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Artificial intelligence and algorithms assisting personal finance. A legal and economic perspective¹

Sztuczna inteligencja i algorytmy w służbie finansów osobistych.
Perspektywa prawno-ekonomiczna

Abstract

The fourth industrial revolution, Economy 4.0 and Finance 4.0 are facts. Technological changes in the context of finance have resulted in a more active application of artificial intelligence, machine learning and algorithms for product ranges and services aimed at individual clients. Examples of applying AI within the financial sector are automated creditworthiness assessment and financial advice (robo-advice). The article presents these areas from a legal and economic perspective. The wider application of algorithms within the financial sector requires a non-conventional approach by regulators in order not to over-regulate this new and promising segment of the financial services market.

Keywords: artificial intelligence, algorithms, creditworthiness, machine learning, robo-advice

JEL: O30, E22, D14, D18

Streszczenie

Czwarta rewolucja przemysłowa, Gospodarka 4.0 i Finanse 4.0 stały się faktem. Zmiany technologiczne w obszarze finansów doprowadziły do coraz częstszego wykorzystywania sztucznej inteligencji, uczenia maszynowego i algorytmów do przygotowania oferty i obsługi klientów indywidualnych. Przykładem zastosowania sztucznej inteligencji jest automatyczne badanie zdolności kredytowej czy doradztwo finansowe (robo-advice). Celem artykułu była prezentacja tych zagadnień z perspektywy prawno-ekonomicznej. Zastosowanie algorytmów w finansach wymaga niekonwencjonalnego podejścia przez regulatora, aby nie przeregulować tego nowego i perspektywicznego segmentu rynku usług finansowych.

Słowa kluczowe: sztuczna inteligencja, algorytmy, automatyzacja decyzji kredytowych, uczenie maszynowe, automatyczne doradztwo finansowe

Introduction

The progress of digitisation affects many areas of our lives. One of the standout trends is automation based on machine learning or deep learning, which are often equated with what is widely understood as artificial intelligence. Without delving into terminological issues, it can be assumed that "algorithmisation"

is a fact in many areas and this trend may be safely expected to continue, boosting the capabilities of many entities in the area of prediction (forecasting) or inference. Management by algorithms permeates our socio-economic reality — from politics and state governance, public administration, to the transformation of various business models that cover virtually all sectors in the digital economy (Szpringer, 2020).

One area that is "susceptible" to the use of artificial intelligence in the broad sense is the financial sector, where algorithms may be used in fields such as improving risk management processes, including credit, product selection or broadly understood robo-advice, as well as to significantly improve the efficiency of AML, i.e. counteracting money laundering and terrorist financing. The challenge for regulators and financial supervision will be the introduction of legal standards in the field of robo-advice that will ensure the security of participants in business transactions yet, on the other hand, that will not be too restrictive and inhibit the development of this innovative segment of the financial services market (Waliszewski, 2020).

Evidence of the importance of AI in the context of the financial sector is, for example, the inclusion — in selected aspects of draft legislation for a harmonised framework for artificial intelligence in the EU² — clear references to the CRD package regulating banks (Article 9 (9), Article 17 (3), Article 18 (2), 19 (2), 20 (2), 20 (4) second subparagraph, 29 (5) second subparagraph, 43 (2), 61 (4) second subparagraph and Article 62 (3) of the proposed regulation), as well as an indication of the artificial intelligence systems responsible for assessing creditworthiness for high-risk systems subject to specific requirements.³

The European Banking Authority (EBA) indicated in one report⁴, that in the coming years, one may expect more use of Big Data and advanced analytics, which are supposed to improve many of the processes currently used in entities in this sector. Similar conclusions, supplemented with specific planned action, can be found, among others in the Strategy for the EU on Digital Finance by the Commission (EU).⁵

At the same time, at the European Union level, and to some extent nationally, intense work is underway to create a legal and regulatory framework for AI as it is widely understood. This includes issues such as the principles of liability for the operation of an algorithm, the release and use of data (including personal data), security and fundamental rights, which are a very important, albeit occasionally controversial, area of interest for EU institutions and bodies in the context of how artificial intelligence is used.

