Artificial Intelligence in the Financial Sector – Innovation and Risks*

Anna Domokos ⓘ *– Péter Sajtos* ⓘ

Artificial intelligence has come a long way and achieved many breakthroughs. Today, this technology is in the focus of public debate again and is increasingly part of our everyday lives. The financial sector is no exception to this trend. As this technical paper demonstrates, given the risks associated with efficiency-enhancing business opportunities, there may be a case for a possible sector-specific regulatory framework, which is essential to exploit the potential of the technology while minimising the risks.

1. Introduction – historical background

Since its beginnings, artificial intelligence[1] has reached a number of significant milestones. While the field of research dates back to the 'Artificial Intelligence' conference at Dartmouth College in 1956 (*Harvard University 2017*), and the first results were published as early as in the 1960s, following the creation of Eliza, the first 'official' chatbot system (*Tarnoff 2023*), it did not become popular among the public and was not widely used until several decades later, when ChatGPT became publicly available at the end of 2022, leading to a significant shift in the focus of artificial intelligence solutions.

Looking back over the past 20 years, Google search trends make it clear that the period relevant in this respect is by no means limited to the last 1 to 3 years, both in terms of theoretical research and practical results (*Figure 1*). In particular, the period 2016–2017 can be considered as a breakthrough in the field of deep learning.[2] During this period, Google published the 'Attention is all you need' study of the concept of transformer models, and OpenAI became more widely known among developers. It was also the time when cross-enterprise initiatives to promote the interoperability of solutions were first launched (e.g. with Facebook and Microsoft), and we were introduced to Sophia, the intelligent humanoid robot, and AlphaZero


Anna Domokos: Magyar Nemzeti Bank, Legal Expert. Email: domokosa@mnb.hu
Péter Sajtos: Magyar Nemzeti Bank, Head of Department. Email: sajtosp@mnb.hu

[1] See *Figure 2* for the definitions of each term.
[2] See *Figure 2* for the definitions of each term.

(an enhanced version of Google DeepMind AlphaGo, which was capable of advanced self-learning, including the ability to master chess in a few hours after learning the rules of the game). However, there is no doubt that the emergence of ChatGPT and subsequent research have proven to be a new catalyst in the field of artificial intelligence (*Marr 2018; Goldman Sachs 2023; Karjian 2023*).
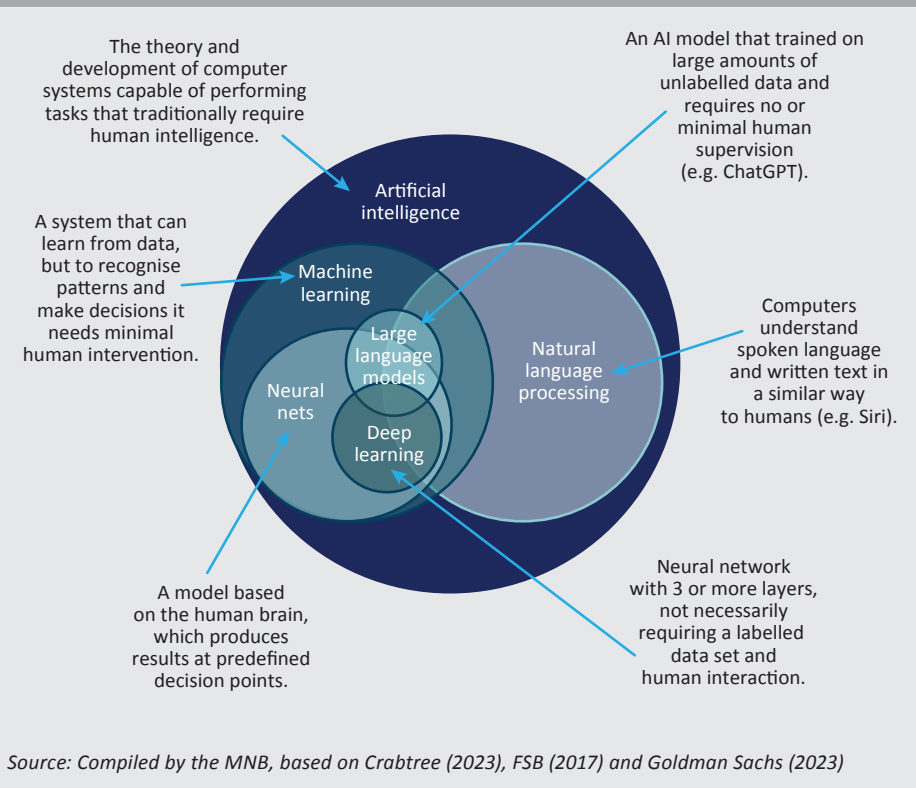
Figure 1
Trends in Google searches for 'Artificial intelligence' over the past 20 years, with some key milestones during this period

