data with smaller rivals and make it easier for users to move their data.

4.1. Proposal for a new EU AI framework

Building on previous EU initiatives launched since 2018 aiming to build a "European approach to AI" (i.e. trustworthy

[40] Source Linklaters AI in financial services - 2019.

[41] AI and ML in financial services. Market developments and financial stability implications. FSB November 2017.

[42] The objective put forward in the political guidelines was to define standards in a number of areas such as high-performance and quantum computing, algorithms and tools to allow data sharing and data usage that may become the "new global norm" and also help the EU to achieve technological sovereignty in these areas.

[43] This strategy has three objectives: making technology work for people, supporting a fair and competitive economy and enhancing democratic values. The proposed AI and data frameworks relate to the two first objectives. Regarding the third objective, the Commission will present by the end of 2020 a 'Digital Services Act' aiming to establish clear safety and liability rules for all digital businesses to access the Single Market, strengthen the responsibility of online platforms and protect fundamental rights. The Commission will also propose a review of the eIDAS regulation, allowing for a secure electronic identity that puts people in control of the data they share online. Emphasis is also put on cybersecurity by promoting cooperation through a Joint Cyber Unit that protects critical European infrastructure and strengthens the cybersecurity single market.

[44] The EU's digital strategy indicates the path that Europe needs to take to pursue its own way: a digital Europe that reflects European values i.e. putting people first in developing technology; promoting European values of fairness and openness and the defence of human rights in the design and implementation of technology. Over the next five years, the Commission will focus on three key objectives to promote technological solutions that will help Europe pursue its own way towards a digital transformation that works for the benefit of people and respects our fundamental values: technology that works for people; a fair and competitive economy; and an open, democratic and sustainable society. (Source: Shaping Europe's digital future – Q&A 19/02/20).

and ethical) and also to encourage its uptake in the EU, the Commission published in February 2020 a White Paper on AI that is under consultation with a 4 month delay for responding. The objective is to propose an EU framework for AI by the end of 2020.

In Europe, the two objectives of developing AI and managing its risks are considered in combination as a way to position the EU as the leader of trustworthy and fair AI over time[45]. In the US and Asia, initiatives have so far focused mainly on innovation and supporting the development of AI. Some principles for the use of AI have been published in the US but these are not binding.

The emphasis of the EU on mitigating risks associated with AI, rather than simply encouraging innovation, has been criticized by some observers who consider that this may put the EU at a competitive disadvantage with the US and Asia, increasing costs and impeding investments[46]. The Commission however considers that AI development in the EU requires reinforcing trust in the technology and ensuring appropriate accountability. In addition, the EU has demonstrated with the GDPR its capacity to influence a more user-centric development of data use in digital development, which could also be successful in the AI field.

There also seems to be an increasing trend at the global level to condition AI development to certain principles. For example the OECD published in May 2019 a set of principles for the responsible stewardship of trustworthy AI, although they are not binding[47]. Industry-led guidance on the ethical development and use of AI have also been published e.g. by some bigtechs, as well as proposals to encourage "open data" approaches with a wider sharing of aggregate data.

The EU AI framework comprises two main components.

Action plan to support the development and uptake of AI in the EU

In terms of support to the development and uptake of AI in the EU, the White paper proposes stepping up actions in multiple areas including:

- Investment in AI projects (following the adoption of the Dec 2018 coordinated action plan on AI across Member States) leading to R&D investments in AI at EU level in line with the US and China and efforts to coordinate R&D and to reinforce digital skills across the EU
- A promotion of AI adoption by the public sector and public-private partnerships
- Actions to support the development of high-performance computing.

A European regulatory framework for AI

The White Paper also proposes the development of a European regulatory framework for AI, designed to reinforce trust in the technology both from businesses using it and customers and complete existing sectoral rules[48] and domestic AI frameworks[49], with the objective of also avoiding policy fragmentation. The Commission identifies several necessary areas of improvement: the opaqueness of AI, which makes it difficult to identify and prove possible breaches of law, uncertainty regarding the allocation of responsibilities, issues related to the autonomous behaviour of certain AI systems, new safety risks related to the use of AI…

The Commission proposes developing a framework that is proportionate to the risks mentioned above and not overly prescriptive in order to be adaptable and not create an excessive burden for smaller companies in particular.

