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SUSTAINABLE DEVELOPMENT IN THE ERA OF FINTECH AND ARTIFICIAL INTELLIGENCE

IDEA ZRÓWNOWAŻONEGO ROZWOJU W DOBIE FINTECH I SZTUCZNEJ INTELIGENCJI

The paper concerns sustainable development in the context of the dynamic changes currently occurring in financial markets, driven by the advancements of artificial intelligence (AI) and financial technology (FinTech) applications. Innovative financial mechanisms, such as intelligent investment algorithms, AI-based credit scoring, and automated advisory systems, can support the achievement of sustainable development goals by enabling more effective risk management, directing capital toward green projects, and enhancing financial inclusion. The importance of appropriate financial regulation is emphasized, including the role of regulatory sandboxes that allow innovations to be tested in a safe environment, particularly with regards to mitigating systemic risk. The author argues that while the integration of AI with the FinTech sector has the potential to create a more sustainable financial system, it requires the development of regulatory frameworks that support innovation while protecting the public interest.

Keywords: sustainable development; artificial intelligence (AI); FinTech; financial regulation; regulatory sandbox

Artykuł analizuje problematykę *sustainable development* w kontekście dynamicznych zmian zachodzących na rynkach finansowych, wynikających z rozwoju Artificial Intelligence (AI) i technologii FinTech. Wskazuje, że innowacyjne mechanizmy finansowe, takie jak inteligentne algorytmy inwestycyjne, scoring kredytowy oparty na AI czy zautomatyzowane systemy doradcze, mogą wspierać realizację celów zrównoważonego rozwoju poprzez efektywniejsze zarządzanie ryzykiem, alokację kapitału w zielone projekty oraz zwiększenie inkluzywności finansowej. W artykule podkreślono znaczenie odpowiedniego *financial regulation*, w tym rozwiązań takich jak *regulatory sandbox*, które umożliwiają testowanie innowacji w bezpiecznym środowisku i ograniczają ryzyko systemowe. Autor dowodzi, że integracja AI z sektorem FinTech kreuje możliwości stworzenia zrównoważonego systemu finansowego, przy jednoczesnej potrzebie wypracowania ram regulacyjnych wspierających innowacje i ochronę interesu publicznego.

Słowa kluczowe: zrównoważony rozwój; sztuczna inteligencja; FinTech; regulacja rynku finansowego; piaskownica regulacyjna

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I. INTRODUCTION

When on 9 May 1950 Robert Schuman presented the key elements of the plan that he had drawn up in collaboration with Jean Monnet, and which became to be known as the Schuman Plan, no one could have imagined that a few decades later the world would be as we know it today. Today's world was then described in science fiction rather than in the daily news, and it is now a world in which robots instead of humans do most of the work, telescopes discover and document the farthest reaches of the universe, and one of the most common appliances in a world of 8 billion inhabitants is a mobile phone.

One may argue that none of this would have been possible without the power of the human mind, whose creativity and capabilities lie at the root of countless inventions, including the most recent and arguably most significant: artificial intelligence (AI). This term is now ubiquitous, present in practically all modern languages, drawing interest from numerous fields of science, including law. Its confrontation with the latter means that AI and the law together trigger off a certain reaction entailing exploration, questions, and uncertainties, the analysis of which, in the author's opinion, requires first of all, the human and axiological factor (Kloza et al., 2025).

The law governing our reality is a social phenomenon that combines both real and formal aspects and must therefore be seen as a guarantor of sustainable development. Such a perspective is close to the values of the European Union, as stated *inter alia,* in Article 3.3 of the Treaty on European Union,[1] which reads: 'the Union shall establish an internal market. It shall work for the sustainable development of Europe based on balanced economic growth and price stability, a highly competitive social market economy, aiming at full employment and social progress, and a high level of protection and improvement of the quality of the environment. It shall promote scientific and technological advance.'