Source: Compiled by the MNB, based on Google Trends
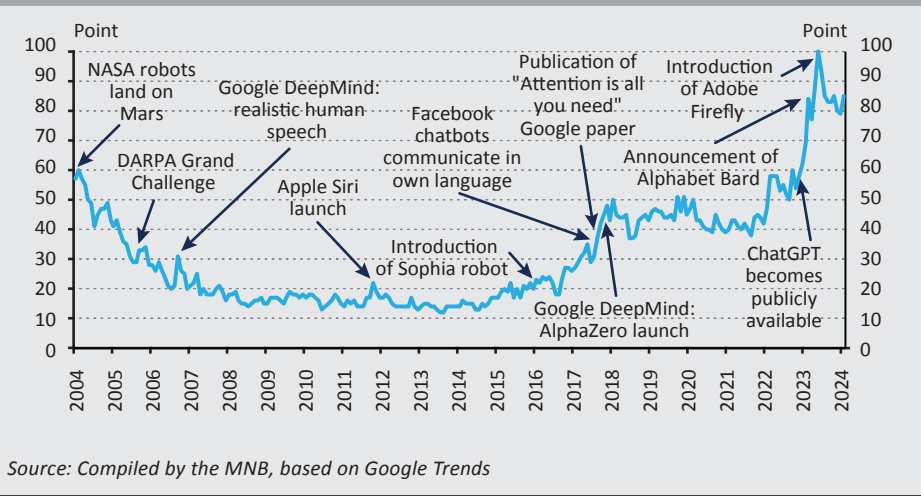
2. The definition of artificial intelligence

The complexity of the technology is demonstrated by the fact that, despite nearly 70 years of scientific research in the field and its presence in our everyday lives, there are still different approaches instead of a single, universally accepted definition of the concept. In short, it is a general concept that refers to the theory and development of computer systems capable of performing tasks that traditionally require human intelligence. That broad approach can thus encompass several operational models (e.g. machine learning, natural language processing, deep learning, etc.). A structured framework of this is presented in *Figure 2*.

Figure 2
Glossary of artificial intelligence

The theory and development of computer systems capable of performing tasks that traditionally require human intelligence.

An AI model that trained on large amounts of unlabelled data and requires no or minimal human supervision (e.g. ChatGPT).

A system that can learn from data, but to recognise patterns and make decisions it needs minimal human intervention.

Artificial intelligence

Machine learning

Large language models

Natural language processing

Neural nets

Deep learning

Computers understand spoken language and written text in a similar way to humans (e.g. Siri).

A model based on the human brain, which produces results at predefined decision points.

Neural network with 3 or more layers, not necessarily requiring a labelled data set and human interaction.

Source: Compiled by the MNB, based on Crabtree (2023), FSB (2017) and Goldman Sachs (2023)

In this area, the definition of artificial intelligence (*Russell et al. 2023*) and the principles created by the OECD have functioned as the main starting point for both use case research and regulatory efforts in the recent past. However, the OECD definition is only a current consensus, which has been updated several times over the years (2016,[3] 2019,[4] 2023[5]). As the technology evolves, so does its definition, making it difficult to develop an appropriate regulatory framework. However, a common definition is essential for effective communication between the actors involved in the use of the technology (e.g. business users, regulators, technologists). Precisely defining the subject of future legislation relevant to the technology can help to create legislation that supports the safe deployment of artificial intelligence by also promoting trust regarding its use.

