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Opportunities and challenges of artificial intelligence in banking and financial services

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Abstract

AI is a crucial element of the banking and financial industries, providing affordable and reliable banking services. The market for AI in the banking sector is expected to grow at a CAGR of 32.6% from 2021 to 2030, reaching $64.03 billion by 2030. Banks use AI technologies to automate their operational processes, improve customer support, and mitigate potential risks, ultimately increasing efficiency and productivity. AI can help banks identify fraudulent activities and prevent them from occurring. It can also analyze customer data and provide personalized services to customers. Additionally, AI can help banks make better decisions by analyzing large amounts of data. By using AI, banks can reduce costs and increase profits while providing better services to their customers.

Keywords: Artificial intelligence; Machine learning in Banking; Opportunities; Financial services

1. Introduction

The rapid progress in computer hardware, software, and internet technologies has brought irreversible changes to our societies. It is now difficult to imagine an economic agent without computers, the internet, or mobile devices. The pace at which IT is evolving offers great opportunities to expand the client base, introduce new products or improve existing ones, and increase efficiency in a relatively short period of time. However, companies that miss out on the current IT wave might be overtaken by events soon.Among the various IT breakthroughs of recent years, the advancement in AI is particularly remarkable. In short, AI refers to computers having cognitive skills similar to humans, which could result in immense efficiency gains for firms and their clients alike. The financial sector has been one of the early experimenters with AI technologies, not least due to its likely contribution to stronger profitability. Therefore, it is essential to take a closer look at the potential role of AI in banks' digital transformation.

2. The remarkable difference between artificial intelligence and regular IT application

Businesses have mostly used IT solutions to automate tasks that need human participation. The developers of these IT applications have determined their limits, and these solutions have had low capabilities by design. They have been largely inflexible and unable to understand or act by themselves. But this is changing more and more as technology improves quickly. Artificial intelligence is the ability of computer programs to learn and use knowledge without human interference and involvement. By watching the world around them and processing information by themselves, AI systems make inferences and take suitable actions. They improve their performance over time by learning from their previous decisions and their accuracy level. AI is not a new concept and was first named at the Dartmouth Conference in 19561. However, some recent IT breakthroughs have enabled great progress in AI's capabilities

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- The growth of internet usage has resulted in huge amounts of digital information being created and stored. The amount of data produced worldwide increased by 17 times in about 10 years. Predictions indicate another five times increase from now until 2025. This large amount of information, after being cleaned and organised (i.e. big data), is the basis of data-driven decision-making.
- The processing power of computers has increased enormously. A common measure of that, the number of transistors, has grown 10 m times since the 1970s. The speed of central processing units, another factor affecting processing power, increased by 6,750 times over the same period.2 This allows algorithms to process information much faster and enhances the accuracy of their decision-making.
- Other developments – such as the decrease in data storage costs, improvements in data mining processes or a growing number of IT experts – have further boosted the possibility and capability of AI. For example, the hard drive cost per gigabyte has reduced from around USD 5,000 in 1990 to some USD 0.025 today, while the number of IT specialists increased by 50% in the euro area between 2007 and 2017. Big data as input, data identification methods such as machine learning and the lower cost of these tools have been the main factors behind AI's recent fast success in understanding languages, recognising objects and sounds, and observing and solving problems by themselves.

Machine learning : There are various approaches to programming computers so that they mimic human decisionmaking. Decision trees, ranking or prioritising are among the more established solutions. A relatively new approach is machine learning (ML). ML is a subset of AI and refers to computer programs that recognise patterns and make predictions based on them. Typical examples are internet platforms that recommend particular products or news stories to users who might like them based on previous preferences. By continuously analysing new data and scenarios, ML tools make adjustments to decision-making processes without being specifically programmed to do so. They are therefore able to learn from data. Subcategories of ML are deep learning, as well as supervised, unsupervised and reinforcement ML. ML tools process vast quantities of data through neural networks. In short, these are processes which classify data on successive layers. In doing so, they rely on the probabilities of possible outcomes. They make decisions based on the most likely outcome, even though it might turn out not be the perfect choice in the end. However, neural networks involve a feedback loop. Depending on the accuracy of the outcome from previous trials, they update their approach to perform better the next time.