This regulation combines many elements closely related to the idea of sustainable development in the broad sense, for which the combination of two very different yet complementary components may prove crucial: financial markets – particularly the FinTech sector – and artificial intelligence. The underlying thesis of this article is the belief that the proper use of modern technologies in financial markets may promote sustainable development in all key areas of human activity. A properly designed AI supporting the development of technology and innovation, which is what FinTech essentially represents, is capable of enhancing financial market inclusivity by reaching those segments of society that have not yet had the opportunity to take advantage of the instruments these markets offer.

The question that arises here is how to interpret the word 'proper', which by its nature is extremely broad and ambiguous. Within the context of this discussion, carried out in this article, the most appropriate seems to define

[1] Consolidated version of the Treaty on European Union, OJ C 202/1.

it in terms of correctness, that is, compliance with specific social and legal norms. An innovative financial system based on AI must operate in accordance with both the rules of conduct shaped by society and its core values, as well as those codified by the state through law. Law, as a social phenomenon encompassing both real and formal aspects, should be regarded as a desirable tool for shaping interpersonal relationships, as it allows us to view the reality around us in a comprehensive manner.

This becomes particularly relevant today, in the age of modern technology, when the challenge facing humanity is to find an appropriate legal framework that will, on the one hand, ensure the development of these technologies and, on the other hand, secure human control over them.

This is especially true for AI, whose development will undoubtedly continue to progress towards forms of neural networks previously unknown to humans. In doing so, it will transform all aspects of our daily lives and work, including those related to the functioning of the financial market as its essence lies primarily in the role it plays in creating the most important commodity of all time: money. Money is the building block of capital, without which it would be difficult to imagine the functioning and development of the world. Its 'birthplace' is the financial market where a revolution has been underway for several years and AI is one of its key players.

The roots of this revolution can be traced to changes in the regulatory approaches to this market segment, including at the EU level, manifested, among other things, in its disintermediation. As a result, areas once reserved for traditional financial institutions, such as banks, for example have begun to be taken over by new types of financial intermediaries. These intermediaries, using the latest technological solutions and often anticipating upcoming trends, have offered a range of innovative instruments that are often faster, easier, and cheaper to use, and obviously more attractive to customers, and increased their interest in them. This parallel reality has been created by entities operating in the FinTech sector. As will be discussed later, this sector currently makes the most frequent and widespread use of AI capabilities in the financial market, while its players who operate globally, across sectors and across borders, often escape the scrutiny of financial market regulators. These circumstances pose a real challenge to regulatory bodies because, while ensuring stability and security, regulations should not hinder innovations, which are a crucial part of the economy today and determine its competitiveness and development in the future (Jurkowska-Zeidler & Janovec, 2024, pp. 9–19).

When we confront the above dilemmas with the challenges posed by AI today, there emerges an extremely complex reality the desire to understand it lies at the heart of this article. The analysis will focus primarily on one aspect of the financial market regulation process that will be examined from the perspective of the use of AI and particularly FinTech entities. This element is a regulatory sandbox which has also been the addressee of one of the most important EU legislative acts concerning AI, which is Regulation (EU) 2024/1689 of the European Parliament and of the Council laying down har-

monized rules on artificial intelligence (AI Act).[2] This key document defines the regulatory framework for the development, implementation, and use of artificial intelligence, and is currently the subject of lively debates on both the solutions it proposes and their assessment in terms of effectiveness when compared to the regulatory philosophy adopted on AI in other countries, particularly the US and China, where a pragmatic, pro-market approach plays a central role. The dominant theme in it is not so much legal solutions as the values on which regulators base them (Kokocińska, 2023, pp. 63–79). In the case of the EU's Act, adherence to fundamental rights (Charter of Fundamental Rights of the European Union[3]), such as respect for human dignity, freedom, democracy, equality, the rule of law and solidarity is evident as there are concerns that they may be threatened in the event of an uncontrolled development of AI. However, there may be a price for the adherence to principles, such as a risk of regulatory arbitrage or the outflow of businesses developing AI-based technologies that in the search for more favourable regulatory environment will choose countries with a more lenient approach to these values (Pięta, 2018, pp. 243–244). It is difficult today to give a clear answer as to how this regulatory race will unfold. What is certain is that AI will continue to develop. The question is whether it will become a technology that supports human development or whether it will threaten the future of humanity by having created, as Filip Biały (2025, p. 14) writes, a complex reality based on the perversion of the tools that are often manufactured with infringement of intellectual property, using vast amounts of energy and thereby exacerbating the climate crisis, resulting in an apparent increase in productivity and creating an illusion of a reduced workload because owing to rapid analyses tasks are completed faster. This, however, creates the risk that next time more tasks will be assigned. Another threat, particularly evident in the financial market, is the control over data, which, being the lifeblood of AI, when transferred without control, may pose a significant threat to fundamental rights. These and other dilemmas should be part of the discussion on the development of AI and should also be taken into account when approving AI-based FinTech instruments analysed in regulatory sandboxes. Sandboxes, perceived as a flexible regulatory technique, make it possible to combine two regulatory philosophies often discussed in debates on new technology legislation. One is based on the precautionary principle, while the other is linked to the principle of permissionless innovation. The former focuses on reducing potential risks through preventive measures, while the latter is based on the practical use of technology and the experience gained from that use, helping to improve it and deepen understanding. Both approaches are important for creating an effective and efficient legal framework which includes, for example, algorithms

