

Review Paper

# Integration of the Financial Market in the EU Economic System: The Role of Artificial Intelligence

Olena Bobrovska<sup>1\*</sup>, Tetiana Savostenko<sup>2</sup>, Taisiia Krushelnytska<sup>3</sup>, Olena Kakhovska<sup>4</sup> and Liliia Shevchenko<sup>5</sup>

<sup>1</sup>Department of Economics and Social and Labor Relations, University of Customs and Finance, Dnipro, Ukraine

<sup>2</sup>Department of Administration and Lokal Self-government, Dnipro University of Technology, Dnipro, Ukraine

<sup>3</sup>Department of Management and Publik Administration, Dnipro State Agrarian and Economic University, Dnipro, Ukraine

<sup>4</sup>Department of Analytical Economics and Management, Dnipropetrovsk State University of Internal Affairs, Dnipro, Ukraine

<sup>5</sup>Department of Public Administration and Local Self-government, Dnipro University of Technology, Dnipro, Ukraine

\*Corresponding author: bobrovskaya.o.u@gmail.com (ORCID ID: 0000-0002-2174-9040)

Received: 19-12-2022

Revised: 22-02-2023

Accepted: 01-03-2023

## ABSTRACT

Financial integration as a new vector of EU development has already made tangible progress. However, to analyze ongoing integration processes, it is necessary to have a clear understanding of the essence of "financial integration", the availability of a certain coordinate system that will allow the researcher to answer a number of important questions: what is considered completed financial integration, at what stage of financial integration is the EU, how quickly integration processes are progressing in EU financial markets, what apparatus should be used and with what indicators when analyzing the financial integration of the EU. The article considers the processes, problems, and prospects for the integration of the financial market within the economic system of the EU. The expediency of using artificial intelligence to forecast and regulate the EU financial market in order to facilitate the successful completion of its integration is substantiated. An analysis of the potential functions of artificial intelligence in this context has been carried out.

## HIGHLIGHTS

- The article is devoted to substantiating potentials of using AI in the processes of management and regulation of the EU' financial market integration.
- The obtained results demonstrated the challenges of gaining and systematizing complex data needed for effective regulation of financial market under conditions of integration.
- The practical significance of the research lies in the possibilities of its use by EU regulatory bodies when making and implementing decisions concerning further integration of financial market.

**Keywords:** Financial Market, Integration, Artificial Intelligence, Big Data, Capital Market, EU economics

The integration of the financial markets of the member countries of the European Union into a single financial market with common rules of operation and uniform norms of legislation started shortly after the creation of the Customs Union in the EEC, that is, at the turn of the 1960-1970s. It was by no means a linear process, it experienced both ups (approval of the P. Werner Plan, adoption of the financial sections of the Single European Act,

as well as the Maastricht Treaty and its protocols), and periods of stagnation in development. The creation of an economic and monetary union in the European Union (EU) in 1999 led to a new wave

**How to cite this article:** Bobrovska, O., Savostenko, T., Krushelnytska, T., Kakhovska, O. and Shevchenko, L. (2023). Integration of the Financial Market in the EU Economic System: The Role of Artificial Intelligence. *Econ. Aff.*, 68(01): 583-598.

**Source of Support:** None; **Conflict of Interest:** None



of efforts by EU institutions and member states to deepen integration in the financial sector of the European economy (Juncker *et al.* 2015; Stavárek *et al.* 2012). The general slowdown in the development of the European economy at the beginning of this century has become an additional motive for the EU institutions to step up activities in this area. The elimination of barriers to the movement of capital and the provision of services by financial institutions is designed to increase the efficiency of the use of financial resources, strengthen the competitive environment and attract additional volumes of foreign investment to the markets of the EU countries.

However, the integration of the EU financial markets is possible only to the extent to which the states are ready to transfer part of their functions in the field of financial services regulation to the supranational level in order to overcome the difficult financial situation and strengthen their own position in the international arena. Moreover, the financial crisis in this context is an incentive to create additional mechanisms in this area (Klymenko *et al.* 2016; Kryshchanovych *et al.* 2022). Today, in the conditions of a difficult financial and economic situation in the world, the question of whether the communitarian institutions, and above all the European Commission, will be able to transfer the regulation of the EU financial market to the supranational level remains unanswered. The current EU financial policy is aimed at harmonizing various segments of the financial sector of the European economy: banking, insurance, investment (primarily investment funds), as well as the securities sector.

Cooperation of the countries of the Old World in the field of financial services is carried out at two levels. At the global level, it is about compliance with the current rules of the global economy in such areas as the purchase and sale of shares and securities, investment activities, and the movement of capital. At the local level, these are mortgage lending, insurance, pension funds, that is, everything that concerns the interests of individual consumers. Each EU member state initially had its own rules and standards governing such transactions and operations. Since the establishment of the foundations of the economic and monetary union, the financial policy of the EU has been aimed both

at harmonizing and implementing the current legislation, and at creating additional legal and regulatory instruments that contribute to the better functioning of the single market in the field of financial services. Thus, such a policy should favour the interests of private clients, who facilitate the activities of individual companies and individuals (Raposo and Lehmann, 2019).

At the same time, the contradictory impact of the financial market on the functioning of economic systems, the creation of GDP is the main prerequisite for a deeper analysis of this structure. The multifaceted nature of the financial market, which consists of several interrelated sectors, requires an analysis of the main aspects of the integration of its sectors (Deyneha *et al.* 2016; Akimov *et al.* 2021). The main sectors of the financial market include monetary, credit, stock (investment), currency, and insurance. Integration of currency, stock, insurance, and other markets affect financial integration.

To increase the level of integration, the financial market must go through the following stages of development:

- ♦ The stage of coordination, which involves the harmonization of financial policies through joint consultations of participants on the use of various tools to achieve their goals;
- ♦ The stage of harmonization means a smooth transition to a single financial policy based on the convergence of national financial markets;
- ♦ The stage of unification, which involves the implementation of a single financial policy in the participating countries to achieve a complete economic financial union, with a supranational regulatory body that determines the priorities for the strategic development of the financial market in the global economy.

Today, increasing the level of integration of the European financial market within the economic system suggests the following (European Commission, 2021; Nardo *et al.* 2021):

- ♦ Development of securitization methods as an innovative form of financing
- ♦ Computerization and informatization of financial markets management
- ♦ Implementation of the concept of virtualization for the development of the derivatives market

- ♦ Development of a global insurance institution
- ♦ Development of network forms and ways of integrating financial markets in the global economy
- ♦ Creation of innovative financial instruments and technologies.

In particular, global databases and integrated computer systems for managing financial markets will increase the level of integration, since with the help of information technology it is possible to carry out banking operations without borders (Akimova *et al.* 2020; Gaman *et al.* 2022).