3. Aritificial Intelligence investments on rise

AI has evolved rapidly in recent years and is being tested and applied in various domains. However, measuring its adoption is not easy due to measurement challenges. For instance, firms may use AI to improve their processes, which is not directly visible for analysis. Also, it is sometimes hard to distinguish between standard IT solutions and pure AI applications. To address these limitations, data on venture capital (VC) investments in AI start-up firms can be helpful.3 In 2018, AI start-ups got a whopping USD 24 bn globally, up from less than USD 2 bn in 2013.

VC investments grew strongly in the last two to three years. AI firms have also become more attractive for acquisitions. In the past 20 years, 434 companies in the AI sector have been bought, 220 of them since 2016 alone.4 Of the total VC amount in 2018, almost USD 15 bn went to AI start-ups in the US, and another USD 6.5 bn went to Chinese firms. In 2017 and 2018, the number of VC deals levelled off. But the average size of VC investments increased, showing that VC went into more mature AI firms with larger capital needs than typical early stage start-ups. For example, SenseTime Group, a computer vision and deep learning technology developer, raised USD 1.6 bn in VC funding in 2018.

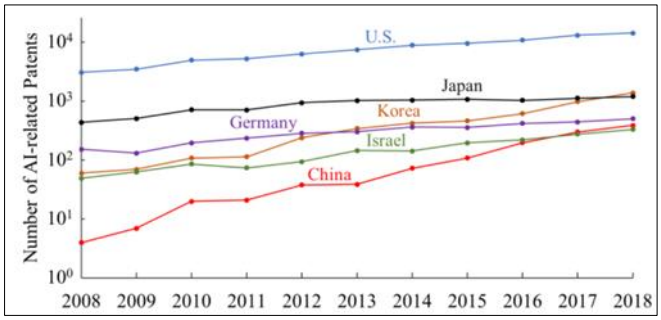

Figure 1 Number of AI-related patents for the selected assignee countries per year (patents granted by USPTO)

With the new capital, the company's value increased to over USD 6 bn, making it the world's most valuable AI unicorn. In the US meanwhile, mainly large tech firms invest in AI start-ups. VC investors see AI as a truly transformative technology with great potential, similar to the internet and mobile revolutions in previous decades. How do AI start-ups spend the funds they get? Initial observations suggest that they recruit new AI talent (which is expensive and hard to find) and broaden their services. Investors may therefore have to wait some time before they get significant returns on their investments.