[2] Regulation (EU) 2024/1689 of the European Parliament and of the Council of 13 June 2024 laying down harmonised rules on artificial intelligence and amending Regulations (EC) No 300/2008, (EU) No 167/2013, (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1139 and (EU) 2019/2144 and Directives 2014/90/EU, (EU) 2016/797 and (EU) 2020/1828 (Artificial Intelligence Act) (Text with EEA relevance) PE/24/2024/REV/1, OJ L, 2024/1689.

[3] Charter of Fundamental Rights of the European Union (2012), OJ C 326, 26.10.2012.

created, used and enhanced in the financial market by AI, and which, when used properly, may support the process of creating a reality based sustainable development.

II. SUSTAINABLE DEVELOPMENT GOALS AND FINANCIAL MARKETS: POTENTIAL CONFLICT OR SYMBIOSIS?

In order to answer the question posed above, it is necessary to analyse two seemingly contradictory concepts: sustainable development and financial markets. This analysis should be set against the backdrop of the current 'Industry 4.0' revolution, which is regarded as the fourth stage of the Industrial Revolution. Industry 4.0 encompasses economic, social, and technological transformation driven by digitalization and smart technologies, which increasingly rely on AI. These changes are vast in scale and are taking place in an environment characterized by an extraordinary pace of innovation, which in turn create a new economic model where sustainable and intelligent production, rather than mass production, is becoming increasingly important. The growing population of our planet implies the need for mass production and for means to ensure the development and prosperity of humanity. Since the beginning of organized social forms, capital has been one of the basic means necessary for development. Today, it originates mainly in financial markets and these markets also create a new international financial architecture (Jurkowska-Zeidler, 2011, pp. 535–548). Operating around the clock, financial markets are global in scope, over them, as once over the British Empire the sun never sets. Their size and cross-border nature, combined with huge data sets termed 'big data' (Szoszkiewicz, 2021, pp. 27–62), have brought about a situation in which innovative technologies such as AI have appeared on the world stage at just the right moment. Their application to financial markets and their assigned functions may support the achievement of sustainable development goals. However, a system in which the financial market will operate in accordance with the principles of ethics, sustainable development and fundamental rights using the achievements of AI must be designed in order to support transformation as well as to protect human dignity and civil (consumer) rights, strengthening at the same time trust in the system (Nowakowski & Waliszewski, 2022, pp. 2–9). The seventeen Sustainable Development Goals (SDGs) formulated in 2015 by the United Nations within the *Transforming our World: The 2030 Agenda for Sustainable Development* (UN, 2015), provide a global framework for achieving these objectives. As stated in the Preamble:

> This Agenda is a plan of action for people, planet and prosperity. It also seeks to strengthen universal peace in larger freedom. We recognize that eradicating poverty in all its forms and dimensions, including extreme poverty, is the greatest global challenge and an indispensable requirement for sustainable development.