Two main cases are outlined. For AI applications employed in sectors considered as being at high-risk as a result of the use of AI[50] and also presenting significant risks in the way AI is used (e.g. significant material impacts on consumers), a certain number of mandatory requirements would apply concerning training data sets, human oversight, etc., that may be further specified through standards. A prior conformity assessment would also be imposed[51], as well as controls and possible sanctions. For AI applications that do not qualify as 'high risk', a voluntary labelling scheme would be established[52]. At this stage, the classification of financial services has not been specified.

4.2. Proposal for a European strategy for data

Opportunities and challenges

Data is essential for the development of AI, supporting the training of AI systems and the provision of data-enabled insights, services or products… Having access to sufficient and appropriate data and ensuring an effective use, sharing, processing and storage of data are therefore necessary for achieving the objectives fixed by the EU regarding AI.

Several challenges need tackling in this area. At present there is not enough data in the EU to enable a strong development of the digital economy, with insufficient access to public sector information from the private sector and vice-versa and obstacles to the sharing of privately-held data. The main reasons

[45] AI-related EU or domestic initiatives also build on GDPR principles regarding personal data, which impose a transparent and lawful use of data and also put forward a certain number of fairness and security principles for the use of data that are relevant to AI i.e. fair use of data, consent for automated decisions, data security…

[46] See for example FT article dated 28/2/2020.

[47] As well as recommendations for governments for fostering the adoption of AI. These principles were adopted by OECD member countries, but not legally binding and may be subject to differences in approaches to ethics and attitudes towards data privacy across countries. The FSB and the BCBS have been assessing the impact of AI on financial services institutions and their customers and published reports in 2017 and 2018.

[48] Existing sectorial rules (such as financial regulations) cover a large number of issues (e.g. customer protection, risk management…) in a technologically neutral way and the GDPR regulation also provides rules on data protection and privacy.

[49] Some domestic AI frameworks are being developed, but there is no common EU AI framework.

[50] Such as healthcare, transport, energy or parts of the public sector.

[51] This assessment enforced by competent national and European Authorities would ensure ex-ante that the appropriate requirements are in place. These requirements would relate in particular to training data sets used, data and record-keeping, human oversight, information provision,… and apply to all operators providing AI-enabled products and systems in the EU, whether they are established in the EU or not.

[52] The operators having obtained such a label would then be awarded a quality label for their AI applications with binding requirements to preserve the benefit of the label.

for this, according to the Commission, include a lack of trust between economic operators, a lack of legal clarity in certain area such as IoT data[53], and issues with data interoperability and quality, impeding the combination of data from different sources. In addition the dependence of EU businesses and public administrations on data infrastructures belonging to non-EU tech providers, which have a strong market power and may be subject to foreign jurisdiction legislation in some cases (e.g. the US Cloud Act) was underlined. Moreover, there is still room for progress in Europe in the uptake of cloud services, which offer scalability to deploy technologies like AI, according to the Commission (although this is probably more the case for non-financial companies, SMEs and the public sector than for financial institutions)[54]. Businesses are moreover confronted with data portability and multi-cloud interoperability issues. In addition, Europe still lacks data skills and literacy to succeed in the data economy.

Another challenge is fragmentation between Member States in terms of legal frameworks and also of actions, which may impede the ability of Europe to leverage the scale of the internal market.

Proposed EU data strategy

The Commission has already taken significant steps on data since 2014 with: the GDPR regulation concerning personal data (General Data Protection Regulation), due to be revised, that ensures that individuals remain in full control of their data; the Regulation on the free flow of non-personal data across the EU; the Cybersecurity Act and the Open Data directive (concerning the re-use of public sector information) - to which sector-specific legislation on data access has been added, such as the Payment Services Directive (PSD 2).

The first aim of the EU for the coming 5 years is to create a single European data space - i.e. a single market for data[55] - allowing access to and the sharing of personal and non-personal data, including confidential and sensitive data, across the EU. This should allow businesses and the public sector to have easy access to huge amounts of high quality data in a fair and trustworthy way, fully respecting European values and rules[56]. A second objective is to ensure Europe's sovereignty in technologies and infrastructures that are key for the EU to be able to play a key role in the data economy.