In modern conditions, managerial decision-making processes are based on complex computer modeling, statistical analysis of large data sets and the use of the latest mathematical modeling methods (Deshpande and Kumar, 2018). Thus, there is a need to improve the reliability of systems that serve information and payment flows, asset trading and securities storage.

We believe that the concept of development of cloud, Big Data, and artificial intelligence (AI) technologies is promising in this direction. Cloud technologies have the potential to eliminate these shortcomings and improve information support at all levels of competence, both the main and supporting activities of participants in socio-economic processes. The totality of information flows transmitted through the means of modern communication, the development of tools for transmitting and receiving information require solving the problem of maximum rationalization of the use of space and energy.

The creation of network integration structures will make it possible to obtain a synergistic effect from joint financial operations by all participants in the financial market (Kalyayev *et al.* 2019; Kryshtanovych *et al.* 2022;). Network forms and ways of integrating financial market participants contribute to the establishment of trusting relationships between subjects, “enliven” the global financial space, and also ensure the rational mutually beneficial use of space and time resources.

In our opinion, technological innovations, in particular artificial intelligence, are the most successful in increasing the level of integration of financial markets. AI is now rightly called “a tool

for the development of financial globalization” (Barbaglia *et al.* 2021).

Research institutes, corporations, educational institutions and governments are in the race to dominate the development of AI. Fintech startups based on artificial intelligence Upstart, Icertis, Circle, etc. are showing exponential growth, as well as venture capital funding for them. This is because such technologies lead to automation, decentralization, and data-driven prediction. Evidently, integration of financial market today is going on in the conditions of active AI solutions implementation on this market, which determines the need to consider possibilities of AI application in regulation and decision-making activities.

## LITERATURE REVIEW

The formation and development of European financial integration took place in stages and quite harmoniously with a greater or lesser degree of integration, i.e., in all sectors banking, securities, and insurance. Council Directive 73/183 “on the abolition of restrictions on freedom of establishment and freedom to provide services in respect of self-employed activities of banks and other financial institutions (1973) can be considered the beginning of European regulation of banking sector policy. This Directive in fact was the practical implementation of Art. 94 of the Treaty on the establishment of the EU (Consolidated version of the treaty on the functioning of the European Union, art. 115): The Council, on the proposal of the European Commission and after consulting the European Parliament and the Economic and Social Committee, unanimously adopts directives on the approximation of laws and legal acts of the bodies of the executive power of the Member States, exerting appropriate action on the creation or operation of the common market (Litvinova *et al.* 2020; Khomiuk *et al.* 2021).

Today one can talk about certain successes in the field of integration of the financial markets of the EU countries. However, despite the external regulatory convergence, the harmonization of financial services is often of a political and declarative nature, which is reflected in the Financial Services Action Plan. This Plan was adopted in 1999 and contains 42 banking, insurance, and other regulatory measures to be introduced in EU member states. At the

same time, speaking about the implementation of the Plan, it is necessary to clearly distinguish between two levels: global and local. As a rule, at the local level, adaptation takes longer and is more difficult; therefore, a “transition period” has been introduced for member countries. According to Boldeanu and Tache, this can be explained by the peculiarities of national legislation and law enforcement practice (Boldeanu, and Tache, 2015). The result of the implementation of the Plan was the adoption by the EC of 26 Directives, which were fully implemented into national legislation in various areas of financial regulation. This applies to electronic money, reorganization and liquidation of insurance companies, mergers, taxation in income taxes at interest rates, money laundering, prudential regulation of electronic money institutions, financial instruments, insurance intermediation, etc.

Ultimately, the goal of integrating the financial services sector is to complete the formation of a single capital market as one of the factors of production along with goods, services, and labour. In this sense, the Lamfalussy Committee, which proposed a four-level system of legislative regulation of financial markets, played a colossal role in the development of financial integration. On July 17, 2000, the EU Council of Ministers of Finance (ECOFIN) decided to establish an ad hoc group of the Lamfalussy Committee. A few months later, a special report was published highlighting the main recommendations: the need for framework legislation, greater powers for committees, increased cooperation between national regulators, and stronger enforcement of regulations (Initial Report, 2000). It was decided to apply a four-level regulatory approach (Marjosola, 2014):

1. Common basic principles for legislation are agreed at EU level. The Commission, after extensive consultations, makes a legislative proposal to the Council and Parliament in accordance with the joint decision-making procedure;
2. Implementation of the principles set at the supranational (EU) level through the comitology procedure;
3. The bodies of the Member States cooperate with each other and develop common standards and norms adopted at the first and second levels;

4. More attention is being paid to the implementation of Community law. Naturally, the main role is assigned to the EC, but in cooperation with the regulatory authorities of the EU Member States and the private sector.

Although the adoption of the Lamfalussy approach was delayed by the European Parliament for almost another year, the EC did not wait and began to implement the new approach in its proposals and directives. In addition, national authorities also began to function actively and created the European Committee for the regulation of the stock market (the third level committees) (Panasiuk *et al.* 2020; Panasiuk *et al.* 2021). According to the charter documents, the committee aims to improve coordination in the field of securities regulators, while remaining independent of the European Commission.

The creation of the European Securities Committee (second level) took place immediately after the European Parliament (EP) agreed to the new procedure. The EP agreed on the condition that it would be fully informed of the decisions taken by the Committee and that it would have sufficient time to make appropriate decisions.

The most important development from an institutional point of view was that the EC was “at the helm” in accordance with the comitology procedure. The EC has drafted legislative initiatives, participated in the work of the European Committee for the Securities Market, developed implementing measures at the second level and chaired the meetings of the European Committee on Securities. However, the bodies of the Member States also played an important role). They maintained control in the European Committee for the Regulation of the Securities Market, unanimously making appropriate proposals. Moreover, they also retained a regulatory function in the course of voting (voting by a qualified majority) on the draft implementation measures submitted by the EC to the European Securities Committee.

The new procedure was initially applied to the stock market; however, it was subsequently extended to the banking and insurance sectors.

Thus, integration developed on the basis of a system of mutual recognition of banking

organizations duly established under the laws of another member country. The banking sector can be considered as the most striking example of “mutual recognition”: a separate state recognizes on its territory banking organizations established in other member states. However, according to Article 109 of the Treaty on the Establishment of the European Community (Consolidated version of the treaty on the functioning of the European Union, art. 131), the provision on the national central bank must comply with the Treaty on the Establishment of the European Community and the regulation on the ESCB. However, the question of control remained fundamental whether to maintain the role of supervision over the activities of financial institutions at the national level. Until recently, this function (prudential supervision of the activities of credit institutions) was entirely at the national level, while the European System of Central Banks (ESCB) determined exclusively the vector of policy and did not challenge the status quo.