> All countries and all stakeholders, acting in collaborative partnership, will implement this plan. We are resolved to free the human race from the tyranny of poverty and want and to heal and secure our planet. We are determined to take the bold and transformative steps which are urgently needed to shift the world onto a sustainable and resilient path. As we embark on this collective journey, we pledge that no one will be left behind.
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> The 17 Sustainable Development Goals and 169 targets which we are announcing today demonstrate the scale and ambition of this new universal Agenda. They seek to build on the Millennium Development Goals and complete what these did not achieve. They seek to realize the human rights of all and to achieve gender equality and the empowerment of all women and girls. They are integrated and indivisible and balance the three dimensions of sustainable development: the economic, social and environmental.
>
> The Goals and targets will stimulate action over the next 15 years in areas of critical importance for humanity and the planet.

These five critical areas encompass: people, planet, prosperity, peace, and partnership. It should be noted that, due to their role in creating and controlling capital, financial markets may have a key role in achieving the SDGs.

Before presenting examples that illustrate the links between the SDGs and financial markets, it is important to highlight the key functions most commonly attributed to the latter. Financial markets should always be considered in a broader context, as part of the financial system and the overall economic system on which society is based. In practice, these relationships are bi-directional, as evidenced – unfortunately – by the financial crises that have occurred in recent years. Turmoil in financial markets inevitably affects society, although occasionally it is the financial condition of its members that contributes to the emergence of a crisis. Hence the increasing attention that has recently been devoted to the contemporary model of financial market regulation, particularly with regard to segments that elude traditional patterns and divisions. One such segment is the FinTech industry, which operates globally and often extraterritorially, using financial innovations that are difficult to capture within a legal framework.

Nevertheless, regardless of whether we are dealing with innovative solutions or traditional forms of financial activity, such as state-supervised and regulated banks, the core functions performed by financial entities or institutions remain a constant variable. The most commonly recognized functions include:

– the allocation function, relating to the channelling of capital from entities with surplus capital to those with a demand for it;

– the transformation function, associated with capital concentration, which allows investment capital to be generated from small-scale client savings;

– the stimulation function, aimed at the effective management and allocation of capital, for example, towards development-oriented initiatives;

– the informational and control functions, carried out through regulatory mechanisms that impose reporting and disclosure obligations on market participants.

The functions outlined above can be illustrated with examples drawn from the SDGs. Moreover, it will soon be possible to consider applying solutions

offered by the financial market to the implementation of each of these goals. Supported by AI, financial markets will be capable of allocating capital more effectively, based on the analysis of large volumes of data. As might be expected, more accurate measurement of risk will help to mitigate its negative effects.

Financial markets could direct the available capital to projects aimed at combating poverty, supporting renewable energy, or promoting smart cities. Based on a subjective selection of several of the 17 SDGs, the potential of financial markets and AI could be combined in the following areas:

– through the appropriate use of AI in credit assessment and by enabling entities that have not previously had such opportunities to access financing for their projects (SDG 8 – Decent Work and Economic Growth);

– access enabled to previously excluded communities to use innovative payment and microfinance solutions combined with low-cost energy electronic devices (SDG 1 and 10 – No Poverty and Reduced Inequalities);

– Agro-FinTech platforms: applying AI to support platforms involved in crowdfunding and risk mitigation for agricultural activities, including in impoverished regions (SDG 2 – Zero Hunger);

– Blue Bonds and sustainable marine projects: supporting the analysis of economic development projects related to the sustainable use of marine and ocean resources, fostering economic growth (in specific regions) and job creation, while protecting aquatic ecosystems and biodiversity. These initiatives could be financed through the issuance of 'green' bonds, also referred to as Blue Bonds (SDG 12, 13 and 14 – Responsible Consumption and Production; Climate Action; Life Below Water);

– supply chain monitoring and combating greenwashing: using AI to monitor supply chains and identify misleading practices that falsely present products, services, and activities as more environmentally friendly than they really are. The aim of such practices is to improve an entity's image rather than to actually reduce its negative environmental impact (SDG 12 and 16 – Responsible Consumption and Production; Peace, Justice, and Strong Institutions).