The EU's data strategy aspires to put in place a fit-for-purpose data framework resting on 4 pillars:

- **Rules on data access, use and sharing:** An EU cross-sectoral governance framework providing mechanisms and tools to support decisions on data access, use and sharing and related interoperability standards will be proposed in Q4 2020, followed by measures in Q1 2021 to make high-quality public sector data sets available for re-use across the EU. The Commission will also explore the need for legislative action to encourage data sharing across sectors and eliminate barriers to the use of data that may be taken forward in a possible Data Act (2021). This will include the assessment of issues such as conflicting rules across the EU, the present market power of certain platforms and the relevance of EU competition rules in the area of data.
- **Development of EU data infrastructures and related rules:** A high impact project on European data spaces, in order to strengthen Europe's data infrastructures and capabilities is proposed. The Commission's objective in the period 2021-2027 is to establish common interoperable data spaces in strategic sectors at EU level by combining investments in next-generation data infrastructures, the interconnection of existing cloud and edge infrastructures[57] and computing capacities, as well as related tools and governance mechanisms. The first steps proposed by the Commission are the signature of Memoranda of Understanding with Member States by Q3 2020 to avoid a multiplication of cloud federation and data-sharing initiatives across the EU and the establishment of a comprehensive EU cloud rulebook by Q2 2022, building on existing codes of conduct, in order to ensure the adherence of cloud service providers to EU rules when they operate on the EU market[58]. The setting up of a cloud services marketplace for EU public and private sector EU users offering cloud processing software and platform services complying with these EU cloud requirements is also proposed.
- **Enhancement of data rights:** An enhancement of individual data rights, completing GDPR, regarding the access to and the use of machine-generated data such as IoT and smart device data is planned.
- **Development of sectoral European data spaces**[59]: the objective is to foster the development of European data spaces in domains of public interest and strategic sectors, including financial services, in order to ensure the availability of large enough pools of data and of the necessary tools and infrastructures (e.g. with sector specific rules).

Additionally, the proposed EU data strategy intends to facilitate international data flows by lifting unjustified barriers and digital restrictions created by third-country jurisdictions and ensuring that data protection and security and fair and trustworthy market practices are enforced.

The focus of EU proposals mainly on EU-generated data that may be inferred from the objective to create European data spaces has been criticized by some market observers, despite this latter

[53] e.g. regarding who can do what with co-created or IoT data.

[54] 1 company in 4 is using cloud services in the EU according to the Commission and 1 in 5 for SMEs (source A European strategy for data February 2020).

[55] Also open to data from across the world.

[56] In particular personal data and consumer protection, competition law.

[57] The cloud federation component of the High impact project will foster the gradual rebalancing between centralised data infrastructure in the cloud and highly distributed and smart data processing at the edge, interconnecting emerging edge computing capacities from the start.

[58] This rulebook will in first instance offer a compendium of existing cloud codes of conduct and certification on security, energy efficiency, quality of service, data protection and data portability.

[59] Data pools combined with the technical tools and infrastructures needed to use and exchange data, as well as appropriate governance mechanisms and technical standards.

proposal regarding international data flows. Restricting the scope of data for training and using AI systems may indeed restrict their performance, particularly for scientific or healthcare applications. However, the possible consequences for financial services of a stronger focus on EU data would need to be further assessed.

5. Sectoral regulations and initiatives in the financial sector concerning data and AI

Currently there are very few EU policy frameworks that were developed with AI in mind, except GDPR or PSD 2 and the non-legislative fintech action plan, which also applies to AI developments[60].

The use of AI is therefore largely governed at present by the application of existing financial regulations[61] and principles that generally apply to fintech developments such as technology-neutrality (i.e. same business, same risks, same rules) and ensuring a balance between encouraging innovation and managing risks. AI however presents particular challenges in terms of accountability, explainability, access to data that need addressing, as previously mentioned. These are due to be covered by the horizontal AI and data policies proposed by the Commission. In addition, the Commission is currently planning a new Digital Finance Strategy for Europe that may address specific issues relevant to the use of AI in the financial sector.

5.1. Payment Services Directive (PSD) 2

PSD 2, the revised Payment Services Directive which entered into application in two successive stages (January 2018 and September 2019) facilitates the sharing of financial data for payment services. One of the objectives of PSD 2 is indeed to introduce more competition in the payments market by allowing fintechs and new third-party providers to have access to existing financial accounts and payment data in order to perform payment services (e.g. initiation of payment orders or aggregation of information from multiple accounts). PSD 2 defines the conditions for ensuring that data transmission can be performed in a safe way in this specific context, respecting data protection (thus completing GDPR)[62].