---

[3] *OECD* (*2016*)
[4] https://legalinstruments.oecd.org/en/instruments/OECD-LEGAL-0449. Downloaded: 9 February 2024.
[5] *Russell et al.* (*2023*)

3. Why can artificial intelligence be important in financial services?

The wave of digitisation-based innovation in recent years has also brought a number of new technological solutions to the financial system. They include mobile payment solutions, for example, whose primary result is making transactions faster and more convenient for customers, while cloud-based solutions mainly help institutions to improve efficiency by modernising data storage and optimising the use of computing capacity. It can be observed that many of the developments that have become established in recent years typically target a smaller part of the financial services value chain, as solutions that affect customers can, for the most part, be separated from those that have a primary impact on internal operations (*MNB 2023*).

Artificial intelligence (AI), on the other hand, may bring about a substantial change, as solutions based on this technology, due in part to the broad and general definition presented earlier, can prove to be relevant at several points of the value chain, and the use cases can cover the entire financial services operating environment (*OECD 2021; Prisznyák 2023*). The use of AI-based solutions can assist more accurate, cheaper and faster decision-making when serving customers (e.g. real-time offers), while also providing advances in automating interactions between institutions and customers (e.g. chatbots) and improving the efficiency of administrative tasks related to specific product application processes (e.g. optical character recognition (OCR) when uploading ID cards) in that context. There are, however, a number of areas in the internal operations of institutions where artificial intelligence can prove to be useful: as an optimisation tool, it may be able to support banks' internal processes related to capital and risk management, thereby improving compliance with operational requirements (*Okwechime 2023*). Moreover, institutions can use more advanced methodologies to estimate or forecast the expected value of key financial indicators[6] (*Gartner 2022*), and it may also be relevant for the trading strategies related to the portfolios they manage, both in forecasting market movements and effects and in the automated execution of trade transactions.


[6] *E.g. ROE, interest margin*

In addition to the above, certain areas of application can also be identified which support both individual institutions and the financial system as a whole. On the one hand, cybersecurity can be improved through the appropriate use of artificial intelligence to develop more effective fraud detection solutions or appropriate automated protection mechanisms, which might also benefit customers. Moreover, AI-based solutions may also increase the efficiency of regulatory compliance and the relationship with supervisory authorities (e.g. automated data transfers).

It should also be emphasised that financial institutions are complex economic entities, which means that various process elements and tasks related to general corporate functions are involved in their operation. This is another area where the sector may benefit from artificial intelligence, whether in order to increase the efficiency of the management of human resources, or in issues that indirectly affect the functioning and competitiveness of institutions, such as image design, optimisation of the territorial distribution of branch networks, or even the design of the internal appearance and layout of branches/customer centres.

It can therefore be seen that the areas of application are rather broad, i.e. financial institutions can find relevant applications for implementing AI-based solutions with predictive and data analytical capabilities, while the creative value creation potential of generative artificial intelligence solutions[7] can also arise in a number of other aspects (*Figure 3*).

---

[7] A type of artificial intelligence systems that generates text, images and other content in response to natural language commands (*Goldman Sachs 2023*).

