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**TRANSFORMATION OF THE FINANCIAL SECTOR
IN THE DIGITAL ERA:
EUROPEAN EXPERIENCE AND
UKRAINIAN REALITIES**

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The theoretical and methodological foundations for the study of digital finance and analysis of the current state of digital finance development in the EU and Ukraine are presented. The educational dimension of digital finance is examined. Strategic approaches to the development of digital finance and education are proposed.

For students of higher education institutions specializing in economics.

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Introduction

The digitalization of the financial sector is one of the key areas of contemporary economic development, particularly under conditions of high uncertainty, global crises, and rapid technological progress. As of early 2026, this topic remains highly relevant both globally and in Ukraine, where public policy actively supports digital transformation processes.

Global trends make digitalization an integral component of financial services. According to research findings, digital technologies (AI, blockchain, open banking, embedded finance) enhance operational efficiency, service personalization, and financial inclusion. In particular, in 2025, key trends included agentic AI, asset tokenization, stablecoins – whose value is pegged to stable assets (such as the US dollar, euro, gold, or a basket of assets) – and instant payments, all of which are transforming traditional banking. According to OECD estimates, a 10 % increase in financial sector digitalization adds, on average, 0,1 % to productivity growth across industries. That is digitalization contributes to productivity growth and reduces costs. Global Findex estimates indicate that around 1,3 billion adults have gained access to financial services through it. At the same time, it generates challenges related to cybersecurity, regulatory gaps, and ethical risks.

In Ukraine, the relevance of digitalization is further intensified by state strategies and the realities of wartime conditions. The government has extended the Strategy for Digital Development of the Public Financial Management System until 2030, originally approved in 2021 and updated in 2025, while the Financial Sector Development Strategy until 2025 emphasizes technological progress, financial accessibility, and cybersecurity. The banking sector has shown stable asset growth, surpassing 3 trillion UAH in 2024. This trend has been accompanied by the increasing adoption of cashless payments, neobanking services, and fintech solutions. Events like the Digital Banking Conference 2025 highlight the role of AI, Open Banking, and RegTech in financial transformation. Digitalization enables banks to

adapt to emerging challenges, enhance competitiveness, and support economic stability.

Research on this topic has significant theoretical and practical importance, as it contributes to the development of strategies aimed at strengthening the resilience of financial institutions, mitigating risks, and integrating Ukraine into the global digital financial ecosystem. Further progress requires focused attention on cybersecurity, regulation, and inclusion, which makes this topic highly relevant for both academic and applied research.

The purpose of this study is to conduct a comprehensive analysis of digitalization processes in the financial sector of the European Union and Ukraine, to further develop their theoretical and methodological foundations, and to assess the role of the educational dimension as a key instrument for the adaptation of society, businesses, and regulators to digital transformations in finance.

The fulfillment of these objectives will not only provide an objective overview of digital finance development but also substantiate practical measures to enhance the competitiveness and resilience of Ukraine's financial system under conditions of global digital transformation.

The object of the study is digital finance, while the subject of the study is the specific features of the development of fintech ecosystem and education in digital finance.

The research methods employed include comparative analysis, a systems approach, content analysis, and expert surveys, TOWS analysis, SWOT analysis, regressive analysis.

The proposed recommendations will contribute to accelerating the digital transformation of Ukraine's financial sector, increasing trust in digital financial services, reducing risks, and ensuring sustainable economic development amid global technological change.

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In preparing the manuscript, the author partially used artificial intelligence tools for text editing, translation of specialized terminology, grammar checking, and assistance in identifying information sources. All results, conclusions, and interpretations presented in the manuscript constitute the author's own contribution.

Chapter 1. Theoretical and methodological foundations of digital finance research

1.1. The concept and essence of digital finance

The phenomenon of digital finance is relatively new in modern economic science and is developing dynamically.

The concept of digital finance developed most actively in the academic literature, particularly during the period from 2018 to 2025, reflecting the integration of new technologies with traditional financial services. The clarification of the essence of digital finance was based on the analysis of definitions presented in scientific publications from a wide range of sources, highlighting specific emphases in certain areas, such as technological support, inclusion, sustainable development, and systemic transformation. The essence of digital finance lies in its role as a force that uses digital technologies to reduce costs, mitigate information asymmetry, enhance financial inclusion, and promote innovation while simultaneously introducing new risks and regulatory challenges.