In tandem, how to regulate the above areas is also being discussed, i.e. whether to create a hard law (and if so, that means legislation or directives) or more flexible regulations of the soft law type. This discussion is not purely academic, as inadequate solutions may hinder the further development of new technologies. Hence, in the case of artificial intelligence, at least now, a mixed approach to this issue has been established. Therefore, the Commission (EU) and the European Parliament are focusing on creating legal solutions wherever harmonisation is necessary (liability for a dangerous product or high-risk artificial intelligence), and proposing recommendations or guidelines wherever there is a need for greater flexibility and where frameworks are impossible to define.

Within the scope of the EU Strategy for Digital Finance, the Commission underlined that "by 2024, the Commission, in cooperation with ESAs, intends to provide clarity regarding supervisory expectations as to how the financial services legislative framework should be applied to

intelligence (AI)". This means that in the coming years one may anticipate some precision of the legal and regulatory expectations specific to the financial sector, which is a desirable direction due to the "sensitivity" of certain areas, such as profiling, assessment of creditworthiness, prediction or risk management. The Polish Financial Supervision Authority recently spoke in a similar vein, identifying barriers to the development of financial innovations, emphasising that it is working on the development of possible guidelines in this area.⁶

Although the scope of this article is quite narrow, it is worth paying attention to the problem of how artificial intelligence is defined, which somehow determines subsequent legal and regulatory (as well as implementary) activities carried out by financial institutions. On the one hand, here one might recall the proposal offered by L. Lai and M. Świerczyński, according to whom AI could be considered "(...) a system that allows you to perform tasks that require a learning process and take into account new circumstances in the course of solving a given problem and which may to varying degrees — depending on the configuration — act autonomously and interact with the environment" (Lai, Świerczyński (ed.), 2020, p. 9) and, on the other hand, refer to the concept defined in the draft legislation on artificial intelligence, where an AI system is understood as software created using one or more techniques and methods (approaches) specified in Annex 1 to the draft legislation (e.g. machine learning or deep learning, as well as Bayesian estimates or statistical methods) and capable of generating a specific result, e.g. content, predictions, recommendations or decisions that have an impact on human-defined objectives.

Any decision as to which definition is correct or more adequate far exceeds the scope of this work. However, the issue of definition is important, as incorporating such systems too broadly within the regulatory framework may cause significant legal and regulatory doubts, e.g. in the context of the solutions used in the assessment of certain types of risks and their modelling (for more see: Dunis, Middleton *et al.*, 2016). For this reason, the previously mentioned sectoral guidelines will be relevant.

Robo-advice

The subject of automated investment consulting, so-called robo-advice or robo-advising, is complex and nestles within the broader issues of FinTech automation of services on the capital market. The phenomenon of automation involves financial institutions offering clients broadly understood investment advice via computer algorithms and completely without, or with the minimal participation of, an employee. Technological solutions related to artificial intelligence and Machine Learning processes are used by investment companies and financial institutions on several levels. This includes in particular: the stage of market analytical research (Research & Development), development of investment techniques and strategies within portfolio management, and the execution of orders or investment advice.

Three theoretical models may be distinguished when it comes to engaging new technologies that arise from the use of machine learning tools enabling very large data sets to be processed. Machine learning allows dependencies to be identified on the broadly understood financial market and determine optimal solutions for the client. These models are as follows (Jajuga, Anczewska, 2021):

- *human advisory*, traditional investment advice, the advisor being an actual person, the most frequently used solution;
- *robo-advisory*, the advisory process is fully automated, from the suitability test to the provision of an investment recommendation via the Internet, also applicable to the automatic execution of financial operations for the client;
- a hybrid model in which the processing of information necessary in the consulting process is carried out entirely with the use of machine learning algorithms, but the consulting service itself is performed by a human being who uses the final results of the algorithms.

In both models involving IT, financial institutions may issue recommendations with regard to a specific, single financial instrument or a set of them — within the scope of a so-called model portfolio.