However, the aggravation of the situation in the European financial market and the global economic crisis prompted the European Union to take more decisive action in this area.

In an attempt to radically change the balance of power in the financial sector of the economy of a united Europe, a number of measures have been taken that go beyond the traditional “redistribution” of public financial resources allocated to aid programs. Among the first such measures, there is an increase in the capital of the European Investment Bank with the possibility of flexible use of its funds (Novak *et al.* 2022).. In December 2008, the European Investment Bank adopted a special plan, the purpose of which was to increase directed lending and other practical measures to mitigate the current financial and economic crisis in response to requests from EU member states (EIB’s Corporate Operational Plan).

However, the turbulence of the financial market in the EU economic system, as well as the instability and rapid dynamics in the global financial markets, largely due to poorly predictable political factors, today require the analysis of a huge amount of data both in the present and in retrospect, as well as competent forecasting, from which the stability of the EU economic system and the success of the completion of integration processes depends on.

A number of economic theories created in the 1950s are based on the assumption of rational behavior of market participants. Around the same time, Herbert Simon formulated an absolute limit to rational behavior, determined by three factors: the computational complexity of the problem, the limitations of the mind, and the maximum time in which a decision must be made. From the presence of the rationality limit (as a task of maximizing personal interest), it follows that market participants, instead of making absolutely rational decisions, find a compromise between sufficiency and their own satisfaction with the result (in the literature, the term *satisficing* is used). The quality of a “good enough” solution is largely determined by how well the methods and mechanisms of finding a solution correlate with the complexity of the problem. In cases where the search for a solution is made by a human, cognitive limitations and features of the human mind come into play: for example, the speed and accuracy of information processing are among the obvious limitations of the mind. In addition to the limitation of computing power and unintentional errors in calculations, the human mind has a number of ‘design features’ that negatively affect behavior in situations of uncertainty. In behavioral economics, these features are called cognitive biases. A classic example of the effect of such distortions on the behavior of market participants is the change in the position of a trader during trading (Coerdacier and Rey, 2013). Before the start of trading, the participant of the experiment believes that it is worth selling the instrument that is falling in price as early as possible in order to minimize losses, and wait for further growth in a position that is growing in price in order to maximize the return. At the same time, the opposite situation arises on the stock exchange: during the price fall, the trader has an internal dialogue the person hesitates before selling the instrument falling in price due to unwillingness to admit the mistake of the purchase and convinces himself that the trend will change soon (Gupta *et al.* 2021; Gavkalova *et al.* 2022;). While the trader is in doubt, the price of the error increases. In a situation where the choice of a stock is successful, the trader sees the price increase and, instead of waiting for the most favorable price, he starts selling at the beginning of the increase, because the need for a reward for the right choice pushes him to

sell prematurely. The behavior of a trader in the market may not correspond to his intentions, since the influence of cognitive distortions on human behavior can completely neutralize the presence of a developed intellect. In the case of making a decision by a person, the objectively limited rationality of any intellect is further narrowed by the computing power of the brain and cognitive distortions. In such a situation, the ability of a person to design intelligent systems that can be delegated part of the work comes to help. All the more so it is crucial when it is about the actions of integrated market institutional participant, whose decision makes significant effect on the whole system.

Advanced forms of artificial intelligence are a unique combination of the qualities of an organic mind and an engineering system with their own advantages and disadvantages that affect the application of these technologies. From the point of view of robotization, a trained machine can act as a beneficiary agent with the ability to issue a high-quality subjective judgment on a large amount of data without emotional overtones and conflicts of interest. Since artificial intelligence is a technology, its use by humans is also subject to cognitive distortions: the creator of the system can make a mistake when developing software or distort the learning process with an inaccurate representation of the observed phenomenon. In this case, the user may mistakenly trust the system, which makes suboptimal decisions on his behalf (Akimov *et al.* 2020; Kryshatanovych *et al.* 2022). On the other hand, the potential benefits of robotic decision-making may be offset by the users of the system, as their behavior may be influenced by another cognitive distortion the need for a sense of control. Man is afraid of what he does not understand. If the AI has implicit knowledge that cannot be conveyed to the user through simple rules, then at any point in the decision making, the user can deviate from the machine's incomprehensible but nevertheless optimal proposal and consider this "transition from autopilot to manual mode".

The success of a function that is being automated with the help of artificial intelligence largely depends on the degree of its alignment with related functions in the organization. For example, within a typical institutional investor, there are three interrelated functions: analytics, portfolio

management, and trading. Each of them can be automated separately, including with the help of artificial intelligence. At the same time, each function has its own characteristics and operates with a data set that is not 100% different from the other two functions, does not completely coincide with them, but somehow intersects. In such a situation, there is a risk that adjacent functions will search for optimal solutions on different versions of data on the same set of financial instruments, which will affect the final result in an unobvious way. One of the key success factors is the provision of a single information space for the performance of related functions in a business process.

In this regard, it is necessary to have a regulatory framework that determines which parts of the AI-based system should be visible to each of the participants. One of the key factors for transparency in the interaction between the consumer, the manufacturer, and the regulator is the availability of standard tools for validating AI-based systems.

The literature notes that "today, artificial intelligence is rapidly changing the way the financial system works, taking on the main functions of saving money and ensuring operational efficiency. It is assumed that in the future, artificial intelligence will help both risk managers and financial authorities. However, this could destabilize the financial system, creating new tail risks and exacerbating existing ones due to bank procyclicality" (Barrau and Douady, 2022).

The task of managing and interacting artificial intelligence with the financial system, from the point of view of regulators or the private sector, has different dimensions. The regulation and control of financial activities can be divided into two main categories micro and macro. Micro-problems covering microprudential rules focus on day-to-day risks such as day-to-day line-item losses, fraud and regulatory compliance.

Although this process is detailed, the emphasis here is made on short and medium duration and control of many recurring similar events, which greatly facilitates the work of micro-AI. The 'picture' is different with macroprudential policy and related private sector objectives, such as long-term tail (residual) risk, which macro AI must take into account (Bickley *et al.* 2021).

Thus, AI is well suited to solving microproblems, but it faces serious conceptual and practical problems when used for public or private macro purposes. In this regard, it seems particularly appropriate to consider practical and promising areas for the use of AI for the integration of financial markets within the economic system of the EU.

## MATERIALS AND METHODS

The methodological basis of the study was the principles of dialectical logic, system analysis and synthesis, and the identification of cause-and-effect relationships. The methods of scientific abstraction, logical thinking, comparisons and analogies, and the method of generalizations were used as research tools.