Digital finance represents a new paradigm for the functioning of the financial system, formed under the influence of information and communication technologies (ICT), process automation, big data analytics, artificial intelligence, blockchain technologies, and other technological innovations.

The generic concept of this paradigm is the concept of digital finance.

Early definitions of the essence of digital finance in 2018 – 2020 focused on technological support and inclusion.

At this stage, digital finance emphasized the expansion of financial services through digital channels, highlighting their accessibility for low-income population groups.

Ozili P. K. [1] defines digital finance as «financial services delivered through mobile phones, personal computers, the Internet, or cards linked to a reliable digital payment system». The essence of digital finance lies in its potential to promote financial inclusion by reducing transaction costs and

expanding outreach, particularly in developing countries, while simultaneously stabilizing financial systems through the reduction of information asymmetry.

Pazarbasioglu C. et al. [2] describe digital finance as «financial services that rely on digital technologies for their delivery and use by consumers». Their key characteristics are scalability and efficiency, which ensure broader access to financial services in low-income regions, although they also create cybersecurity risks.

These definitions emphasize the essence of digital finance as a tool for the democratization of finance; however, they remain technology-oriented and do not take into account broader systemic implications.

During 2021 – 2023, scholars increasingly focused on the integration of finance with emerging technologies such as artificial intelligence, blockchain, and big data. Thus, researchers described the essence of digital finance through a hybrid model that combines innovation with traditional finance.

Babarinde G. F. et al. [3] define digital finance as «a type of financial service that uses digital products such as personal computers, the Internet, mobile phones, cards, and related technologies». This increases the accessibility of financial services and reduces their costs, making it possible to use niche services such as peer-to-peer (P2P) lending.

Osterrieder J. [4] conceptualizes digital finance as «the rapid development of new technologies, products, and business models that has occurred in recent years». Here, the essence shifts toward innovation and the expansion of application boundaries, emphasizing the role of blockchain in reducing the number of intermediaries.

Thus, the essence of digital finance during this period is defined as a transformational ecosystem rather than merely a delivery mechanism, with an emphasis on risks such as data privacy.

Definitions of digital finance over the last three years have increasingly emphasized sustainable development, inclusiveness, and systemic changes in the financial system. Contemporary studies integrate aspects of sustainability and regulation, viewing digital finance as a paradigm for resilient and inclusive systems.

Hughes L., Seddon J. J. M., and Dwivedi Y. K. [5] understand digital finance as «revolutionary changes in financial technologies», focusing on challenges such as regulation and inclusion. The authors examine digital

finance through the concepts of FinTech and the digital transformation of the financial sector as a process of transforming traditional financial services and business models under the influence of digital technologies, including big data, artificial intelligence, mobile platforms, cloud technologies, automation, blockchain, and digital customer interaction channels.

The authors emphasize that the digitalization of finance manifests itself through the transition from traditional banking models to digital platforms; the development of FinTech companies and digital banks; the use of mobile financial services and contactless payments; the personalization of financial products based on data; and the integration of new technologies with financial infrastructure.

Thus, according to Hughes L., Seddon J. J. M., and Dwivedi Y. K. [5], digital finance represents a field of financial activity that emerges as a result of the digital transformation of the financial sector and is based on the use of digital technologies for the creation, delivery, and management of financial services, products, and business models.

At the same time, it should be noted that the primary focus of the authors' study is the analysis of the challenges of digital transformation in the financial sector using Interpretive Structural Modeling (ISM) and Analytic Hierarchy Process methods (AHP).

Lastauskaite A. and Krusinskas R. in their article [6], define digital finance as «a new financial model that integrates financial activities with new technologies (artificial intelligence, blockchain, etc.)» to improve productivity, which was demonstrated through mixed-method research on European firms.

Mo Y. et al. [7] define digital finance as «a new paradigm of financial services used to achieve broad coverage, low cost, and sustainable development». Accordingly, Mo Y. et al. argue that combining digital finance with ESG principles is a pathway toward sustainable development and long-term financial performance.

Gulati T. et al. [8] define digital finance as «financial technologies, digital payment systems, and digital financial products, including digital derivatives and digital securities», that is, as a comprehensive digital ecosystem analyzed bibliometrically for trends.