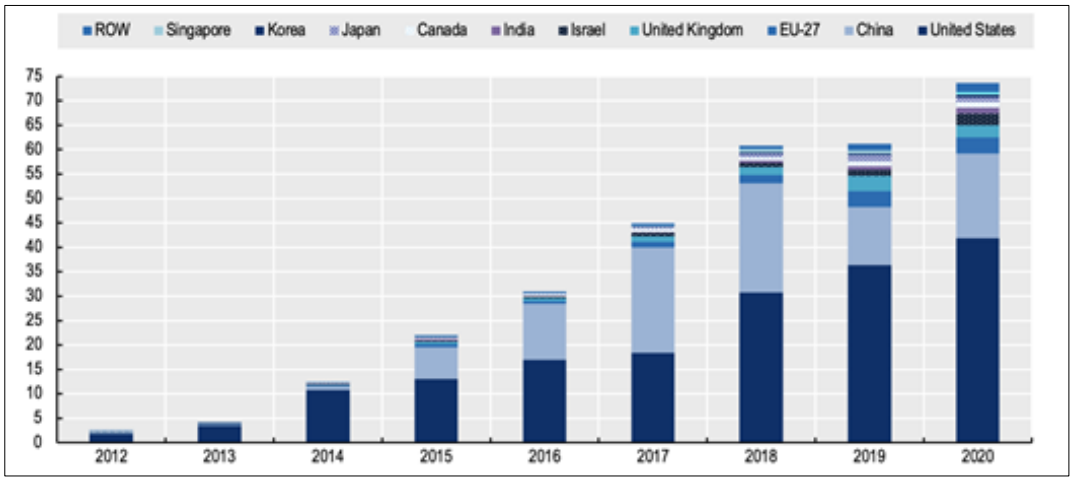

Figure 2 Estimated value of VC investments in AI start-ups

4. Artificial intelligence: A new frontier for intellectual property rights

The number of patents filed in a technological field is often an indicator of its usefulness and economic value in the future. AI-related technologies saw a surge in patent applications, reaching 20,000 in 2016, twice as many as in 2010. Half of these patents were in computer vision, a technology that is widely used in self-driving cars and faces fierce competition. The US had the largest share of AI patent applications in 2015 (the most recent data available by country), with about one-third, followed by China with 25%, up from 10% in 2010. Japan and the EU-28 each had 14%, down from around 20%. China seems to be taking over the EU and Japan in AI research and development, which could have significant consequences in the long run. In the EU, Germany and France were the source of half of all AI patent applications.

Along with the UK (16%) and Sweden (8%), they made up most of the EU's AI patents. Patents grant a legal monopoly and create first-mover advantages. Countries that lag behind in AI implementation may face large economies of scale and risk falling behind for a long time.

The European Commission proposed a budget for research and innovation projects in Europe in March 2019, in response to the growing global competition in IT and AI. Horizon Europe is the successor of Horizon 2020, which had a budget of EUR 77 bn for 2014-2020. Horizon Europe plans to allocate EUR 100 bn for 2021-2027. One of its main sub-categories is the Digital Europe Programme, which aims to invest EUR 9 bn in projects related to high-performance computing and data, AI, cybersecurity and advanced digital skills. Horizon Europe is a positive step towards improving AI technology in Europe, but its effectiveness is uncertain. Its predecessor received 115,000 proposals for innovation and research between 2014 and 2016, but only 14,000 were funded, a very low success rate. The high demand for funding shows the need for more support, but the high rejection rate suggests some underlying issues. Other solutions, such as increasing IT literacy at early stages or enhancing IT infrastructure, may be needed to boost the quality and quantity of AI and innovation projects.

5. IT implementation in banking

Banks often embrace IT opportunities early. This applies to both the back office, where they have used modern technologies for a long time (e.g. for payment processing), and the front-end. A case in point is automated teller machines (ATMs), one of the first IT applications in banking. They took over the repetitive tasks of bank employees, such as cash withdrawal and account balance checks. They simplified the access to standard banking services for clients and improved the efficiency of banks. Since the first ATM was installed in London in 1967, they have become common

devices in branches. In Europe, their numbers have increased to three ATMs per bank branch in 2017, up from one ATM per four bank branches in 1987. Bank employees, freed from routine cash-handling tasks, could focus on other services, such as relationship banking (i.e. meeting clients' individual needs) and offering other bank products like credit cards, loans and investment products.

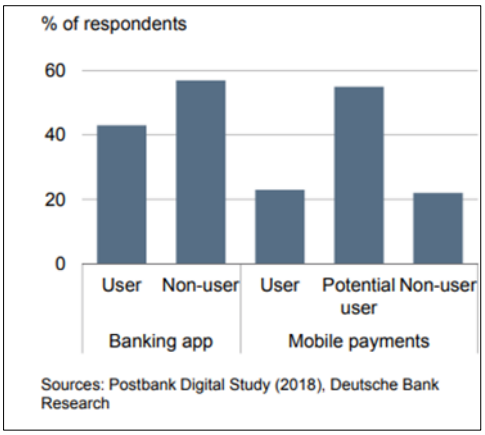

Figure 3 Mobile banking Statistics

Online banking is another instance of banks adopting new IT for clients. Since the late 1990s, the internet has become a popular medium for banking services. Direct or internet banks with few or no physical branches appeared. Almost all banks began to offer online banking services. In 2018, more than half of the adult population in the EU used internet banking to check their account balances or transfer funds. In some countries, such as Denmark, internet banking penetration rates are very high (90%). In Germany, 59% of individuals used internet banking in 2018, up from only 35% in 2007.