Understanding the processes of European financial integration is also valuable for obtaining a comprehensive understanding of the quality and dynamics of the ongoing transformation of the international financial system.

## RESULTS

AI may be guided solely by designated rules, but more often it obtains information through machine learning, whereby a computer algorithm obtains data and derives a statistical model driving the data in a reduced form. The usefulness of AI for any task mainly depends on its structure. The best use case for AI is the problem of decision making by a single agent with known fixed goals, rules, and predetermined limited action space. The more deviations from this scenario, the worse the AI works.

Macro AI is hampered by three reasons. The first one is that the optimal rules for making decisions by economic agents depend on the structure of the underlying environment. Any changes in this environment, including those caused by macro AI, will force agents to adapt their decision-making rules. The behavioral responses that AI infers from historical data depend on the observed environment and can be disrupted if AI tries to use them for control purposes (Deshpande and Kumar, 2018).

To regulate the financial system, macro AI cannot rely solely on traditional machine learning methods that infer patterns from existing data. It will have to supplement this with an understanding of the causal

structure of the system, including the response functions of economic agents and the underlying political system.

Paradoxically, the problem facing the AI in charge of the macro goal is the data itself. The financial system may seem like an ideal place to use AI as it generates seemingly endless amounts of data, but measurement issues, fragmentation, and hidden relationships limit the amount of information that can be collected (Deshpande and Kumar, 2018). This is not a big hindrance for micro-applications, but it is likely to misinform macro-AI.

Also, a common feature of crises is that they occur suddenly. Systemic crises are also generally unknown, and each crisis has statistical patterns that determine its uniqueness, making it difficult to study existing data. It also means that regulators only know after the fact what to protect against. All they can do in advance is specify common goals (Bickley *et al.* 2021).

However, the question arises: how to define a specific goal here maintaining the stability of the financial system, all the more so – integrated one? Currently, this is achieved through modular organizational structures with formal and informal channels of communication, with the selection of personnel based on education, experience, and performance, but it is not known how to reproduce such decentralized goal setting mechanisms in the development of AI. If a regulatory AI is to act autonomously, humans must first set its goals, but a machine with fixed goals running in a very complex environment can behave unexpectedly.

One of the biggest challenges for anyone tasked with overseeing any aspect of finance is measuring risk. After all, an important part of achieving the macroeconomic goal is controlling the risk of major shocks. Risk factors are divided into exogenous and endogenous.

Exogenous risk is easy to measure with statistical methods, whether it is traditional risk models or machine learning. The measurement process uses historical observations of relevant variables to infer the distribution of future outcomes. The fundamental assumption that risk is exogenous is that economic agents interacting with the financial system do not change it.

Endogenous risk, in contrast, implies that everyone who interacts with the system changes it. Endogenous risk arises as a result of the interaction of economic agents and, as a rule, is most serious when they cease to behave independently and begin to coordinate their actions (Kryshtanovych *et al.* 2021; Levytska *et al.* 2022). This happens when stress limits their behavior such as increased capital and margin requirements, or the need to liquidate investments to pay off. The consequence of this can be a feedback loop between market stress, mandatory restrictions, and harmonized behavior, which eventually is leading to a major stress event or crisis (Bickley *et al.* 2021).

AI is well suited for measuring and managing exogenous (external) risks because it can use large data samples, well-established statistical methods, and plenty of repetitive learning events because these goals are simple. Therefore, artificial intelligence is likely to make a significant contribution to micro-regulation and internal risk management within integrated financial market.

In order to measure endogenous risk, it is necessary today to determine the accumulation of those threats that can lead to a crisis in many years (that is, in long-term prospect). Meanwhile, the nature of endogenous risks varies greatly, making it difficult to extract general patterns and use machine learning, so there is no obvious way to measure endogenous risk. The main outcome factors are hidden until they emerge during a crisis.

For the most part, micro-authorities are concerned about exogenous risk, so the AI that exists today is good for them. However, for macro-bodies, the calculation of endogenous risk is more important. In order for AI to be of fundamental help in predicting such risk, it must understand the internal causes of the deterioration of the situation and act strategically, taking into account how market participants will react to events that did not occur before. It follows from the above that there is a dichotomy between macro- and microfinance issues, which directly affects how useful AI can be in predicting macro risks.

## DISCUSSION

According to ECB experts, much remains to be done to create the image of a strong and independent supranational supervisory authority with a high

level of standards and responsibility. However, it seems that such opportunities are available to it.

First, the regulations governing the functioning of the Single Supervisory Mechanism (according to which representatives of national supervisory authorities have a majority of votes in the Supervisory Board of the ECB) provide that the ECB has the right to make decisions not only on matters of general policy, but also in relation to specific banks. At the same time, this group of powers does not overlap with the solution of tasks on monetary policy issues within the framework of the ECB Governing Council. This separation of powers complicates the task of the ECB, which is to ensure the full impartiality of the members of the Supervisory Board, to ensure that they act in the interests of the EU as a whole, and not in the interests of a particular state, which may be contrary to the goals of the Single Supervisory Mechanism. A determining factor in achieving this goal will be the ability of the ECB to achieve cohesion and unity among the majority of national observers (and ideally between all) (Bukowski, 2021; Ehigiamusoe and Lean, 2018). According to ECB officials, the ECB is currently successfully coping with the role of a single supranational supervisory authority, as evidenced by the success achieved in improving the stability of the EU financial system (favorable economic conditions have been created for conducting cross-border banking activities; over the past two years, there has been a steady trend towards equal distribution of the level of public debt among the member states of the Eurozone) (Danko and Suchy, 2021).

Secondly, the ECB promotes the formation of a single model for the implementation of supervisory activities, which will help to gradually eliminate national differences in the methods, principles, and mechanisms of supervision. A consistent personnel policy is also essential in achieving this convergence and ensuring uniformity of supervisory practices. As it was noted above, the majority of the ECB's original supervisory staff was drawn from national supervisory bodies and this was expected to ensure effective coordination within the Single Supervisory Mechanism between the ECB's supervisory structure (consisting partly of national representatives) and national supervisors based in EU member states. Conversely, the ECB may encourage its own employees (not representing



the supervisory authorities of a particular state) to work outside Frankfurt. In the future, the ECB may study and apply the experience of other states in the implementation of supervisory activities (for example, the US Federal Reserve System, the Banking Regulatory Commission of China) or the experience of other European supervisory authorities, in particular, the system of European antimonopoly authorities, which is taken as a model when modeling the single supervisory mechanism.