Figure 3
**Key AI-based use cases for commercial banks**
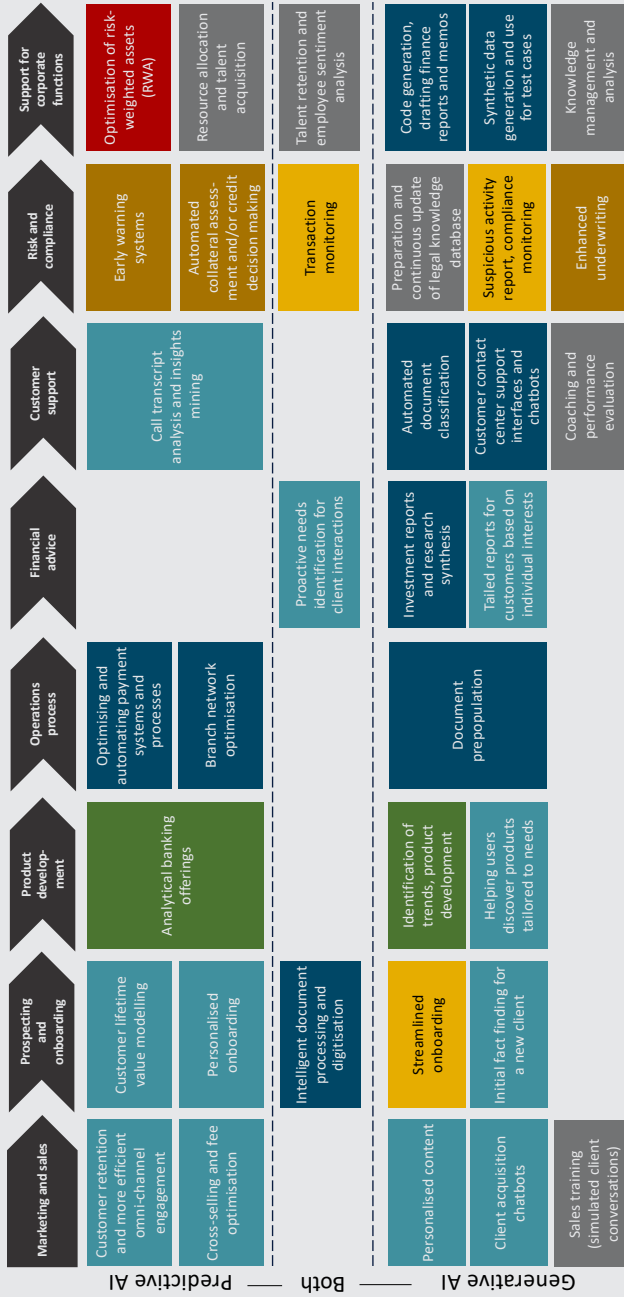
Source: Riemer et al. (2023), Figure 4

4. The uptake of AI-based solutions within the financial system

The financial system's interest in artificial intelligence began much earlier than the developments seen in the last few years. According to certain studies, the financial system has been among the leaders compared to other industries in the use of artificial intelligence or even more advanced machine learning solutions: according to S&P's Global 2022 survey, financial institutions had the second-largest market share (18%) in terms of using machine learning solutions, second only to IT and the telecom industry and lagging behind by just a single percentage point (*Fernández 2023*). In recent years, alongside other digitisation developments, banks have implemented a number of AI-based solutions to help them operate with increased security and efficiency (*Figure 4*). However, recent developments and the sudden surge in interest in the technology are expected to further boost the penetration of solutions based on this technology.

Figure 4
Areas of application of artificial intelligence in commercial banks' operation
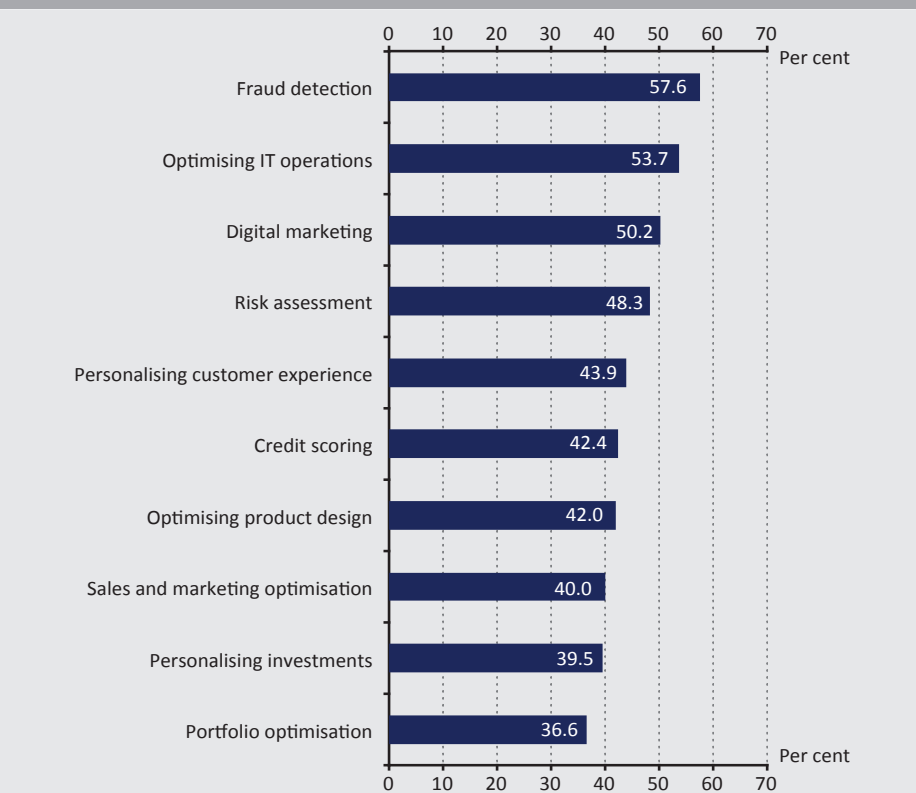
Note: International survey; as a percentage of respondents
Source: The Economist (2022:3)