The data sharing requirements of PSD 2 may increase the size of the pool of financial data accessible to AI processing with payment-related data and may be a first step towards the wider sharing of personal financial data in line with 'open finance' principles. Certain financial players and public representatives however consider that the present PSD 2 rules create market asymmetries and suggest that real-time data sharing should be extended to non-financial data such as search data, ecommerce data or social media data generated by non-financial companies and digital platforms, provided customers consent to it. This may indeed allow financial institutions to better leverage the benefits of the EU data space (e.g. helping them to improve predictions, personalisation and risk assessments regarding their existing customers and allowing them to provide funding or investment services for new categories of clients[63]).

5.2. EU Fintech action plan

The non-legislative Fintech action plan published in 2018 by the Commission recommends actions that have now been implemented, aiming to adapt the EU financial regulatory framework to digitalisation and create an environment where innovative FinTech products and solutions can be rapidly developed across the single market, without compromising financial stability or consumer and investor protection. Although there are no specific actions relating to AI in this plan, AI is part of the solutions potentially benefitting from these measures.

In addition, the Commission subsequently set up an expert group on regulatory obstacles to financial innovation (ROFIEG), which published in December 2019 a report covering a broad range of issues that need tackling for the development of fintech in the EU. Some of these address challenges that are relevant for the uptake of AI.

The expert group recommended that the Commission in cooperation with the ESAs and relevant international standard setting bodies should provide guidance on how to meet explainability and interpretability requirements of AI applications in respect of supervisors and consumers[64].

Some other recommendations of the ROFIEG group[65] relating to data processing and sharing may also contribute to the development of AI including: measures to provide legal certainty on the access to and processing of non-personal data by different stakeholders[66]; rules to broaden the real-time sharing of data to non-financial data[67] with appropriate user control, in order to extend PSD2 data sharing requirements, as mentioned above; and guidance to assist financial institutions in the ethical (i.e. transparent and fair) use of data.

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[60] Some domestic initiatives, such as the "Fintech roadmap for Europe" published by the German Finance Ministry at the end of 2019 also address relevant issues for AI such as the need to extend GDPR in order to ensure customer confidence and customer responsibility with respect to data use. November 2019.

[61] Source Linklaters – AI in financial services - 2019.

[62] Payment service providers must for example inform their customers about how their data will be processed. They will also have to comply with some other customers' rights under data protection rules, such as the right of access or the right to be forgotten.

[63] Some observers however point out that a significant part of the data collected by Bigtech platforms at present may be difficult to share, given that it concerns the way individuals interact with their services and their online behaviour - See FT article for example "EU faces tough battle over Bigtech's hold on data" 21/02/2020.

[64] The Group also concluded that AI will realise its full potential when knowledge representation, machine learning, deep learning and natural language processing are employed in concert. This integrative approach should help minimise the risks associated with the current approach of using 'black box' machine learning and deep learning, which results in outcomes – e.g. client on-boarding or investment recommendations that cannot be explained, by either machine or human. Explainable AI technologies will therefore be required.

[65] Some additional measures proposed regarding supervision may also facilitate the uptake of AI: measures to enhance supervisors' understanding of technology and the development of RegTech and SupTech, efforts to provide reporting and compliance information in a human and machine readable format.

[66] completing the GDPR framework focused on personal data.

[67] e.g. search data or social media data.

5.3. Projects of a new Digital Finance Strategy for Europe

The Commission is due to propose in Q3 2020 a new digital finance strategy that will build on the actions listed previously.

A consultation paper published in April 2020 seeks comments notably on the prospects of AI in finance and how to support its uptake (i.e. regulatory obstacles that may need tackling, challenges and risks that need addressing and possible new measures that may be needed including new certification, auditing or registration mechanisms, etc.). The consultation also covers several other relevant areas for AI such as the access to publicly available data, the access to and sharing of personal data and the facilitation of financial compliance and supervision.

Annex 1

AI pre-requisites

Access to relevant data

The development of AI is dependent on access to appropriate and sufficient data (in quantity, quality, representativeness…) to train and operate AI systems. Data has exponentially increased over the last few years[68], opening the way to AI development, and the trend is due to continue notably with the growth of Internet of Things (IoT)[69] data. This creates two main challenges for financial institutions. One is having access to a wide enough pool of relevant data, which raises questions about whether the EU financial industry has access to sufficient data to reap the benefits of AI and potential obstacles to the sharing of data (with platforms, fintechs and non-financial firms). The second challenge is being able to process data in a variety of formats that may be increasingly unstructured and achieve sufficient quality of data e.g. with behavioural data generated by the development of the (IoT). This requires data mining capacities to refine, enrich and consolidate data.