Thirdly, the powers of the ECB include the collection of information and the formation of databases that show the results of the functioning of the Single Supervisory Mechanism. Undoubtedly, the results of the “comprehensive assessment” in 2014 generated a huge amount of information, but such work needs to be carried out on an ongoing basis. The current activities of the ECB under the Single Supervisory Mechanism include the ongoing collection and analysis of data on the activities of banks controlled by the ECB and on the state of the economic and financial system of the EU. In the future, as a result of improved legislation in the banking sector, likely there will be even greater standardization of the procedure for presenting the financial statements of banks (PwC, 2015). However, at the moment, most banks provide consolidated financial statements using International Financial Reporting Standards (IFRS), and many regional banks, such as German ones, use national accounting standards. The procedure for carrying out audit activities, as well as auditing standards themselves also differ and depend on national legal regulation, which is explained by the low level of harmonization of rules and regulations in this area. The collection and analysis of risk information is carried out by the ECB’s Risk Assessment System (RAS), which became operational in 2015. The Risk Assessment System is a model developed by the ECB for analyzing and evaluating the activities of banks, which also determines the norms for mandatory (regulatory) reporting of banks. The quality and completeness of reporting are necessary conditions for the effective exercise of supervisory powers. To this end, the Single Supervisory Mechanism uses standardized reporting, taking into account the Implementing Technical Standards on Supervisory Reporting (COREP) and Financial Reporting (FINREP) developed by the European Banking Authority

(Acharya and Steffen, 2016). The definition of capital, as well as the procedure for assessing risks, are far from uniform in the Eurozone countries and, therefore, their full harmonization should be a priority for the ECB activities.

The ECB also determines the frequency of stress tests and the level of transparency of their results (Moloney, 2016). Most likely, the ECB will contribute to increasing the level of transparency of supervision every year until the completion of the European banking union construction.

Fourthly, the ECB will have to solve the problem of achieving the same level of supervision over the largest banks (controlled directly by the ECB), on the one hand, and less significant banks (supervised by national supervisors on a permanent basis, but subject to the jurisdiction of the ECB in accordance with Council Regulation No. 1024/2013 of October 15, 2013 (SSM Regulation)) on the other. To address this problem, the ECB has focused primarily on less significant banks that are in practice independent from each other in terms of operational management, but are interconnected in the framework of a systemic risk analysis (such as the system of German savings banks institutional protection). The ECB has characterized such systems as “virtual groups” (Valiante, 2016). In addition, the ECB, together with national supervisory authorities, develops and approves standards for the implementation of supervision of less significant banks (about 3,300), which also ensures the harmonization of supervisory practices.

The ECB and the national supervisory authorities work closely with each other while verifying whether banks comply with EU law and resolve problems at an early stage. Thus, the ECB and the national supervisory authorities of the member countries of the European Banking Union are the main components of the Common Supervisory Mechanism. The objectives of the Single Supervisory Mechanism, and accordingly the objectives of the ECB and national supervisors, are as follows (Barbu and Strachinaru, 2016; Bukowski, 2021):

1. Ensuring stability and increasing reliability of the European banking system;
2. Deepening financial integration in the EU banking sector;

3. Ensuring permanent supervision of the EU banking sector.

The ECB, as an independent EU institution, exercises supervision from the point of view of common European interests through:

1. Development of a common approach to the implementation of current supervision;
2. Taking coordinated actions and preventive measures in the event of a crisis.

As part of the Single Supervisory Mechanism, criteria for determining the significance of a bank have been developed:

1. The total value of assets exceeds 30 billion euros;
2. Importance for the economy of a particular state and the EU as a whole;
3. The total value of assets exceeds 5 billion euros, and the ratio of the ratio of cross-border assets/liabilities in more than one Member State to the ratio of the total value of assets/liabilities exceeds 20%;
4. The bank in question has requested or received funding from the European Financial Stability Facility operating under the European Stability Mechanism.

The current development of integration processes in the EU is directly associated with the creation of a financial union, that is, with the formation of a single pan-European financial space in other words, financial integration. Thus, financial integration has been one of the main areas of work of the European Central Bank and the European Commission for several years. The topic of financial integration was actively discussed in the speeches of Jean-Claude Trichet and other high-ranking EU officials; elements of the infrastructure of the pan-European financial market appear and are actively developed: TARGET 2, TARGET 2Securities (T2S), STEP, CCBM 2, SSSs, etc.

It should be also mentioned that the law of one price is an economic concept, according to which, in the space of an integrated market, prices for identical goods must match. In other words, if the given market is recognized to be integrated, then the dispersion of prices for goods with the same characteristics should be equal to zero or close

to this value. The economic explanation for zero variance is quite simple. In the event of a significant price deviation from the market average, buyers will massively switch to using a similar cheaper product, which will push the price deviation down and bring the market back to a balanced state. At the same time, of course, there should be no significant restrictions for buyers and sellers throughout the integrated space that would prevent them from carrying out trade operations. First of all, it is about tax, customs, and trade regulation. The integrated market system must be completely homogeneous so namely the price as the main source of information in a market economy determines the choice of a buyer or seller.

So, according to the approach of the single price rule, in a financially integrated market there is no possibility for arbitrage in financial instruments between EU member states. Ideally, a financial instrument (for example, a corporate bond of a higher credit rating with a quarterly 5% coupon maturing) bought, for example, in Spain, can be sold in Poland at the same price (plus transaction costs). At the same time, prices cannot differ greatly (i.e., a bond with the same characteristics issued by another company must have the same quote). Thus, it will be possible to speak about the presence of a single supply and demand in the EU financial market, in contrast to the current state of affairs, when each EU member state is characterized by its own financial market with its own buyers and sellers.

In one of his speeches, Jean-Claude Trichet pointed out that, in its ideal understanding, the implementation of the law of one price (LOP) should imply the observance of the same 'rules of the game' for all potential traders, the provision of uniform working conditions for them and the provision of free access to trade in all products. Then there will be no obstacles in the implementation of trading operations and any price deviations will be instantly arbitrated and return the system to the equilibrium state of a single price (Lake *et al.* 2022).

Thus, in order to perfectly comply with the LOP approach, it is necessary to fulfill the criteria of the legal approach described earlier. At the same time, in the analytical publications of the ECB, more emphasis is placed namely on the single price rule.

For example, this approach is actively used in the analysis of the segment of banking services for individuals (as one of the components of the financial market). Due to the fact that in the EU the rates on bank deposits, as well as on loans, are strikingly different, and the dispersion of deviations of these rates across EU member states exceeds the same indicator calculated for the US states, one can talk about the slow flow of integration processes in this sector and their insignificant development, which traditionally causes concern among the ECB management.