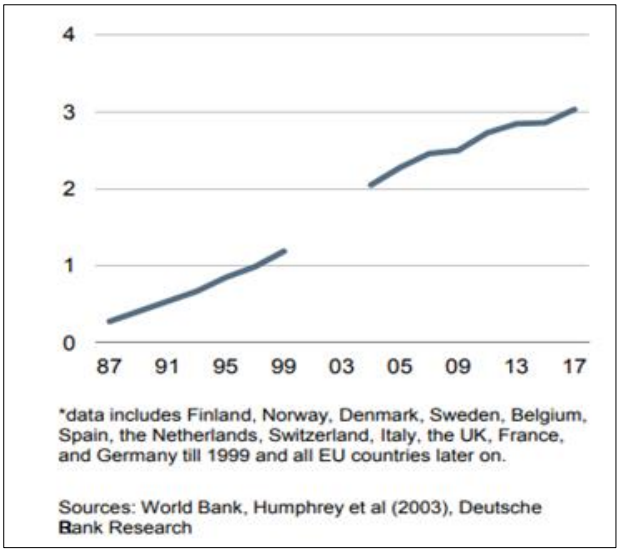

Figure 4 ATM to bank branch ratio in Europe*

For clients who have little time to visit a branch, online banking has become the main tool for standard services. The way that bank clients access the internet has also changed. Germans, for example, are more and more using their mobile devices for internet banking, and some 40% of them have a banking app on their mobile phones. Furthermore, one-fifth of them also use their apps for mobile payment services. This is especially popular among younger, more educated and internet-savvy individuals. With banks and their clients interacting on virtual platforms and more and more people using online services, banking is becoming less reliant on branches.

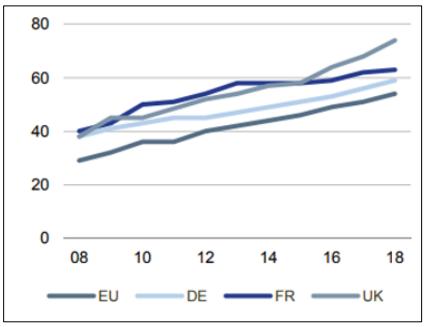

Figure 5 Internet banking shows persistent growth

6. Artificial intelligence in banking

Banks rely on data for almost all their businesses, from traditional lending and deposit taking to investment banking and asset management. Therefore, banks can benefit greatly from autonomous data management without human intervention, which can enhance speed, accuracy and efficiency. AI applications in banking can be grouped into four main categories: 1) customer-oriented front office applications, 2) operations-oriented back office applications, 3) trading and portfolio management, 4) regulatory compliance.7 However, banks are mostly still exploring AI technologies rather than fully applying them in their processes. Customer- and operations-oriented AI solutions seem to be more actively investigated than others:

- AI is being tried for real-time detection and prevention of fraud in online banking. Credit card fraud has been one of the most common types of cybercrime in recent years, worsened by the rapid growth in online and mobile payments.8 To spot fraudulent activity, AI algorithms examine the plausibility of clients' credit card transactions in real time and compare new transactions with previous amounts and locations. AI stops transactions if it finds risks.
- AI is also being tried in KYC processes to verify the identity of clients. AI algorithms scan client documents and assess the validity of the information given by comparing it with information from the internet. If AI algorithms find discrepancies, they flag them and a more thorough KYC check by bank employees is done.
- Another area where banks are experimenting with AI technologies is chatbots. Chatbots are digital assistants that communicate with clients by text or voice and aim to handle their requests without the involvement of a bank employee.
- Banks are also investigating AI to visualise information from legal documents or annual reports, for example, and to extract important clauses. AI tools create models autonomously after observing the data and back testing to learn from their previous errors to improve accuracy.
- Some existing financial technology tools also evolve into true AI solutions over time. Good examples are robo-advisors that enable full automation in some asset management services and online financial planning tools that help customers make smarter consumption and saving decisions. As these financial technology solutions advance, they increasingly use techniques that search data and find patterns in them autonomously.