Automated investment consulting, so-called robo-advice has only been subjected to rather fragmented regulation under investment legislation and the market awaits a more comprehensive sanctioning of this issue under EU law. Some hints may be found, for example, in Regulation (EU) 2017/565⁷ or Regulation (EU) 2017/589⁸ (about algorithmic trading, not robo-advisory trading per se), although this runs more like a guideline than a hard legal requirement.

Nevertheless, activity in this area is becoming more and more visible at the regulatory and supervisory level. Actions in this direction have already been taken by foreign supervisory authorities, including leading ones, such as BaFin, SEC or FCA (Dybiński, 2020). The chronological structure of activity at the EU level includes the following documents, although it should be remembered that some information can also be found in other regulations:

- On 4 December 2015, the Joint Committee of European Supervisory Authorities published a consultation document on the automation of financial consulting.
- An EC communication presenting the FinTech action plan of March 2018.
- In 2017, the EBA published a comprehensive discussion paper on its attitude to FinTech issues.
- In September 2018, following the consultation paper of December 2015, a Joint Committee report was issued presenting the results of the automated investment advice market research.
- In 2018, the ESMA updated the guidelines connected with examining the suitability of services and instruments, partially taking into account the issue of robo-advice in investment services.
- In September 2020, the European Commission announced a digital finance strategy for the EU to be implemented by 2024.

The potential benefits of automation in financial services include: lower costs, greater repeatability of advice and

a greater number of potential customers that can be served and interested in new solutions.

In turn, potential threats could be related to the lack of direct contact between the client and the employee, who could provide clarification, and the dependence of the entire process on the efficient operation of the IT infrastructure. In addition, robo-advice includes the so-called model risk denoting a wrong human programming of the algorithm supporting investment decisions. The disadvantage of robo-advice is its pro-cyclicality, because in the robo-advice model, a certain group of clients are advised, and they spread their knowledge — for example, among their friends on social networks, and these friends repeat certain investment activities, but without seeking any advice, even though their financial or material situation may be quite different (Szpringer, 2017). Errors or bias in the algorithms or the data underlying these calculations can create systemic risk to the detriment of the consumers.

In Poland, an investment advisory service is a brokerage activity which, in order to perform, requires a relevant permit from the Polish Financial Supervision Authority (Article 69 (1) of the Act on Trading in Financial Instruments). In the case of entities (most often these will be investment firms and some banks) holding the appropriate permit, it is not required to submit a separate application. However, if the intention is to conduct such activity "from scratch", it will be necessary to undergo an extensive and time-consuming licensing process, which will be essentially the same as the process of obtaining a permit for "traditional" brokerage activities. Perhaps in the future there will be special licenses for robo-advisers, but at this stage it is necessary to meet all the requirements set by the act (Nowakowski, 2020).

According to the position of the Polish Financial Supervision Authority of November 2020 on the provision of robo-advisory services, an investment firm should take into account the suitability of the financial instrument for its addressees, the quality of the instrument and the ability of the investment firm to obtain information to properly assess the suitability of financial instruments for the client. The scope of a robo-advisory service should always ensure that one financial instrument is selected from among a sufficient number of others. Robo-advice requires the investment firm to create a well-configured and tested algorithm for assessing the suitability of a financial instrument or service. The investment firm should adopt mechanisms to detect inconsistencies in the client's responses. The suitability assessment process may use customer-friendly solutions.

Certain requirements also arise in the context of transparency towards the customer. The regulations for the provision of the service should include information describing the algorithms used, as well as the limitations and risks associated with the algorithms. It can be claimed, however, that although the position of the Polish Financial Supervision Authority is very much needed, the recommendations for robo-advisory services do not differ significantly from the requirements set for classic investment advisory services.

In line with the EU's 2020 digital strategy, one of its aims is to promote the widespread use of AI tools. By 2024, the Commission, in cooperation with the ESAs, intends to provide clarity with regard to supervisory expectations as to how the financial services legislative framework should be applied to solutions using AI. An option under consideration is also the introduction of the sectoral guidelines for artificial intelligence in the financial sector, mentioned in the introduction.