However, despite the ease of understanding of the LOP approach and its apparent obviousness, the one price rule has a number of serious assumptions (Ehigiamusoe and Lean, 2018; Gnath, *et al.* 2019):

1. It is assumed that there is perfect competition in the market under consideration. The number of participants in perfect competition is too large for any one of them or their group to have a decisive influence on price dynamics. The price is actually set from the outside and is completely determined by the classical law of supply and demand. At the same time, there are no serious barriers to entry into the market, and it is quite easy for any new firm to start working on it (unlike the situation on monopolistic, oligopolistic, and other markets);
2. It is assumed that in the market under consideration, each participant has all the information. First of all, it concerns the price. As soon as the price changes somewhere, all market participants immediately become aware of this. And, as indicated earlier, this information allows to immediately switch from the consumption of a more expensive to a cheaper product and return the market to an equilibrium state;
3. All market participants behave rationally, i.e., in accordance with the so-called human model "homo economicus". Simplified rational behavior can be defined as follows: a person will buy from two identical goods the one the acquisition of which is associated with lower costs (goods with a favorable price). In other words, the "homo economicus" person does not have emotions that in real life are of decisive importance when making purchases.

All of these assumptions severely limit the application of the one price rule. After all, in the existing European economies, in the absolute majority of cases, the market is characterized by imperfect competition. Moreover, the level of consolidation of financial markets is extremely high. Not without reason, among market participants, there is such a thing as "market makers" (for example, brokers who undertake to keep firm quotes for certain types of securities (currencies, etc.), which have a significant impact on price dynamics.

In addition, the traditional problem of any economy is the asymmetry of information, when it is not possible to have comprehensive information on any product or market. And this is understandable. Indeed, the search for information often requires serious costs (both time- and material one), therefore, limited resources require not the best (i.e., at the lowest price that is not quite easy to be found), but the most optimal choice under the given conditions.

The assumption of rational behavior of market participants is also far from reality. The choice of market participants is often determined by loyalty to the issuer of a particular financial service or product (for example, when placing a deposit), their location (for example, when obtaining a mortgage loan), country preferences, etc.

All this makes forecasting and making fully informed decisions very difficult, and sometimes actually impossible.

Thanks to scientific and technological progress, a way has appeared to achieve the maximum effect in the field of forecasting using artificial intelligence, when the computer itself can learn, because with an increase in the number of information resources that are used in the model, the accuracy of the forecast increases, and the loss associated with uncertainty in making decisions are reduced this is possible due to the use of neural networks.

The main feature of the network, indicating its broad capabilities and high potential, is a technique that allows to significantly speed up the process of processing information, and the network becomes resistant to errors that may occur on some lines. An artificial neuron is the basis of any artificial neural network. Neurons are relatively simple, single-type elements that mimic the work of brain neurons. The

human nervous system and brain are made up of neurons that are interconnected by nerve fibers. Nerve fibers are capable of transmitting electrical impulses between neurons. It is known that all the processes of transmission of irritations from the skin, ears and eyes to the brain, the processes of thinking and controlling actions all this is implemented in a living organism as the transmission of electrical impulses between neurons (Deshpande and Kumar, 2018). Each artificial neuron is created by analogy with human brain nerve cells. An artificial neuron, as well as its natural prototype, has a group of synapses (inputs) that are connected to the outputs of other neurons, as well as an axon the output connection of this neuron from where the excitation or inhibition signal enters the synapses of other neurons. It is obvious that the action of the neural network depends on the magnitude of the synaptic connections. Therefore, when developing a neural network structure that will meet a specific task, the developer must determine the optimal values for all weight coefficients. This stage is called neural network training, and the ability of the network to solve the problems posed to it depends on how well it will be performed.

The main learning parameters are: the quality of the selection of weight coefficients and the time spent on training. Currently, all neural network learning algorithms can be divided into two large classes: supervised and unsupervised. The network is learning in order to give a set of outputs for a certain set of inputs. Each such input or output set is considered by developers as a vector. Learning occurs by sequentially presenting the input vectors while adjusting the weights in accordance with a certain procedure. During the learning process, the weights of the network gradually become such that each input vector produces an output vector (Barrau and Douady, 2022). Supervised learning assumes that each input vector has a target vector that represents the desired output. Together they are called the training pair. Typically, such a network is trained on a plurality of such training pairs. An output vector is presented, the output of the network is calculated and compared with the corresponding target vector, the difference (error) is fed back into the network and the weights are modified according to an algorithm that seeks to minimize the error (Deshpande and Kumar, 2018).

The training vectors are presented chronologically, the errors are determined and the weights are adjusted for each vector until the error reaches an acceptably low level.

Unsupervised learning is a plausible model for the learning of a biological system. Many scientists have worked on this model, since with such training there is no need for a target vector for outputs and, therefore, there is no need for comparison with predetermined ideal answers. Such a training set consists of only input vectors. The learning algorithm adjusts the weights of the network so that consistent output vectors are obtained, i.e., so that the representation of sufficiently close input vectors gives the same outputs. The learning process, therefore, extracts the statistical properties of the training set and groups similar vectors into classes (Barrau and Douady, 2022). Presenting for input a vector from an existing class will give a certain output vector, but before learning it is impossible to predict what output will be produced by a given class of input vectors. Analysis of influencing factors with further output of information about the subsequent long-term and short-term behavior of the value that is predicted this is the task of an automated system for predicting long-term and short-term trends in finance (in particular, stock) markets. As initial data (influencing factors) for this forecast, various macro- and microeconomic indicators, information from trading floors, data provided by information and trade agencies, and expert assessments of specialists are used.

The number of factors that affect the forecast depends on the market instrument that is considered in a particular market situation. Some factors affect all markets, while others only certain ones. Also, the impact of these factors may change over time as market trends change. Based on the fact that at any different points in time there is a clear relationship between stock markets and market instruments, it is possible to use information about the trends of one market as the initial data for forecasting trends on other markets.

Forecasting in the market is a fairly significant area of application of neural networks in the financial sector. Standard methods that do not use neural networks are based on a rigid fixed set of "game rules" that lose their relevance over time due to changes in conditions. In addition, this type of

system is too slow for situations that require the player or regulator to make instant decisions. Thus, the use of neural networks is a fairly powerful forecasting method that allows reproducing quite complex dependencies. Neural networks for market forecasting have the following advantages:

- ♦ Ease of use, as neural networks learn from examples. A neural network user selects representative data and then runs a learning algorithm that automatically comprehends the structure of the data.
- ♦ Neural networks are attractive even from an intuitive point of view, as they are based on a primitive biological model of nervous systems. In the future, the development of such neurobiological models may lead to the creation of truly thinking computers (Barrau and Douady, 2022).
- ♦ Prediction of financial time series is a necessary element of any investment activity, and regulators are not an exception – for example, when making a decision on currency intervention in the interbank foreign exchange market.