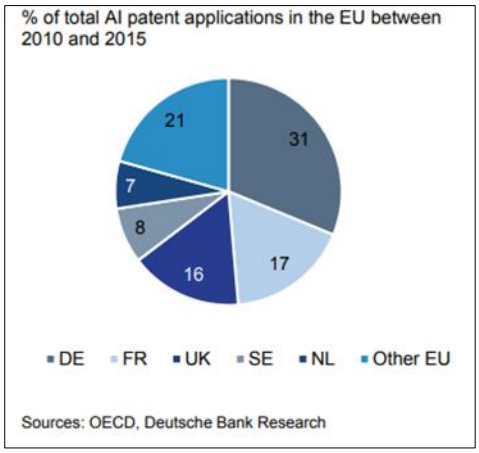

Figure 6 AI activity concentrated in a small set of EU countries

A real-life application of AI: Deutsche Bank's Alpha-Dig platform 9 Using AI and machine learning tools, it is possible to quantify geopolitical risk and predict its effect on financial markets. For example, Deutsche Bank's Alpha-Dig platform (Alpha-Dig) infers context from news media, social media, and other natural language articles, and then builds a picture of a country's political risk profile. Alpha-Dig first uses algorithms to mine global financial news as a proxy for how much media attention there is towards certain countries' risks. The process uses Natural Language Processing and machine learning techniques to infer context in a news article and ensure that positive and negative indicators are gleaned from it. As a second step Alpha-Dig overlays learnings from Wikipedia whose articles are largely accurate and easily readable for machines. To adjust for potential biases, the platform uses readership data to see what topics are trending. Once data from the mainstream financial news is enhanced with learnings from Wikipedia, Alpha-Dig can create a picture that shows how political issues have become more or less important over time. Among other statistical methods, Z-scores can be calculated, which look at the average amount of daily geopolitical news for a topic in the recent past and see what proportion of all geopolitical news is consumed by that topic. If a particular political event is receiving attention that is greater than two standard deviations more than normal, it is labelled an 'outlier' event. Obviously, no system can accurately forecast geopolitical implications all the time. But via tools like Alpha-Dig, an objective measure that can assist investors in what are notoriously difficult times can be created, thanks to advancement in AI. Source: Deutsche Bank Research. Konzept. January 2019, p. 34-39

Table 1 AI in Banking fields

Customer focused	-Credit scoring -Insurance policies -Client -facing chatbots -Know your customer
Operation focused	-Capital optimisation -Model risk management -Stress testing -Fraud detection
Trading and portfolio management	-Trade execution -Portfolio management
Regulatory compliance	-Regulatory technology -Macroprudential surveillance -Data quality assurance -Supervisory technology

7. Constraints to use Artitificial Intelligence in banking industry

Data quality and availability: Banks often lack enough and reliable data to train and use AI models effectively. They may need to access external data sources or partner with other entities to enrich their data. They may also face privacy and security issues when handling sensitive customer data.

Regulatory and ethical compliance: Banks need to comply with various regulations and ethical standards when using AI, such as ensuring fairness, transparency, explainability, and accountability. They may need to adopt frameworks and guidelines to ensure that their AI applications are aligned with the law and the expectations of customers, regulators, and society.

Organizational and cultural readiness: Banks need to transform their organizational structures, processes, and cultures to embrace AI and foster innovation. They may need to invest in talent development, change management, and agile ways of working. They may also face resistance from employees who fear being replaced by AI or lack the skills to work with it.