Despite robo-advisory regulations being planned in the near future, it will not be so simple to make them effective in as much as there is a risk of introducing excessive regulations and reducing the dynamics of market development. Applying the same supervisory tools to traditional financial advice and the use of machine learning systems may not be enough. In particular, it would appear that the current process of confirming the competence of advisers is completely incongruous with the market of new technologies.

The problem is apparent when trying to assess the correct functioning of an algorithmic system before it is put into operation. While in the case of IT systems based on fixed algorithms, the subject of the analysis may be the correctness of decision rules, due to the specificity of artificial intelligence such an approach will usually turn out to be ineffective. In this case, the entire process of system operation should be validated: from design, through the learning stage, to development and final operation. Therefore, performing external supervision over such a system will require not only appropriate knowledge of financial instruments, but also strong technical competence.

Due to the current advancement of robo-advisory products (focusing mostly on a narrow range of financial instruments, i.e. ETFs and the forex market), this challenge is not perceived as a potential difficulty by the regulators themselves (Rojczak, 2020), although the Polish Financial Supervision Authority has taken a clear stance on certain requirements, including in relation to employees of broadly understood compliance. Certain assumptions in this regard are included in the policy for the development of artificial intelligence in Poland from 2020, albeit systemically.⁹

The task of creating an innovative and specific legal framework for robo-advisers should be approached carefully as there are a real mixture of features in robo-advisers that can generate new challenges for existing laws, rules, institutions and entities that merely give advice or manage portfolios, or also make investments on behalf of their clients (Bayón, Vega, 2018).

The development of robo-advisory platforms and their acceptance by individual investors clearly contributes to financial integration and helps to create equal opportunities. The platforms allow private investors to access a wide portfolio of profitable financial instruments — mainly ETFs — covering global asset classes. These products are not readily available to many private investors around the world, especially in less developed retail financial markets, as many retail banks do not offer (actively) profitable products to ordinary customers. Robo-advisers also deliver personalised financial advice on automated databases to the masses. Until

now, personalised advice has mainly been available to more affluent or wealthy investors. For less developed retail financial investment markets, the degree of financial inclusion will be even higher with increasing penetration of ETF products and additional advisers (Schwinn, Teo, 2018).

Automation in creditworthiness assessment

Machine learning algorithms used to improve the speed and efficiency of loan portfolio management, including consumer loans, as well as credit risk, are gradually becoming a standard in the financial sector. Their strong efficacy is indicated, among others, by studies of experts from the Bank for International Settlements (Gambacorta, Huang, Han, Wang, 2019) or the EBA.¹⁰ One of the most interesting applications of automation are the creditworthiness assessment tools used, among others, by banks.

The applicable provisions of the banking law explicitly allow for the application of solutions of this type, as indicated, *inter alia*, by art. 105a of the Banking Law. At the same time, this is one of the challenges facing banks (and the financial sector in general) due to the numerous obligations in terms of transparency and explainability (see also the EBA guidelines on granting and monitoring loans¹¹ as well as an announcement from the Polish Financial Supervision Authority¹² — in particular point 4.3) that do not only impact the cost of implementing relevant systems but also maintaining them. The new emerging "soft" regulations in the field of artificial intelligence or rather algorithm explainability may deepen the state of uncertainty and, to some extent, inhibit the development of these solutions. One example of this is the extensive Commission (EU) expert report on algorithmic bias (Janneke, Raphaële, 2020), which could also prove relevant for financial innovation in the financial sector.

Moving on to legal analysis, it should be noted that this is an issue that transcends the legal and regulatory framework of the financial sector and affects areas such as personal data protection or the use of big data.

Art. 105a sec. 1 of the Banking Law provides that banks (although the catalogue is slightly broader) may assess creditworthiness (and weigh credit risk) based on the automated processing of personal data (with certain limitations, more on which later) whereby those affected will have the right to:

1. Receive relevant clarification as to the grounds for any decision made.
2. Obtain human intervention to appeal a decision.
3. Express their own position.