5. Potential benefits and risks of the use of artificial intelligence in finance

In reviewing the benefits and risks, it is important to consider the general nature of the technology across the entire financial value chain. While announcements and news regarding the technology typically focus on the impacts on customer-side use, AI-based developments can go far beyond customer-only solutions, as described earlier at the description of possible use cases.

At the same time, as there are a number of potential applications that directly affect customers and their financial behaviour, it is worth first considering the advantages and disadvantages of artificial intelligence from the customer's perspective. The benefits include lower fees and even lower lending costs, making use of the efficient and rapid analytical capabilities of the technology, while a detailed and more accurate analysis of the multiple data sets that can be used (unstructured data, qualitative factors) will make financial services more widely available, as they provide a more comprehensive and accurate picture of a customer's risk profile. At the same time, the use of this technology in the digital space might also open up significant scope for the spread of personalised, custom-tailored financial services and administration, which can improve the customer experience and make managing finances faster and more convenient. From the customer's perspective, however, if the system makes decisions based solely on the data it receives, or if the data used to train the artificial intelligence models is incomplete, inaccurate or insufficient, potential risks such as bias or discrimination in the lending and insurance processes, or the risk of financial exclusion for customers deemed riskier by artificial intelligence, should also be taken into account. In addition, the use of sensitive and personal data also raises ethical questions about the application of the technology to a specific financial decision (*IMF 2021*).

The potential impact of the uptake of AI-based solutions, on both markets as a whole and on individual institutions, may be significant. Artificial intelligence can optimise the functioning of institutions, while providing efficiency gains and a more advanced operating environment, the effects of which, if they are felt by an increasing number of institutions, can benefit the entire financial system, ultimately increasing the competitiveness of the sector as a whole. On the other hand, risks must also be taken into account. The so-called 'black box' effect of complex models and the difficulty of explaining the rationale behind decisions based on artificial intelligence models are often discussed, and dilemmas may arise in that respect in the functioning of institutions, in terms of the demarcation of responsibilities. Moreover, as the technology-relevant expertise and development capacity are typically available from external partners, the dependence on third-party service providers may increase due to the use of AI-based solutions. Given that third-party providers of AI-based solutions may be linked to more than one institution, risk

factors may emerge for the sector as a whole as more of these solutions appear in the financial system or if an AI provider becomes a systemically important actor (as it is an increasing trend in cloud services or mobile payment solutions offered by BigTech companies). Consequently, the problems encountered by the companies that develop these solutions and those that support their operation may have an impact on financial actors. In addition to the above risk factors, cybersecurity and data management are also crucial aspects since, for example, AI-based decision-making typically involves the feeding of sensitive customer data into models (*FSB 2017; Bódi et al. 2023*).

6. Opportunities to regulate artificial intelligence in the financial sector

We have seen that while the use of AI-based technology solutions is becoming more widespread, they can also pose risks at the level of customers, institutions or even the system as a whole. In addition to developing procedures based on the institutions' own interests and the disciplining power of the market, they can also be addressed through regulatory means. The starting point may be the emergence of a non-sector-specific, comprehensive regulatory approach, such as the EU Artificial Intelligence Regulation, the final provisions of which were subject to political consensus and a provisional agreement between the European Parliament and the Council in December 2023 (*European Council 2023*) and on 13 March 2024, the European Parliament approved the Artificial Intelligence Act (*European Parliament 2024*). This is the first legislation on an international level to regulate the use of artificial intelligence systems, along with the 'Blueprint for an AI Bill of Rights"[8] in the USA. On the other hand, there are also promising international examples of recommendations and principles specific to the financial sector (e.g. in the Netherlands,[9] Germany,[10] Singapore[11] and Hong Kong[12]).