Therefore, for a qualitative forecast, it is necessary to use qualitatively prepared data, as well as neuropackages with greater functionality. A fairly large number of specialized software is designed to work with neural networks, some of which are more universal, while others are highly specialized.

Despite the separation of platforms by specializations, cross-platform solutions also exist and work successfully – in them, several specializations are implemented. Already today, there are many real-life examples of how AI-based products and platforms are transforming the financial ecosystem.

In terms of financial sector policy, recent events show that private and public prudential regulatory systems have not evolved in line with changes in financial innovation and should become more effective in the future. Financial innovation is one of the important sources of improving economic performance in the medium term, and, therefore, their development should be allowed, and encouraged (Sapir *et al.* 2018). However, new financial products often exploit gaps in existing prudential regulation, which can create problems. In addition, recent market turmoils has drawn

attention to the need for effective financial safety nets and fast-acting crisis resolution mechanisms. Under these conditions, the use of AI tools based on Big Data seems not only expedient, but critically necessary, due to the number of influencing factors and the complex relationships between them. According to Canadian SQL Power Group, “The financial world is on the edge of a technological revolution which will enforce AI and constant availability of machine readable data as the blueprint for sustainable business models to build a long term supervisory strategy ... Euromoney conducted a global survey called ‘Ghosts in the Machine’ on AI, risk and regulation in financial markets. They interviewed 424 senior executives from financial institutions and FinTech companies and asked them about their views on Artificial Intelligence in financial regulation. They learnt that many executives see AI as a tool that will help improve financial institutions’ risk management through more in-depth assessment of risk in companies and more incisive, comprehensive and informed credit-risk assessment. They also found that AI to be unbiased, prudent and offered an unprecedented depth and breadth of insight, and the ability to act on information and learning from its actions” (SQL Power Group, 2023).

## CONCLUSION

The implementation of the project to create a European integrated financial market and banking union has not yet been completed and there are many controversial issues in its functioning, including in relation to the activities of the ECB. Firstly, at the moment the ECB does not control such significant financial institutions as, for example, insurance companies, stock market operators, and exercises constant supervision only over the largest banks. Secondly, within the framework of the European Banking Union, the issue of the “shadow” banking sector and what role the ECB will play in resolving this issue has not yet been resolved. Nevertheless, the EU Banking Union is a new historically important stage in the development of European integration, within which there was a transfer of a significant part of the powers from the member states of the Eurozone (and the EU member states that signed the accession agreement) to the supranational level. The European Banking Union

has taken the legal regulation of banking supervision in the EU to a qualitatively new level, according to which the ECB has been given a significant amount of authority to carry out systematic work to improve the stability, transparency, and reliability of the EU financial system.

The EU countries have managed to implement an unprecedentedly ambitious integration project. The integration of the financial market is a necessary element for the full functioning of the economic and monetary union, but at the same time one of the most difficult in modern conditions. In particular, when creating a single market for services, the adoption of financial integration measures took place at different speeds and often acquired national specifics. The spread of the sovereign debt crisis in a number of EU countries made it necessary not only to create a new financial market management system, but also to reconsider the possibilities of financial regulators and approaches to the implementation of European norms at the national level.

The axiom is that the integration of the financial market largely depends on its regulation. At the same time, the regulation of the financial services market in the EU is carried out both at the supranational level, extending to all EU countries, and at the national level, taking place in accordance with the main regulatory legal acts of the European Union.

However, the centralized vulnerability of the European financial system has manifested itself in recent years in problems such as weak economic growth, weak fiscal regulatory mechanisms and unsustainable national banks. Patchwork national regulations and fragmented oversight did not in themselves cause the situation, but created fertile ground for increased financial instability.

The implementation of the EU rules, which differed in speed and nature, played a huge role in the nature of the crisis itself and in its spread. Back in 2011, the European rightly Commission made an official statement that regulatory divergence has become a source of official uncertainty and has led to reduced transparency and comparability.

In such conditions, artificial intelligence, based on Big Data and machine learning, is seen as the future of financial regulations, enabling comprehensive analysis of extremely complex data and situations

of uncertainty, thus allowing making more effective decisions in the process of EU financial markets integration.

## REFERENCES

- Acharya, V.V. and Steffen, S. 2016. Capital markets union in Europe: Why other unions must lead the way. *Swiss J. Econ. and Statistics*, 4: 319-329.
- Akimov, O., Karpa, M., Parkhomenko-Kutsevil, O., Kupriichuk, V. and Omarov, A. 2021. Entrepreneurship education of the formation of the e-commerce managers professional qualities. *Int. J. Entrepreneur.*, 25(7).
- Akimov, O., Troschinsky, V., Karpa, M., Ventsel, V. and Akimova, L. 2020. International experience of public administration in the area of national security. *J. Legal, Ethical and Regulatory Issues*, 23(3).
- Akimova, L., Akimov, O., Maksymenko, T., Hbur, Z. and Orlova, V. 2020. Adaptive management of entrepreneurship model as a component of enterprise resource planning. *Acad. of Entrepreneur. J.*, 26(3).
- Barbaglia, L. et al. 2021. Data Science Technologies in Economics and Finance: A Gentle Walk-In. In: Consoli, S., Reforgiato Recupero, D., Saisana, M. (eds) *Data Science for Economics and Finance*. Springer, Cham. [https://doi.org/10.1007/978-3-030-66891-4\\_1](https://doi.org/10.1007/978-3-030-66891-4_1)
- Barbu, T. and Strachinaru, A. 2016. Capital Markets Union: Opportunities and Impact on the European Financial Market. *Stud. in Busi. and Econ.*, 2: 140157.
- Barrau, T. and Douady, R. 2022. *Artificial Intelligence for Financial Markets: The Polymodel Approach*. Springer.
- Bickley, S., Chan, H. and Torgler, B. 2021. Artificial intelligence in the field of economics, CREMA Working Paper, No. 2021-28, Center for Research in Economics, Management and the Arts (CREMA), Zürich.
- Boldeanu, F. and Tache, I. 2015. The Financial System of the EU and the Capital Markets Union. *Int. J. Econ. and Busi. Administra.*, 3: 41-51.
- Bukowski, S. 2021. *Financial Integration in the European Monetary Union*. Routledge.
- Coourdacier, N. and Rey, H. 2013. Home Bias in Open Economy Financial Macroeconomics. *J. Econ. Lit.*, 51(1): 63-115.
- Danko, J. and Suchy, E. 2021. The Financial Integration in the European Capital Market Using a Clustering Approach on Financial Data. *Econ.*, 9(2): 89.
- Deshpande, A. and Kumar, M. 2018. *Artificial Intelligence for Big Data: Complete guide to automating Big Data solutions using Artificial Intelligence techniques*. Packt Publishing.
- Deyneha, I.O., Akimova, L.M. and Kratt, O.A. 2016. Regional features of marketing mix formation in rural green tourism. *Actual Prob. Econ.*, 9(183): 184-194.
- Ehigiamusoe, K.U. and Lean, H.H. 2018. "Do economic and financial integration stimulate economic growth? A