AI and data skills

AI systems act with some degree of autonomy (i.e. without following a pre-determined set of instructions) and may adapt to perceptions of the environment, but their behaviour is largely defined ex ante by the instructions set out by their developers and the input they receive. In addition to the quality and adequacy of the data set used to train the system, the performance of AI systems is dependent on the way the problem to solve is encoded, the extent and suitability of the training and the way the algorithm or the artificial neural network[70] used to perform the assessments is designed, which all require high level AI engineering skills. An additional challenge in some cases is understanding whether the output that has been produced is optimal or if additional training or processing would help to improve it. Performing these different tasks requires specific AI engineering and data scientist skills that are currently in limited supply.

Appropriate hardware: computing power and specialised chips

The availability of sufficient processing power is another prerequisite for the implementation of AI systems with ever more demanding AI data treatments and sophisticated algorithms, which necessitate having sufficient computer power and specifically designed chips. Progress is being made in terms of computer power, with high-performance computers[71] that may be accessed remotely via cloud services and new generations of computing that are being experimented, such as quantum computing (QC) may help to solve some of the most complex problems in a shorter time e.g. to improve data-driven predictions[72].

Annex 2

AI applications in the financial services sector[73]

- New value propositions leveraging data analytics and alternative data to generate new insights, used for robo-advice or improving portfolio management and financing proposals (e.g. loans)
- Risk management including regulatory compliance, fraud detection, trading surveillance and liquidity and counterparty risk evaluations
- Automation and process reengineering of administrative tasks, reporting or compliance activities
- Customer acquisition and management with AI systems used for speeding up on-boarding and improving customer segmentation, cross-selling and personalisation
- Customer service with AI-enabled customer communication channels (e.g. chatbots, virtual assistants).

New value propositions leveraging data analytics and alternative data

Credit scoring, pricing and underwriting: AI-assisted credit scoring used notably by fintechs e.g. for SME loans potentially brings together multiple sources of data in order to determine credit worthiness, repayment ability and credit risk: i.e. revenue or financial data used in traditional credit risk analysis as well more unstructured social media and business data and behavioural factors. This can help to improve the pricing and conditions of loan offers or to speed up and simplify the assessment process.

Trading and portfolio management: AI can support investment decisions and portfolio monitoring by providing additional insights, reducing research costs (automating a large part of data analyses) and improving the timing of

[68]With 90% of the world's data generated in the last 3 years and data volume doubling every 2 to 3 years.

[69]IoT is the interconnection via the Internet of computing devices embedded in everyday objects, enabling them to send and receive data.

[70]Artificial neural networks (ANNs) model the way neurons interact in the human brain and use learning techniques inspired from the human brain.

[71]High performance computers can be further enhanced with distributed or grid computing architectures in order to scale up processing.

[72]With QC it is possible to run several simultaneous data processes and handle more easily multiple datasets, thus accelerating training and analyses.

[73]Sources: AI applications in financial services – Oliver Wyman 2019 ; Bank 4.0 Brett King 2019; Decoding AI in financial services Clara Durodié 2019.

their delivery (fast access to extensive archives of data), as well as their user-friendliness. AI facilitates the analysis[74] of increasing large amounts of data, from different sources (e.g. corporate financial reports, financial analyst reports, news feeds, social media feeds from corporates and influencers, etc…), considering different stakeholders (i.e. shareholders, employees, customers, suppliers, society…), and in varied formats (e.g. ESG data that often comes in large quantities and in an unstructured and inconsistent way, sentiment indicators…). AI also helps to assess indicators complementary to purely financial proxies (e.g. ESG, extent of digitalisation efforts, sentiment). With these improvements, AI can help to better address the non-linear nature of real-world events in investment decisions[75] or tail-risks and can support sentiment analysis with NLP or ML supported analysis of publicly available information. AI also helps to improve algo / HFT trading, increasing the ability to check multiple market conditions and data sets simultaneously, make predictive assessments and also improve execution timing and reduce errors due to emotional or psychological factors.

Claim management and risk modelling: In the insurance sector ML applications can help to improve the accuracy of risk predictions and also claim determination, thus improving financial performance. ML can also help to improve products or premium calculations with new pay-as-you-drive or usage-based insurance using in-car or in-home monitoring devices made possible by IoT applications.