The new capabilities of artificial intelligence, in particular generative artificial intelligence, can enhance or complement human performance in so many ways that the final result of their use is difficult to control or verify by human capacities. Therefore, mapping the potential risks and establishing appropriately applicable principles and regulatory frameworks may also be necessary to avoid potential harm and, in turn, to build trust in the technology (*Harkácsi et al. 2021*). Given

---

[8] https://www.whitehouse.gov/wp-content/uploads/2022/10/Blueprint-for-an-AI-Bill-of-Rights.pdf. Downloaded: 9 February 2024.

[9] De Nederlandsche Bank (DNB) (2019): *General principles for the use of Artificial Intelligence in the financial sector*: https://www.dnb.nl/media/voffsric/general-principles-for-the-use-of-artificial-intelligence-in-the-financial-sector.pdf

[10] Bundesanstalt für Finanzdienstleistungsaufsicht (BaFin) (2021): *Big data and artificial intelligence: Principles for the use of algorithms in decision-making processes*. https://www.bafin.de/ref/19594552

[11] Monetary Authority of Singapore (MAS) (2019): *Principles to Promote Fairness, Ethics, Accountability and Transparency (FEAT) in the Use of Artificial Intelligence and Data Analytics in Singapore's Financial Sector*. https://www.mas.gov.sg/~/media/MAS/News%20and%20Publications/Monographs%20and%20Information%20Papers/FEAT%20Principles%20Final.pdf

[12] Hong Kong: Hong Kong Monetary Authority (HKMA) (2019): *High-level Principles on Artificial Intelligence*. https://www.hkma.gov.hk/media/eng/doc/key-information/guidelines-and-circular/2019/20191101e1.pdf

the comprehensive nature of the technology and the ever-increasing pace of its development, it may be beneficial to establish a sector-specific guideline for domestic financial actors to promote the use of artificial intelligence systems in Hungary, taking into account, among other things, security, ethical decision-making and the maintenance of lawful and prudent data management. A non-binding guideline or recommendation could be an appropriate tool to support initiatives by domestic market players within a flexible framework, for example by setting out a general framework of interpretation and definition, principles for application and evaluation mechanisms. Such a document could even include recommended practices or processes, bearing in mind both the need for prudent and safe use and the need for regulatory flexibility to keep pace with the evolving technology.

References

Bódi, R. – Fáykiss, P. – Nyikes, Á. (2023): *The Systemic Risks and Regulation of BigTech – "Too Big(Tech) to Fail?"*. Financial and Economic Review, 22(1): 5–20. https://doi.org/10.33893/FER.22.1.5

Crabtree, M. (2023): *Artificial Intelligence (AI) vs Machine Learning (ML): A Comparative Guide*. Datacamp. https://www.datacamp.com/blog/the-difference-between-ai-and-machine-learning. Downloaded: 7 February 2024.

European Council (2023): *Artificial intelligence Act: Council and Parliament strike a deal on the first worldwide rules for AI*. Press release, European Council. https://www.consilium.europa.eu/hu/press/press-releases/2023/12/09/artificial-intelligence-act-council-and-parliament-strike-a-deal-on-the-first-worldwide-rules-for-ai/. Downloaded: 7 February 2024.

European Parliament (2024): *Artificial Intelligence Act: MEPs adopt landmark law.* https://www.europarl.europa.eu/news/en/press-room/20240308IPR19015/artificial-intelligence-act-meps-adopt-landmark-law. Downloaded: 13 March 2024.

Fernández, M. (2023): *AI in Banking: AI Will Be An Incremental Game Changer.* S&P Global, 31 October. https://www.spglobal.com/en/research-insights/featured/special-editorial/ai-in-banking-ai-will-be-an-incremental-game-changer. Downloaded: 29 January 2024.

FSB (2017): *Artificial intelligence and machine learning in financial services – Market developments and financial stability implications*. Financial Stability Board. https://www.fsb.org/wp-content/uploads/P011117.pdf. Downloaded: 7 February 2024.