As the above examples show, the combination of the capabilities, functions, and objectives of financial markets, AI, and the SDGs has tremendous potential for symbiosis rather than conflict, which, if properly utilized, could promote the idea of sustainable development.

For this to occur, however, several conditions must be met. One is the adoption of a clear set of priorities (Greek: *taxis*) and principles (Greek: *nomos*), in other words, a taxonomy – a method of classifying and organizing elements into groups according to specific criteria. In this context, such a classification brings together specific types of economic activity and assesses them through the prism of their impact, particularly on the environment, and their contribution to the achievement of sustainable development goals.

This requirement has also been recognized at the EU level and is reflected in several important legislative acts adopted in recent years, including:

– Directive (EU) 2022/2464 of the European Parliament and of the Council of 14 December 2022 amending Regulation (EU) No 537/2014, Directive 2004/109/EC, Directive 2006/43/EC and Directive 2013/34/EU, as regards corporate sustainability reporting (OJ L 322, 16.12.2022);

– Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088 (OJ L 198, 22.6.2020);

– and Regulation (EU) 2019/2088 of the European Parliament and of the Council of 27 November 2019 on sustainability-related disclosures in the financial services sector (OJ L 317, 9.12.2019), which is of material importance for the functioning of the financial market.

The last of these pieces of legislation is an excellent example of how sustainability issues can be incorporated into the functioning of financial markets. Article 1 of Regulation (EU) 2019/2088 sets out its objectives by establishing harmonized rules for financial market participants and financial advisers regarding transparency in the integration of sustainability risks, the consideration of adverse sustainability impacts in their processes, and the provision of sustainability-related information on financial products.

An interpretation of the regulation allows us to conclude that it imposes certain obligations on financial institutions to monitor their activities in terms of their impact on sustainable development. These obligations include a requirement to implement a transparency policy regarding risks that threaten sustainable development (Fedorowicz & Zalcewicz, 2024, pp. 47–55) and a broadly understood information policy. The latter is considered one of the key instruments applicable to, among other things, financial institutions, which are obliged to publish on their websites:

– information about their policies on integrating sustainability risks in the investment decision-making process, and

– a clear and reasoned explanation of whether, and if so how a financial product considers principal adverse impacts on sustainability factors.

The proposed solution is significant and, as might be expected, will raise public awareness of sustainable development issues. The regulatory philosophy presented here is similar to that applied in the food or pharmaceutical markets, where business operators are obliged by law to disclose certain types of information. Hopefully, in the same way that consumers make choices about food they buy, basing them on nutritional information provided, also financial market participants, when making investment decisions, will take into account their impact on the objectives of sustainable development, drawing on the information provided under Regulation 2019/2088 (Rutkowska-Tomaszewska & Gałązka, 2024, pp. 223–232). As a result, this will allow to support investments in alternative energy sources that constitute a step towards mitigating the negative climate change (Michalski, 2022, pp. 33–43). As can be seen, potentially each of us, can potentially contribute to building a better world through financial markets operating in the spirit of sustainable development. Support for these efforts can also come from new technologies developed in the FinTech sector.

III. ARTIFICIAL INTELLIGENCE AS A CATALYST FOR THE DEVELOPMENT OF THE FINTECH SECTOR SUPPORTING SUSTAINABLE GROWTH

Artificial intelligence is undoubtedly one of today's most frequently researched topics, partly due to its ubiquity in everyday life. AI is permeating our reality and playing an increasingly important role, particularly in relation to financial markets. Moreover, given the significance of these markets for the functioning of states and societies, it has become necessary to determine the scope of control over the impact of modern technologies on the stability and security of the financial sector (Calzolari, 2021, pp. 32–33).

This is an evolving sector in which there are noticeable signs of erosion in existing rules and principles. The days of traditional banking, when banks were public institutions with a guaranteed monopoly on money circulation, now seem to be over. Technological progress, combined with advancing globalization, the liberalization of capital flows, and the blurring of borders in capital transfers, has led to the emergence of new competitors – previously unknown entities often operating in virtual space, using the latest technologies, and open to innovation and rapid change.