Risk management

Fraud detection and AML: AI can help to improve the effectiveness of the detection of frauds such as conduct and market abuse in securities markets or money laundering thanks to the capacity to analyse a vast number of data points, revealing anomalies such as unusual price movements or suspect transactions that may go unnoticed by humans and also improving assessments on a continuous basis. Errors such as trading errors can more easily be detected. AI systems can help to identify a higher percentage of actual cases, reduce false alarms, increase the speed of detection and also facilitate customer on-boarding with more adequate procedures. AI can also help to anticipate risks with predictive analysis based on patterns, customer profiling or risk scores. This may also reduce the cost of such risk management compared to traditional rules-based methods, which require significant manpower and may unnecessarily increase scrutiny in some cases (e.g. for all citizens of a given country or all transactions above a certain amount).

Regulatory compliance and supervision: AI can help both financial services firms and supervisors with the use of RegTech or SupTech solutions in the performance of regulatory compliance activities, which have significantly increased in all financial sectors. ML helps to analyse and improve vast volumes of structured and unstructured data and also potentially identify patterns and relationship in the data.

Risk monitoring: AI systems can help financial institutions to calculate liquidity positions and evaluate risk exposures (e.g. counterparty risk) on an on-going way in a much faster way.

Automation and process reengineering

Back office processes: NLP and ML can help to automate numerous middle and back office processes involving the processing of documents such as applications, requests, checks…or data-based processes (e.g. reporting).

Internal processes: AI can be used for improving a number of internal processes such as recruitment (e.g. candidate screening), employee retention (identifying patterns in behaviour), legal functions (e.g. scanning past cases or incidents to forecast legal risks) and internal financial functions (e.g. scenario planning, error detection…).

Customer acquisition

Marketing: AI can improve customer segmentation in an adaptable and dynamic way. Based on behaviour patterns and preferences, ML applications allow visibility across customer engagement behaviour, helping to identify new business opportunities or customer segments to target. AI can also help to achieve real-time personalisation of offers to customers or of the way offers are communicated to customers, such as personalisation offers during an online navigation or identifying appropriate moments for making financial offers based on consumption patterns. This is at present mainly based on the data held by the financial institution, but external data (e.g. from social media) can also potentially be used.

Sales: AI is also used to leverage existing customer-relationship management (CRM) opportunities for cross-selling products or identify the appropriate moment for making a commercial offer. AI systems can also be used to improve customer interaction in sales channels.

Customer service

Customer interaction: NLP and ML can be used for new customer on-boarding. Chatbots and virtual assistants on a natural language processors are used to support customer interaction, dealing with frequently-asked-questions, assist with simple financial requests or perform account services. These intelligent assistants are trained to 'understand' financial terms and the different ways customers ask questions about their money or financial activities. AI can also help to develop predictive customer service.

Information and advice: AI can be used to provide personalised advice and information in a more effective way in the wealth management area for example with robo-advisors that can make investment proposals based on investors' profiles, projects and behaviours. AI can also improve financial planning by aggregating consumer financial information in a predictive way.

[74]E.g. establishing hypotheses on possible relationships and correlations between data and the results obtained when they are used in investment analysis for ex. relationship between the value of a company and its ESG commitments or level of digitalisation and establishing proxy indicators to measure the company's commitments and capabilities (e.g. environmental scores from rating agencies, number of statements concerning ESG, investments…).

[75]As opposed to traditional risk-factor regression models that assume that markets behave in linear relationships based on factors such as liquidity, macro-economic conditions, company economics such as profitability, debt-to-equity ratio, net cas position…

Annex 3

Factors of success for a wider uptake of AI in the financial sector

Multiplying AI use-cases throughout the financial value chain, for revenue generation as well as productivity gains:

In terms of productivity, it is likely that AI will continue to develop, supporting a new wave of "intelligent" automation of manual activities with the deployment of speech and image recognition and machine learning applications for data intensive activities (e.g. compliance, claims processing, credit underwriting,…). The speed of deployment of these optimisations will depend in particular on the return on investment that can be achieved (with significant investments needed to design and train these new systems, upgrade IT infrastructure and also acquire new skills) and on the additional customer benefits they may provide in terms of reducing administrative workload or speeding up processes.

AI applications also have strong revenue generation and customer satisfaction potential, enabling the improvement of customer segmentation and retention, cross-selling, new product development, mass-advice and personalisation. Some of these applications have however been slower to develop so far because progress here is in part dependent on the access to personal data held outside the financial sector (e.g. purchasing, location data…), as well as the improved use of existing financial data, and on the acquisition or scaling up of new quantitative marketing skills.