Gartner (2022): *Gartner Identifies 5 Top Use Cases for AI in Corporate Finance*. Press Release, Gartner. https://www.gartner.com/en/newsroom/press-releases/2022-10-13-gartner-identifies-5-top-use-cases-for-ai-in-corporate-finance. Downloaded: 31 January 2024.

Goldman Sachs (2023): *Generative AI: Hype, or truly transformative?* https://www. goldmansachs.com/intelligence/pages/top-of-mind/generative-ai-hype-or-truly-transformative/report.pdf. Downloaded: 7 February 2024.

Harkácsi, G.J. – Szegfű, L.P. (2021): *The Role of the Compliance Function in the Financial Sector in the Age of Digitalisation, Artificial Intelligence and Robotisation*. Financial and Economic Review, 20(1): 152–170. https://doi.org/10.33893/FER.20.1.152170

Harvard University (2017): *The History of Artificial Intelligence*. https://sitn.hms.harvard. edu/flash/2017/history-artificial-intelligence/. Downloaded: 12 February 2024.

IMF (2021): *Powering the Digital Economy: Opportunities and Risks of Artificial Intelligence in Finance.* International Monetary Fund. https://doi.org/10.5089/9781589063952.087

Karjian, R. (2023): *The history of artificial intelligence: Complete AI timeline*. Techtarget. https://www.techtarget.com/searchenterpriseai/tip/The-history-of-artificial-intelligence-Complete-AI-timeline. Downloaded: 7 February 2024.

Marr, B. (2018): *The Most Amazing Artificial Intelligence Milestones So Far*. Forbes, 31 December. https://www.forbes.com/sites/bernardmarr/2018/12/31/the-most-amazing-artificial-intelligence-milestones-so-far/?sh=eefd3b67753e. Downloaded: 7 February 2024.

MNB (2023): *FinTech and Digitalisation report*. July 2023. Magyar Nemzeti Bank. https:// www.mnb.hu/letoltes/final-mnb-fintech-digitalisation-report-2023.pdf

OECD (2016): *OECD Science, Technology and Innovation Outlook 2016*. OECD. https://doi. org/10.1787/sti_in_outlook-2016-en

OECD (2021): *Business and Finance Outlook 2021: AI in Business and Finance*. OECD. https:// doi.org/10.1787/ba682899-en

Okwechime, J. (2023): *How Artificial Intelligence is Transforming the Financial Services Industry.* Deloitte. https://www.deloitte.com/content/dam/assets-zone1/ng/en/docs/ services/risk-advisory/2023/ng-how-artificial-Intelligence-is-Transforming-the-Financial-Services-Industry.pdf. Downloaded: 30 January 2024.

Prisznyák, A. (2023): *Horizontal and Vertical Value Creation in Bankrobotics and the AI-Washing Phenomenon*. Financial and Economic Review, 22(3): 97–122. https://doi. org/10.33893/FER.22.3.97

Russell, S. – Perset, K. – Grobelnik, M. (2023): *Updates to the OECD' definition of an AI system explained*. OECD. AI Policy Observatory. https://oecd.ai/en/wonk/ai-system-definition-update. Downloaded: 6 February 2024.

Riemer, S. – Strauß, M. – Rabener, E. – Bickford, J.K. – Hilbers, P. – Kalra, N. – Kapoor, A. – King, J. - Palumbo, S. – Pardasani, N. - Pauly, M. – Rulf, K. – Widowitz, M. (2023): *A Generative AI Roadmap for Financial Institutions.* BCG, 13 November. https://www.bcg.com/publications/2023/a-genai-roadmap-for-fis. Downloaded: 6 February 2024.

The Economist (2022): *Banking on a game-changer: AI in financial services*. The Economist Intelligence Unit Survey. https://impact.economist.com/perspectives/sites/default/files/aiinfinancialservices.pdf. Downloaded: 29 February 2024.

Tarnoff, B. (2023): *Weizenbaum's nightmares: how the inventor turned against AI*. The Guardian, 25 July. https://www.theguardian.com/technology/2023/jul/25/joseph-weizenbaum-inventor-eliza-chatbot-turned-against-artificial-intelligence-ai. Downloaded: 7 February 2024.