This was the beginning of the FinTech sector, which may be considered a new business model based on the use of modern technologies. Its emergence has brought about a redefinition of how financial services are provided, the introduction of new products, and the transformation of traditional ones by making them more accessible and easier to use. Such developments would not have been possible without a shift, however limited, in the previously conservative approach of regulatory bodies. This shift opened existing markets to new players, such as start-ups, payment service providers, and technical service providers.

One example of a regulation embodying this revolution is Directive (EU) 2015/2366 on payment services in the internal market, commonly known as PSD2.[4] It is widely recognized as the precursor of open banking (Masłowski, 2024, pp. 20–50). Without going into detail about the solutions introduced by this legislation – which are well documented in the literature – it is worth highlighting a new category of service provider that PSD2 has enabled to operate on financial markets. Referred to as third-party providers (TPPs), these entities were granted the right to access a special application programming interface (API). This access allows them to deliver certain financial services, such as initiating payments, providing access to account information, or confirming the availability of funds needed to complete a payment transaction in the payer's current account (Nowakowski, 2020, pp. 57–120).

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[4] Directive (EU) 2015/2366 of the European Parliament and of the Council of 25 November 2015 on payment services in the internal market, amending Directives 2002/65/EC, 2009/110/EC and 2013/36/EU and Regulation (EU) No 1093/2010, and repealing Directive 2007/64/EC (Text with EEA relevance), OJ L 337, 23.12.2015.

A key feature of PSD2 is the adoption of the principle of technological neutrality based on the assumption that regulations governing essential issues must be designed in a way that will not hinder the use of new technologies in the future. In practice, this meant creating 'broad' definitions of individual legal institutions capable of keeping pace with the market's dynamic development. The definition of AI contained in the AI Act, which is currently the most important EU legislative act on this topic, was developed in this spirit. Article 3(1) of the AI Act defines AI as 'any machine-based system designed to operate with varying levels of autonomy and that may exhibit adaptiveness after deployment and that, for explicit or implicit objectives, infers, from the input it receives, how to generate outputs such as predictions, content, recommendations, or decisions that can influence physical or virtual environments.'

The example of open banking discussed above perfectly encapsulates the advantages and disadvantages of solutions that accompany the development of the FinTech sector and the use of AI within it (Dziedzic, 2022, pp. 347–366). On the one hand, new services are being created that support market development, including from an inter-sectoral perspective. On the other hand, alongside these positive developments, there are many types of risks associated with the possession and processing of vast amounts of data, their security, such as in cases of cybercrime, and their use in AI-driven analyses, such as creditworthiness assessments.

These concerns are also highlighted by the EU legislator in the AI Act, which identifies and classifies specific types of risk associated with the use of AI, and imposes corresponding obligations on entities that use it. The scope of these obligations depends on the level of risk involved (Rzymowski, 2024, pp. 56–62). The AI Act distinguishes four categories:

1. Minimal risk systems: systems that pose no significant security risks or human rights risks (e.g. Non-Player Character behaviour in computer games).

2. Limited risk systems: systems that affect the user, but do not create serious risks (e.g. chatbots).

3. High risk systems: systems that may harm health and safety or have an adverse impact on fundamental rights, including, for example, credit risk assessment (Nowakowski, 2023, pp. 48–52).

4. Unacceptable risk systems – systems that are banned in the EU, with limited exceptions such as counter-terrorism purposes, because they are considered contrary to EU's values and infringe fundamental rights. A notable example is the social scoring system already used in some countries to assess citizens based on their behaviour, actions, or characteristics (Rojszczak, 2020, pp. 66–69).

The first two categories may be implemented without any additional compliance requirements. By contrast, high-risk systems must meet strict obligations, including a compliance assessment prior to implementation. Systems classified as posing an unacceptable risk – that is, threatening the EU's fundamental rights – are prohibited, apart from narrowly defined exceptions.

As explained in Annex III to the AI Act, the use of AI in the financial market will typically involve high-risk systems and give rise to specific obligations

for financial institutions. These institutions will be required to register such systems in a dedicated EU register, after which they will be subject to testing, compliance assessments, and audits. The decisions generated by AI must also be subject to human oversight (the 'human-in-the-loop' rule). In addition, proper management of risks and the quality of the data stored is essential to limit potential discrimination and counteract the bias affecting users of financial services.