Evolving towards more data and tech-centric business models and business approaches:

Once some initial use cases have allowed financial institutions to experiment with AI and have proven to work for different activities (in terms of efficiency, customer recruitment or satisfaction), reaping the full benefits of AI requires that financial institutions should have a more strategic approach to the technology and evaluate how it may drive or contribute to their business model going forward[76]. A condition of success common to many incumbent financial institutions however, is also their capacity to put data collection and processing more at the centre of their business strategy and operating model in order to build an appropriate data ecosystem and evolving their IT infrastructure to support these changes. Leveraging AI capabilities (as well as digitalisation in general) also requires transforming skills, mindsets and cultures e.g. with increased digital and data capabilities, more agile working processes and an end-to-end process culture that identifies the potential of AI and the added-value of human intervention throughout the value chain.

Developing AI in combination with other new technologies such as cloud, DLT and quantum computing:

The potential of AI can be increased by using it in combination with other new technologies that are developing in parallel. Cloud computing provides data storage and processing power capacities that are necessary to new AI models and can facilitate access to AI tools with AI-as-a-service. Quantum computing will potentially provide AI with new computational capabilities and DLT with more secure encryption capabilities. DLT can play a significant role also in some processes supported by AI such as identity management with no need for centralized verification since DLT offers further possibility to manage data flows individually. AI may for its part facilitate the execution of increasingly complex and automated smart contracts, increasing the use case for DLT to support financial processes.

Enhancing cross-ecosystem collaborations on data and AI applications:

Data and tech oriented partnerships between incumbent financial institutions, fintechs, bigtechs and possibly other non-financial players may facilitate the development of AI technology and processing capacity and also increase access to data in line with the open banking or open data concepts, provided a fair and trustful model of collaboration can emerge. AI solutions could also be leveraged to enhance cooperation at market level in terms of AML, fraud detection or cyber-security, which may be beneficial to all market players. AI may also facilitate closer partnerships between financial and non-financial companies (eg car manufacturers, distributors…) for the provision of financing or insurance solutions using predictive analysis and personalisation features.

Annex 4

Previous EU AI initiatives

AI policy initiatives launched in the EU since 2018

A number of initiatives have been put in place by the EU institutions since 2018, aiming to build a "European approach to AI" (i.e. trustworthy and ethical), address the new challenges brought by AI and encourage its uptake in the EU by the public and private sectors in order to make the most out of this new technology. Europe is well placed to benefit from the potential of AI, according to the Commission's assessment, (with a world class position in a number of areas that are important for AI such as data analysis, software development, high-performance computers etc., large volumes of public and industrial data, competitive manufacturing and services sectors), but some of this potential is currently under-used.

A Communication of the Commission on AI for Europe (25 April 2018) proposes a three-pronged approach: (i) Increasing public and private investments in AI: investment in research, development of toolboxes and local Digital Innovation Hub ecosystems to support non-tech companies, notably SMEs, and public administrations and investment efforts in AI projects coordinated with the EIB; (ii) Developing digital skills through training and cooperation; (iii) Ensuring an appropriate ethical and legal framework for AI including measures to encourage the transparency of algorithms, guidance on product liability and ethical guidelines on the use of AI.

This initiative was completed by a coordinated plan of the EU Member States and the Commission for AI "made in Europe" signed at the end of 2018, aiming at ensuring complementarity

[76] This requires a more systematic approach, identifying for each step in the value chain the additional benefit that AI can bring, the appropriate balance and combination between AI and human intervention, which may vary across individual financial institutions (depending on their customer base, their positioning in the market, their IT skills and/or access to relevant third-parties…).

and synergy between national and EU level actions dedicated to the development of AI in the three areas mentioned above[77]. In terms of investment, this plan foresees an increased coordination of investments across the EU, which would lead to at least €20 Bio of public and private investments in research and innovation in AI from 2018 until the end of 2020 and more than €20 billion per year from public and private investments over the following decade in the EU, in line with investment in the US and China[78].

Other EU initiatives include the publication of ethical guidelines for "trustworthy AI" by the high level group on AI in April 2019 and a report on liability for AI and other emerging technologies published by an expert group on this subject in November 2019.

Annex 5

Proposed EU data strategy (2020)

The proposed EU data strategy rests on 4 main pillars

The EU strategy also has an international dimension aiming to facilitate international data flows. This involves lifting unjustified barriers and digital restrictions created by third-country jurisdictions and ensuring that data protection and security and fair and trustworthy market practices are enforced. To this end, the Commission aims to establish by Q4 2021 a framework to analyse data flows and estimate their economic value within Europe, as well as between Europe and the rest of the world. The Commission will also continue to promote EU data protection rules in order to increase the range of jurisdictions operating with standards regarding personal data similar to the EU and encourage third-country companies to take advantage of EU rules regarding the storage and processing of data.