Integration with legacy systems: Banks need to integrate their AI applications with their existing IT systems, which may be outdated, complex, or incompatible. They may need to upgrade their IT infrastructure, adopt cloud-based solutions, and ensure interoperability and scalability of their AI solutions

7.1. Profitablility in Banking Industry due to Artificial Intelligence

- AI can help banks personalize their services to customers based on their preferences, needs, and behavior. This can increase customer satisfaction, loyalty, and retention, as well as cross-selling and up-selling opportunities. For example, AI can use natural language processing to power chatbots that can interact with customers 24/7 and provide them with relevant information and advice.
- AI can help banks automate their operations and processes, such as fraud detection, KYC verification, document analysis, and credit scoring. This can reduce human errors, operational risks, and compliance costs, as well as improve efficiency and accuracy. For example, AI can use machine learning to analyze transaction data and identify fraudulent patterns in real time.
- AI can help banks generate insights from their data and discover new sources of value and growth. This can enable banks to create new products and services, enter new markets, and optimize their strategies and performance. For example, AI can use deep learning to analyze market trends and customer behavior and recommend profitable investment opportunities.

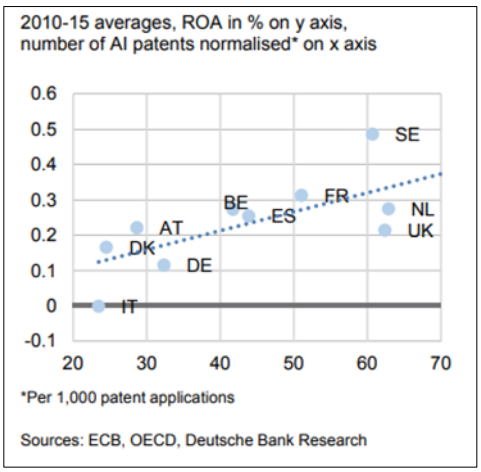

Figure 7 AI and bank profitability: An almost linear relation

% of variation in ROA explained by...

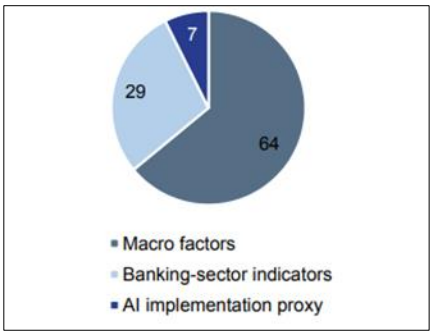

Figure 8 ROA in Europe

Results of panel regression. The dependent variable is the biannual ROA of the banking sector. Explanatory variables are GDP growth, inflation, cost-income ratio, non-performing loans, equity-to-assets ratio, total assets of banks, share of AI patents and time-fixed effects. The time dimension of the analysis is from 2010 to 2015. The countries included are Austria, Belgium, Denmark, Germany, France, Italy, Spain, Sweden, the Netherlands and the UK.

According to a report by McKinsey, AI technologies could potentially deliver up to $1 trillion of additional value for banks each year. However, banks also face some challenges in adopting AI, such as data quality and availability, regulatory and ethical compliance, organizational and cultural readiness, and integration with legacy systems. To overcome these challenges, banks need to have a clear vision and strategy for becoming AI-first institutions, invest in talent development

and IT infrastructure, adopt frameworks and guidelines for responsible AI use, and collaborate with external partners and stakeholders.

8. Conclusion

AI is a technology that can perform tasks that normally require human intelligence, such as reasoning, learning, and decision making. AI can help banks improve their profitability by increasing revenues, reducing costs, and creating new opportunities. AI can help banks personalize their services to customers, automate their operations and processes, and generate insights from their data. However, banks also face some challenges in adopting AI, such as data quality and availability, regulatory and ethical compliance, organizational and cultural readiness, and integration with legacy systems. To overcome these challenges, banks need to have a clear vision and strategy for becoming AI-first institutions, invest in talent development and IT infrastructure, adopt frameworks and guidelines for responsible AI use, and collaborate with external partners and stakeholders. AI is transforming the banking industry and creating new possibilities for value creation and innovation. Banks that embrace AI will gain a competitive edge and enhance their performance in the digital age.

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