This applies also to products offered by different entities operating in the FinTech sector, a term coined by combining the words 'financial' and 'technology' (Szpyt, 2024, pp. 5–20). In the European Union, this term appears increasingly often in public debate on the growing importance of this sector in financial markets and, consequently, on the need for its regulation. In 2018, the European Commission published a communication entitled 'FinTech Action plan: For a more competitive and innovative European financial sector' (FinTech Plan),[5] which provided a comprehensive description of this dynamically developing sector of the economy. The same communication contained the following definition: 'FinTech is a term used to describe technology-enabled innovation in financial services that could result in new business models, applications, processes or products and could have an associated material effect on financial markets and institutions and how financial services are provided.' Importantly, it was also noted that 'FinTech sits at the crossroads of financial services and the digital single market. The financial sector is the largest user of digital technologies and represents a major driver in the digital transformation of the economy and society. There are important synergies between the EU's Digital Strategy, the EU's Cybersecurity strategy, and the EU's FinTech Action Plan.'

It may therefore be concluded that the development of the FinTech sector is inevitable and will certainly lead to more AI-based products being offered. It is important, however, that this development does not focus solely on financial aspects, but also takes into account social and ethical issues, thereby strengthening trust in the market. Hopefully, this will contribute to sustainable development in real terms and not just be a promotional exercise. The combination of FinTech and AI offers enormous potential for positive outcomes. For example, it might support access to microcredit for previously excluded groups, improve risk management in various areas of activity, and enable a more efficient use of resources. It may even be argued that the proper use of the opportunities offered by FinTech is a path to democratizing the way capital is raised, by creating universal and more accessible financial instruments.

However, a balance must be struck between innovation and security, particularly with regard to market stability. This concern is also reflected in the EU Digital Finance Package (European Commission, 2020), which emphasizes

[5] European Commission, FinTech Action plan: For a more competitive and innovative European financial sector, 8 March 2018 (https://finance.ec.europa.eu/publications/fintech-action-plan-more-competitive-and-innovative-european-financial-sector_en).

the digital transformation of the financial sector while ensuring that security, stability and consumer protection are maintained (Urbanek, 2021, pp. 43–44).

One of the instruments that might help fulfil the above conditions is the solution proposed in the AI Act, which is both highly relevant and has been known and used on financial markets for several years (Koleśnik, 2017, pp. 95–96). This is the regulatory sandbox, defined in Article 57 of the AI Act, which states:

> Member States shall ensure that their competent authorities establish at least one AI regulatory sandbox at national level, which shall be operational by 2 August 2026. That sandbox may also be established jointly with the competent authorities of other Member States. The Commission may provide technical support, advice and tools for the establishment and operation of AI regulatory sandboxes. The obligation under the first subparagraph may also be fulfilled by participating in an existing sandbox in so far as that participation provides an equivalent level of national coverage for the participating Member States.

The same provision further states that the establishment of AI regulatory sandboxes aims to achieve the following objectives:

– improving legal certainty to achieve regulatory compliance with this Regulation or, where relevant, other applicable Union and national law;

– supporting the sharing of best practices through cooperation with the authorities involved in the AI regulatory sandbox;

– fostering innovation and competitiveness and facilitating the development of an AI ecosystem;

– contributing to evidence-based regulatory learning;

– facilitating and accelerating access to the Union market for AI systems, in particular when provided by SMEs, including start-ups.

The cited regulation contains a number of requirements concerning two areas: (i) the creation of this type of regulatory sandbox and (ii) the criteria that entities must meet to use it. *Regulatory sandboxes* may be defined as 'concrete frameworks which, by providing a structured context for experimentation, enable where appropriate in a real-world environment the testing of innovative technologies, products, services or approaches – at the moment especially in the context of digitalisation – for a limited time and in a limited part of a sector or area under regulatory supervision ensuring that appropriate are in place' (Council of the EU, 2020, para. 2).