In an announcement made in July 2020, the PFSA¹³ also clarified its expectations, although it did not distinguish between manual and automated processes, indicating, *inter alia*, the need for entities to indicate specific and detailed data about applicants and their financial situation that may have influenced a credit decision made by the lender. This is one of the issues that,

in the context of automation and the wider use of algorithms, is sure to be the focal point of many discussions both within the sector and with regulators.

As far as the possibility of obtaining human intervention in order to appeal a decision should not pose many problems for financial institutions, and is also an expression of how the concept of trustworthy artificial intelligence may be implemented¹⁴, likewise with the right to express one's own position, the right to receive appropriate clarification regarding decisions made might prove problematic to some extent.

Information provided within the scope of creditworthiness assessment

The basis for issuing a decision to grant or not to grant a given loan consists of a range of information and data held by the entity, most commonly a bank. What is relevant here is the purpose and type of the loan, as this will determine which data is used. It should be remembered that the purpose of the "check" is to assess creditworthiness as well as credit risk, which has some bearing on, inter alia, the regulatory (capital) obligations of the institution.

The PFSA has decreed that institutions should provide "personalised and detailed information, including information on measures to be taken by the applicant to remove any obstacles that might sway the lender's decision". Returning for a moment to the Banking Law (Article 105a (1b)), we note what data — in particular — can be used to make an assessment.

On the one hand, these are data relating to a specific person (excluding the "sensitive" data referred to in Article 9 (1) of Regulation 2016/679), and on the other hand, the obligation itself. This is, of course, a sample directory, as indicated by the phrase "in particular". One potentially interesting example is the use of data from social networking sites like Facebook. This may be of particular importance in the context of less financially developed (or excluded) people, but currently not much interest has been shown in such solutions, due to limitations related to the broadly understood provisions on the protection of personal data, among other reasons.

Banks (and other institutions) have their own procedures and methodologies for creditworthiness assessment and risk analysis. Ultimately, however, such decisions are made by human beings based on the facts and the procedures, as well as their own expert knowledge. When it comes to using automated decision-making tools, the process basically relies on a similar range of input data as well as the decision-making process itself. Nevertheless, the matter does become more complicated when algorithms with a more advanced structure or autonomy are used, which may cause decisions to become vague and/or are made taking into account the so-called algorithmic bias. In many cases, therefore, an appropriate data infrastructure will be crucial, as highlighted in the previously mentioned EBA guidelines on loan granting and monitoring (point 4.3.7).

This is relevant because the criteria taken into account when making decisions should be as objective as possible, and in particular should not raise allegations of discrimination, for example, on the basis of gender, skin colour or political affiliation. Incidentally, it is worth noting that in the guidelines of the European Data Protection Board on the relationship between the provisions¹⁵ of the so-called PSD2¹⁶ and Regulation 2016/679, the opinion is stated that some financial data may form a sufficient basis for an algorithm, for instance, to extract sensitive data regarding political views, for example.

The explainability of algorithms

This is one of the central issues in the context of the previously mentioned trustworthy artificial intelligence and AI ethics (for more, see: Smith, 2020). However, at the outset, an indication is required as to what should basically be included in the credit decision itself and in the explanation given to a specific person. Essentially, the PFSA has decreed that this right involves the possibility of "(...) obtaining explanations; obtaining specific and sufficiently detailed information on the basis of which the creditor has assessed the applicant's creditworthiness is crucial here". At the same time, it does not mean that this must be detailed information about the operation of the algorithm, especially not information that constitutes a trade secret.

In its stance on robo-consultancy, the Polish Financial Supervision Authority¹⁷ has indicated that in communication with a client (*ex ante*), the terms and conditions for services rendered should include a description of the algorithms used, as well as the limitations and risks associated with them. Moving on to creditworthiness assessment, it can be assumed that the interested party is granted, inter alia, information on the criteria used, input and comparative data (e.g. with which groups the potential borrower was compared), as well as the methodology or decision-making model used.