1. A cross-sectoral governance framework for data access and use

A first area is the strengthening of EU and Member State governance structures[79] aiming to support decisions on what data can be used in which situations, facilitate cross-border data use and prioritise interoperability requirements and standards within and across sectors. Secondly is making more high-quality public sector data available for re-use across the EU for free in machine-readable format and through standard APIs[80]. Thirdly the Commission will explore the need for legislative action on issues that affect relations between actors in the data-agile economy to provide incentives for horizontal data sharing across sectors, establish data pools and eliminate regulatory and non-regulatory barriers to the use of data in products and services[81]. This could be taken forward in a Data Act (2021) looking at different types of data sharing scenarios[82] and ways to empower individuals so that they become more involved in the data economy.

The Commission will moreover assess which measures are necessary to establish data pools for data analysis and AI systems considering issues such as EU competition rules, conflicting rules across the EU and the present market power of certain platforms.

2. Investments in data and the strengthening of Europe's data infrastructures and capabilities

The Commission's objective is to establish common interoperable data spaces in strategic sectors at EU level by combining investments in next-generation data infrastructures, the interconnection of existing cloud and edge infrastructures and computing capacities and related tools and governance mechanisms. The project will be based on the European federation of energy-efficient and trustworthy cloud infrastructures and related services in order to address the specific needs of industries in the EU including hybrid cloud and with a view to facilitating combined investments of € 4-6 billion with the Member States, of which the Commission could aim at investing € 2 billion.

The first implementation phase is foreseen for 2022 with the development of a cloud rulebook building on existing codes of conduct and certifications and the setting up of a cloud services marketplace for EU public and private sector EU users offering cloud processing software and platform services complying with requirements in areas such as data protection, security, portability, energy efficiency.... The rest of the project should span until 2027. A first step is to sign Memoranda of Understanding with Member States on cloud federation in Q3 2020, in order to avoid a multiplication of fragmentated cloud federations and data-sharing initiatives.

3. Investment in data literacy and enhancement of individual data rights

The Commission will explore the enhancement of portability rights under GDPR in order to give individuals more control over who can access and use machine-generated data i.e. IoT data coming from e.g. smart home appliances or personal data apps. This could be supported by having stricter requirements on interfaces for real-time data access or by guaranteeing the neutrality of personal data spaces.

On-going efforts to improve general data literacy and support the scaling-up of data-based SMEs (part of the Digital Europe and Horizon Europe programmes) are also part of this plan in order to reduce the current gap in data specialists needed to put in place the EU data strategy and also to foster the development of data-based business models particularly for SMEs.

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[77]Many European countries have drafted strategies on how to support AI development and harness its benefits for their countries including Sweden, France, Germany, Estonia, Italy, Denmark, Finland, UK...

[78]Complementing national investments, the Commission will invest €1.5 billion by 2020, 70% more than in compared to 2014-2017. For the next long-term EU budget (2021-2027) the EU has proposed to invest at least €7 billion from Horizon Europe and the Digital Europe Programme in AI.

[79]A legislative framework for the governance of common European data spaces is due to be published in Q4 2020.

[80]This would involve the adoption of an implementing act on high-value data sets under the Open Data Directive (Q1 2021).

[81]This will include an assessment of platforms and whether ex ante regulation may be appropriate to tackle potential market power imbalance issues.

[82]i.e. business-to-government, business-to-business data sharing, compulsory access to data under certain circumstances.

4. Common European data spaces in strategic sectors and domains of public interest

In complement of the actions above, the Commission will promote the development of common European data spaces in strategic economic sectors including financial services and domains of public interest. This should lead to the availability of large pools of data in these sectors and domains, combined with the technical tools and infrastructures needed to use and exchange data, as well as appropriate governance mechanisms (a horizontal framework possibly complemented by sectoral legislation for data access and use and interoperability). In the financial services sector, concrete initiatives are due to be set out in the upcoming Digital Finance Strategy due in Q3 2020, completing the data sharing requirements of the revised PSD (Payment Services Directive). These measures may include a promotion of the use of common pro-competitive technical standards in order to facilitate access to and the processing of publicly-available data in the areas of capital markets and sustainable finance and also to improve market transparency.

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