- critical survey." Economics Discussion Papers, No. 2018-51, Kiel Institute for the World Economy.
- European Commission 2021. European Financial Stability and Integration Review, Technical report, European Commission, Brussels.
- Financial Services Technology 2020 and Beyond: Embracing disruption. PwC: official website. [www.pwc.com/fstech2020](http://www.pwc.com/fstech2020)
- Gaman, P., Yarovoi, T., Shestakovska, T., Akimov, O. and Akimova, L. 2022. Institutional Platform to Ensure the Interaction between the Subjects of Combating Medical and Biological Emergencies Mechanism. *Econ. Aff.*, **67**(04s): 765-775.
- Gavkalova, N., Lola, Yu., Prokopovych, S., Akimov, O., Smalskys, V. and Akimova, L. 2022. Innovative Development of Renewable Energy During The Crisis Period and Its Impact on the Environment. *Virtual Econ.*, **5**(1): 65-77.
- Gnath, K. et al. 2019. Financial market integration in the EU: A practical inventory of benefits and hurdles in the Single Market. Bertelsmann Stiftung, pp. 1-20.
- Gupta, M., Alareeni, B., Akimova, L., Gupta, S.K. and Derhaliuk, M.O. 2021. Application of Fuzzy Logic Data Analysis Method for Business Development. *Lecture Notes in Networks and Systems*, 2021, 194 LNNS. 75–93.
- Juncker J.-Cl., Tusk D. et al. 2015. Completing Europe's Economic and Monetary Union. Brussels, European Commission.
- Kalyayev, A., Efimov, G., Motorny, V., Dzianyy, R. and Akimova, L. 2019. 'Global Security Governance: Conceptual Approaches and Practical Imperatives,' Proceedings of the 33rd International Business Information Management Association Conference, IBIMA 2019: Education Excellence and Innovation Management through Vision 2020, 10-11 April 2019, Spain, Granada, 4484-4495.
- Khomiuk, N., Akimova, L., Bezena, I., Lytvynchuk, I. and Petroye, O. 2020. Planning of socioeconomic development of the territories (experience of European Union). *Int. J. Management (IJM)*, **11**(4): 638-646.
- Klymenko, V.V., Akimova, L.M. and Korzh, M.V. 2016. Regional aspects of middle class development in Ukraine. *Actual Prob. of Econ.*, **4**(178): 178–188.
- Kryshtanovych, M., Akimova, L., Akimov, O., Kubiniy, N. and Marhitich, V. 2021. Modeling the process of forming the safety potential of engineering enterprises. *Int. J. Safety and Security Engineer.*, **11**(3): 223-230.
- Kryshtanovych, M., Akimova, L., Akimov, O., Parkhomenko-Kutsevil, O. and Omarov, A. 2022. Features of creative burnout among educational workers in public administration system. *Creativity Studies* [this link is disabled](#), **15**(1): 116–129.
- Kryshtanovych, M., Akimova, L., Shamrayeva, V., Karpa, M. and Akimov, O. 2022. Problems of European integration in the construction of EU security policy in the context of counter-terrorism. *Int. J. Safety and Security Engineer.*, **12**(4): 501-506.
- Lake, A., Maurin, L. and Minnella, E. 2022. Estimating financial integration in Europe: How to separate structural trends from cyclical fluctuations. European Investment Bank.
- Levytska, S., Pershko, L., Akimova, L., Akimov, O., Havrilenko, K. and Kucherovskii, O. 2022. A Risk-Oriented Approach in the System of Internal Auditing of the Subjects of Financial Monitoring. *Int. J. Appl. Econ., Finance and Accounting*, **14**(2): 194–206.
- Litvinova, I., Akimova, L., Ilchenko, H., Pomaza-Ponomarenko, A. and Yemets, O. 2020. The negative impact of corruption on the economic security of states. *Int. J. Manage. (IJM)*, **11**(5): 1058-1071.
- Marjosola, H. 2014. Regulating financial markets under uncertainty: the EU approach. *European Law Rev.*, **39**(3): 338-361.
- Moloney, N. 2016. Capital markets union: "Ever closer union" for the EU financial system. *European Law Rev.*, **3**: 307–337.
- Nardo, M., Ossola, E. and Papanagiotou, E. 2021. Financial integration in the EU28 equity markets: Measures and drivers. *J. Financial Markets*, 100633.
- Novak, A., Pravdyvets, O., Chorny, O., Sumbaieva, L., Akimova, L. and Akimov, O. 2022. Financial and Economic Security in the Field of Financial Markets at the Stage of European Integration. *Int. J. Professional Business Rev.*, **7**(5): e0835.
- Panasiuk, I., Akimova, L. and Kuznietsova, O. 2020. Modelling and Simulation of the Thermal Performance of Metal Framed Walls. *IEEE International Conference on Advanced Trends in Information Theory, ATIT 2019 – Proceedings*. 2019, pp. 309–312, 9030435.
- Panasiuk, O., Akimova, L., Kuznietsova, O. and Panasiuk, I. 2021. Virtual Laboratories for Engineering Education. *11<sup>th</sup> International Conference on Advanced Computer Information Technologies, ACIT 2021 – Proceedings*, pp. 637–641.
- PwC, 2015. Capital Markets Union: Integration of Capital Markets in the European Union. Report. <https://www.pwc.com/gx/en/banking-capital-markets/pdf/cmu-report-sept-2015.pdf>
- Raposo, I. and Lehmann, A. 2019. Equity finance and capital market integration in Europe. *Policy Contribution*, **3**: 1-13.
- Rey, H. 2015. Dilemma not Trilemma: The Global Financial Cycle and Monetary Policy Independence. NBER Working Paper Series 21162.
- Sapir, A., Véron, N. and Wolff, G. 2018. Making a reality of Europe's capital markets union. *Policy Contribution*, **7**: 1-12.
- SQL Power Group, 2023. Artificial Intelligence: The future of financial regulation. <https://sqlpower.ca/artificial-intelligence-financial-regulation/>

Stavárek, D., Řeprková, I. and Gajdošová, K. 2012. "Theory of financial integration and achievements in the European Union.", In *Financial integration in the European Union*, edited by R. Matoušek and D. Stavárek. London: Routledge Studies in European Economy.

Valiante, D. 2016. *Europe's Untapped Capital Market: Rethinking Financial Integration after the Crisis*. Center for European Policy Studies.