The aforementioned EBA guidelines on loan origination and monitoring indicate that an organisation that uses automated decision-making systems should "understand the models used, including their capabilities, assumptions and limitations, and provide traceability, controllability, robustness and resilience". Of particular relevance for us is the ability to trace the operation of models or algorithms, i.e. explainability, which is an important criterion when assessing whether a given AI system can be categorised as trustworthy and should be audited in accordance with the list prepared by the Commission (EU) experts.¹⁸ E. Tjoa and C. Guan ask some very interesting questions in this context — although the issue of AI they write about is quite different — i.e. who is responsible if something goes wrong, can we explain why it happened? If everything works correctly, are we able to assess why and then make use of it in the future (Tjoa, Guan, 2015, p. 1)? These are very important questions that we often ask ourselves when thinking about how AI is used, and they also have a significant impact on many areas, i.e. the ability

to verify the operation of the system and introduce improvements, learn from AI or simply comply with laws and regulations (Samek, Wiegand, Muller, 2017).

At the same time, there is no one single definition of explainability. Most often it is defined as the ability to recreate the decision-making process of an algorithm, which is supposed to facilitate an understanding of the entire data structure and dependencies that the automated system followed when elaborating a specific outcome. Smaller difficulties may be encountered in the case of rule-based algorithms, but the real challenge related to the black box problem will arise when algorithms learn from their own "experience".

In the case of such — business-wise, the most profitable — solutions, scenarios unforeseen by the creator or operator of the algorithm may come true. From the point of view of a bank that uses advanced algorithms to assess creditworthiness or credit risk, it may be of significant importance, inter alia, in the context of:

- the fulfilment of information obligations towards clients and possible liability, perhaps involving compensation;
- inspection conducted by supervisory authorities — including the standard Supervisory Audit and Assessment;
- internal and external audits;
- the institution's reputation.

In the case of an area so sensitive as the assessment of creditworthiness, the risk of discrimination or algorithmic bias may easily arise, which may consist, for example, in excluding certain groups. Whenever this type of situation arises, it may translate into the above-mentioned operational areas of a bank or other financial institution.

Indeed, if we adopt a fairly broad interpretation of transparency towards someone who was subject to such an assessment, then the relevant information should include details allowing this person to check or improve any "negatives" and then be reassessed. However, if the algorithm based its decision on, for example, the criterion of gender, then this raises an important objection to the institution.

As a consequence, there may also be doubts as to the scope of responsibility in the relationship between the algorithm's creator and operator, which will not always be easy to resolve. Intensive work is currently underway within the European Union to create an appropriate legal and regulatory framework of responsibility for "artificial intelligence", an example of which is a resolution of the European Parliament¹⁹ in this regard.

With some simplification, one may assume that the creator of the algorithm (the back-end operator) and the one benefiting from its use (the front-end operator) may both be responsible, and under certain conditions joint and several liability is allowed. However, in the context of the discussed issue, this is a side topic.

Returning to the issue of explainability, the creditworthiness assessment algorithms should essentially be transparent and "trackable" to be able to generate a report on the decision-making process accompanying each individual decision, especially since the regulations authorise human

intervention where requested. The scope of data will differ here from the category of the potential borrower or the loan product itself.

Recommendations

The problem (or challenge) per se of using algorithms in many areas will deepen with the further development of technology, wider use of Big Data or proposed legal acts, including the so-called Data Governance Act²⁰, as well as with the growing awareness of clients who may inquire about the basis upon which decisions are made by financial institutions.

It is also important that managers be aware that although many of the regulations regarding broadly understood AI are "soft", and therefore voluntary, they cannot be ignored in the context of new solutions used in the financial sector — all the more so as sectoral solutions are planned.

The proper management of "algorithmic" risks²¹ in the case of creditworthiness assessment — from a legal and regulatory perspective — should take into account:

1. The participation of units responsible for issues related to broadly understood compliance with law and regulations during the entire process when solutions are being implemented, as well as ensuring that the units responsible for creating and introducing new solutions have appropriate competency in this area.

2. The introduction of appropriate supervision and criteria for the data used in the assessment of creditworthiness — prior and regular resistance tests will also be relevant here.

3. The assurance, while designing algorithms, of the overarching principles formed for trustworthy artificial intelligence on the basis of "by default and design" and then subjecting the entire implementation process to the principles of so-called product governance.