They are also an excellent place for FinTech entities – and not only them – to test new solutions under controlled conditions, in compliance with regulations and under the supervision of the market regulator. Moreover, they offer an excellent opportunity for start-ups entering the financial market (Fal, 2022, pp. 36–45). Even without sufficient initial capital, such companies can test their financial instruments that exploit the potential of AI on favourable terms, while also shortening the process of obtaining the relevant permits to continue their operations.

As Krzysztof Wyderka (2023, pp. 6–7) rightly points out, regulatory sandboxes are a form of 'institutionalized dialogue' between the creators of modern solutions and the regulators. The use of the regulatory sandbox model allows

one party to familiarize itself with the expectations of the supervisory authority at the testing stage, and the other to better understand the nature of the proposed solutions. Naturally, taking advantage of this opportunity requires meeting certain requirements set out in the provisions of the AI Act. These are specified in the regulatory sandbox action plan – a document agreed between the financial entity and the competent authority (Article 58 of the AI Act). This document sets out, among other things, the objectives, conditions, timeframe, methodology, and requirements for the activities carried out within the sandbox (Olszewski, 2024, p. 65).

The concept of a regulatory sandbox is an excellent example of a smart regulation – a flexible regulation which takes into account both public and private interests. It can be seen as a dynamic feedback loop between the needs of innovators, regulations, and the law, enabling the rapid adaptation of standards to social and economic changes (Bonca & Jabłońska-Bonca, 2024, p. 293).

Introducing a regulatory sandbox demonstrates openness to innovation. Its application in financial markets may help to achieve specific social benefits while minimizing risk. As Rybiński and Królewski (2024, p. 187) aptly stated, in the sandbox, apart from the sand (data) there are also toys (ready-to-use models, including machine learning and artificial intelligence models) that allow for a sophisticated data analysis. An important aspect of this 'play' is determining its rules and preparing a specific set of 'toys' – models. At this stage, the regulatory sandbox becomes an environment where the design of financial instruments can incorporate principles aligned with the idea of sustainable development. This may involve, for instance, including certain values during the credit assessment process that take into account the profile of the targeted consumers. However, it is crucial to instil in both FinTech institutions and the regulators the belief that innovative financial instruments can significantly contribute to sustainable development and become attractive to customers who, knowing that their investment supports important goals, may be more inclined to commit their capital.

IV. CONCLUSIONS

'After God created man, man eventually invented big data and artificial intelligence which introduced a new set of rules that affect the daily lives of others.' (Rybiński & Królewski, 2024, p. 183). These words accurately describe the contemporary reality in which AI and financial markets – two seemingly unbridled forces – are playing increasingly significant roles. These forces profoundly influence and shape social processes on a global scale, but in doing so, they should take into account the values underlying the idea of sustainable development.

There is reason to believe that the integration of these two forces holds great potential and the development of the FinTech sector can support this process. Well-designed financial instruments, tested in a regulatory sandbox

environment – considered to be one of the most advanced forms of smart regulation (Eggers et al., 2018, p. 17) – can help to maintain a balance between innovation and regulation, enabling conscious management of this process (Szpringer, 2020, pp. 215–224).

A proper understanding of innovation is also a way to ensure stability and security by mitigating risk, which can be achieved through a well-designed algorithmic policy that defines the sustainable development objectives to which the use of AI should be directed. The AI Act is a step in this direction, but its adoption has raised concerns and sparked debate over the EU's decision to include AI within a legal framework built on a philosophy that prioritizes certain values over a purely pragmatic approach.

Although innovative technology is sometimes portrayed as a battlefield for privacy (Dolniak et al., 2024, pp. 79–106), it is now a key element of modern financial markets. While occasionally stigmatized, it can serve a just cause. It must be remembered that humanity's strength has always been driven by the urge to understand and harness the laws of nature. Without this drive, there would have been no 'Industry 4.0' Revolution which gave rise to AI, bringing with it significant risks as well as the potential to change the world for the better. The goal should be a world that evolves in a sustainable manner, supported by innovations introduced by financial markets and, in particular, by the FinTech sector.

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