Thus, the review of scientific sources demonstrates that the digital finance paradigm has recently shifted toward efficiency, accessibility, and

sustainability of financial services based on digital technological infrastructure. The analysis of scientific approaches indicates an evolution in the interpretation of digital finance: from understanding it as a tool for providing and delivering financial services [1] to viewing it as a driver of transformational changes in the financial system [5] and a component of sustainable development and ESG-oriented governance [7].

Despite differences in approaches, most researchers emphasize such key characteristics of digital finance as reducing transaction costs, expanding financial inclusion, and decreasing information asymmetry among financial market participants.

It should also be noted that the practical significance of digital finance varies depending on a country's level of economic development. In developed economies, implementation of digital finance is mainly aimed at improving the efficiency of financial processes, supporting sustainable development, and implementing initiatives related to the green transformation of the economy. In contrast, in developing countries, particularly Ukraine, digital finance acquires special significance as a tool for enhancing the resilience, adaptability, and continuity of the financial system under conditions of crises and high uncertainty.

In this study, digital finance is understood as the set of financial services, products, and processes that are delivered, managed, and distributed through digital technologies, platforms, and channels. Unlike traditional finance, which relies on physical infrastructure (bank branches, paper documents, and face-to-face interactions), digital finance is characterized by the use of the Internet, mobile devices, artificial intelligence, big data, blockchain, cloud computing, and other innovative technologies to ensure the accessibility, speed, personalization, and efficiency of financial transactions.

Thus, digital finance encompasses a wide range of digital products, channels, and services that provide flexibility, personalization, and accessibility of financial solutions.

The functionality of digital finance lies in the fundamental transformation of financial intermediation and interactions among market participants. It includes the following key components:

FinTech (financial technologies) – technological innovations that optimize traditional financial services (neobanks, mobile payments, P2P lending);

RegTech (regulatory technologies) – solutions for automating compliance and regulatory supervision;

InsurTech, WealthTech, PayTech – specialized segments of digitalization in insurance, asset management, and payments;

DeFi (decentralized finance) – blockchain-based decentralized financial protocols that eliminate traditional intermediaries;

Open Banking and Embedded Finance – integration of financial services into non-financial platforms (e-commerce, social networks, super apps);

crowdfunding and crowdfinancing;

cryptocurrencies and tokenized assets;

robo-advisors – automated financial advisory services.

The main characteristics of digital finance include:

accessibility and inclusiveness – expanding access to financial services for previously underserved population groups;

personalization – the use of algorithms and ai to provide individualized offerings;

technological intensity – application of fintech, big data, ai, blockchain, mobile applications, apis, and other technologies;

operational efficiency – reduction of transaction costs and processing time;

innovation and flexibility – rapid introduction of new products and adaptation to change;

risk orientation – the need for new approaches to cybersecurity and data protection due to emerging risks (cyber threats, loss of data privacy, system failures).

Therefore, digital finance is not merely a tool but a new paradigm of financial activity that changes interactions among market participants (banks, customers, regulators), transforms financial infrastructure, promotes financial inclusion, and stimulates innovative economic development.

In the methodological context, the theory of digital finance is considered the result of the integration of financial theory (intermediation theory,

information asymmetry theory, and portfolio theory) with the theory of the digital economy, platform markets, and innovative technologies (Table 1.1). This reflects the transition from a linear model of financial intermediation to an ecosystem-based model dominated by network effects, data as an asset, and platform logic.