4. Respect for fundamental rights (especially in the context of non-discrimination) and so-called humanocentrism, including through the development of relevant Key Performance Indicators or related.

5. Ongoing monitoring by relevant units of compliance with the above principles — including with the participation of relevant committees, not only on an ad hoc basis, but on a regular basis.

6. Ensuring the highest level of digital security (e.g. based on the proposed on the operational digital resilience of the financial sector²²), which may minimise the risk of third party actions and interference in the operation of the algorithm.

7. Evaluation of procedures (and possible revision) and policies used in the context of creditworthiness assessment and adaptation to a new model — this also requires appropriate internal training.

Here we have not included equally important issues connected with the protection of personal data, which is relevant not only in the context of information policy or the implementation of rights under Regulation 2016/679, but

also in terms of whether it is possible or not to use certain categories of data for the purposes of creditworthiness assessment.

Conclusions

Our study only refers to two areas of how algorithms are used in the financial sector, although there are many more examples. Nevertheless, their level of use has not evolved enough to talk about a real revolution in finance. There may be several reasons for this.

Firstly, laws and regulations are not clear enough for the use of algorithms to be encouraged for the provision of such

services, and uncertainty about the scope of responsibility may deepen concerns about the admissibility of implementing such solutions.

Secondly, the level of technology development is not always satisfactory, and if the aspect of algorithm transparency is added to the mix, it may turn out that the use of more advanced algorithms may pose a significant risk for any organisation that is obliged to properly manage them.

Next, there are significant staffing and knowledge gaps that are not easy to "bridge" without a more systemic approach.

Finally, there is also a need to educate the potential recipients of these solutions, both in terms of their operation, benefits and risks. There is also a need to revise the legislation regarding communication and consumer protection.

Przypisy/Notes

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² A project published by the Commission (UE) on 21 April 2021, available on the website: [file:///Users/michalnowakowski/Desktop/CBDC/regulation_ai_875509BF-C386-0D30-2CB7E56A798BA4EA_75788%20\(1\).pdf](file:///Users/michalnowakowski/Desktop/CBDC/regulation_ai_875509BF-C386-0D30-2CB7E56A798BA4EA_75788%20(1).pdf) (12.05.2021).

³ Annexe III to the aforementioned draft regulation — file:///Users/michalnowakowski/Desktop/CBDC/regulation_annex_ai_875FDD6D-CC6A-E50A-8E48824677EFED42_75789.pdf (12.05.2021).

⁴ EBA Report on Big Data and advanced analytics. January 2020. EBA/REP/2020/01, https://www.eba.europa.eu/sites/default/documents/files/document_library/Final%20Report%20on%20Big%20Data%20and%20Advanced%20Analytics.pdf (20.03.2021).

⁵ Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on a Digital Finance Strategy for the EU, Brussels, 24.9.2020, COM(2020) 591 final, <https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52020DC0591&from=pl> (24.03.2021).

⁶ Raport z prac Zespołu ds. innowacji finansowych FinTech, https://www.knf.gov.pl/knf/pl/komponenty/img/Raport_z_prac_Zespolu_ds_rozwoju_innowacji_financeowych_73565.pdf (12.05.2021).

⁷ Commission Delegated Regulation (EU) 2017/565 of 25 April 2016 supplementing Directive 2014/65 / EU of the European Parliament and of the Council as regards organisational requirements and operating conditions for investment firms and defined terms for the purposes of this directive, Journal of EU, 2017, L-87/1.

⁸ Commission Delegated Regulation (EU) 2017/589 of 19 July 2016 on supplementing Directive 2014/65 / EU of the European Parliament and of the Council with regard to regulatory technical standards specifying organisational requirements for investment firms engaged in algorithmic trading, Journal of EU, 2017, L-87/417.

⁹ Resolution no. 196 of the Council of Ministers of 28 December 2020 on the establishment of the "Policy for the development of artificial intelligence in Poland from 2020", Monitor of Poland, Official Journal of the Republic of Poland of 12 January 2021, item 23, <https://monitorpolski.gov.pl/M2021000002301.pdf> (25.03.2021).

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