Table 1.1

Methodological foundations of digital finance theory formation

Theory	Authors	Key provisions
Theory of financial innovation	T. Gurley, J. Shaw [9], J. Finkelstein [10]	financial innovation is considered as a process of creating new financial instruments, institutions, and technologies. In the context of digital finance, innovations include the emergence of FinTech companies, digital platforms, and decentralized financial systems
Theory of financial inclusion	World Bank [11], G20 [12], OECD [13]	Focus is on ensuring access to financial services for broad segments of the population, including low-income groups, rural communities, and small and medium-sized enterprises. Digital solutions (mobile wallets, neobanks) significantly enhance financial inclusion
Theory of information asymmetry	G. Akerlof [14], J. Stiglitz [15], M. Spence [16]	In digital finance, the use of big data analytics and open banking helps reduce information asymmetry between consumers and financial institutions
Transaction cost theory	R. Coase [17], O. Williamson [18]	Digital technologies reduce the costs of searching, contracting, and monitoring financial transactions. Smart contracts, blockchain, and digital payment services automate execution of transactions
Behavioral finance	R. Shiller [19], D. Kahneman [20], R. Thaler [21]	Digital platforms can both mitigate and exploit users' behavioral biases through UX design, targeting, and AI-based personalized financial advice
Platform and sharing economy Theory	G. Parker, M. Van Alstyne [22], D. Tapscott [23]	FinTech companies operate as digital platforms that connect consumers and providers of financial services, creating network effects and reducing market entry barriers
Digital transformation concept	McKinsey [24], Accenture [25], Deloitte [26]	Digital transformation of financial institutions requires changes in business models, digital infrastructure, organizational culture, and customer experience
Digital risk management theory	R. Pal [27], S. Musman [28], W. A. St-Hilaire [29]	Digital finance is associated with new risks, including cyber risks, regulatory risks, and privacy risks. As a result, the importance of RegTech, cyber insurance, and information security management systems increases

The main theoretical foundations of digital finance were formed in the 2010s – 2020s and continue to evolve.

One of the main theories is the theory of financial intermediation [30; 31], which explains the role of banks as delegated monitors and reducers of information asymmetry. In the context of digital finance, this theory is being transformed: FinTech platforms and DeFi protocols partially or completely replace traditional intermediaries through smart contracts and transparent data [32]. A key author is L. Kong, who investigates how blockchain reduces information asymmetry and changes competition in financial markets.

The concept of the platform economy in [22; 23] is central to understanding digital finance. Two-sided platforms, such as Ant Group, Revolut, and PayPal, generate network effects, where the value of a service increases with the number of users. Authors G. Parker and M. Van Alstyne [22] emphasize the transition from linear value chains to ecosystems in which data become a key asset.

The long-tail theory [33] explains how digital platforms make it possible to offer personalized financial products to niche segments that were previously inaccessible because of high transaction costs. This is particularly relevant for P2P lending and microfinance.

In the field of decentralized finance (DeFi), a key concept is N. N. Taleb's antifragility, which is applied to protocols that benefit from volatility and shocks [34]. C. Harvey. A. Ramachandran and B. Santoro systematized DeFi as a new blockchain-based infrastructure of finance [35].

A significant contribution was made by researchers of regulatory aspects. D. Zetsche, R. Buckley, and D. Arner, in works [36; 37], developed the concept of FinTech Regulation 3.0, emphasizing the principles of technological neutrality, proportionality, and regulatory sandboxes.

In the context of financial inclusion, the works of the World Bank (Global Findex) and A. Demirgüç-Kunt, L. Klapper are of key importance, empirically demonstrating that mobile money and digital platforms significantly expand access to finance in developing countries [38].

Contemporary authors such as J. Frost, L. Gambacorta, and H. S. Shin [39] study the impact of BigTech (Google, Amazon, Alibaba) on financial stability, proposing the concept of embedded finance – financial services integrated into non-financial platforms.

Thus, the theoretical foundation of digital finance is interdisciplinary, combining classical financial theory with theories of platforms, networks, and

innovation. Key authors – L. Cong [32], C. Harvey [35], G. Parker and Van Alstyne [22], D. Zetsche [36; 37], and others – laid the foundation for understanding digital finance as a new paradigm that radically changes the accessibility, efficiency, and structure of financial markets. These concepts provide a reliable basis for analyzing the practical implementation of digital finance in the EU and Ukraine.

The financial system performs its classical functions regardless of its form (traditional or digital): allocation, payments, investment (accumulation and allocation of resources), control, and incentive functions (price discovery). However, digital transformation fundamentally changes the ways these functions are implemented, making them faster, cheaper, more accessible, and often decentralized (Table 1.2).

Table 1.2

Key functions of digital finance (FinTech, DeFi, Mobile Payments, Embedded Finance, etc.)

Function	Functional content, instrumental forms
Payment	Instant, cheap and global transfers (mobile wallets, P2P payments, stablecoins, CBDC)
Accumulation and distribution of resources	Crowdfunding, P2P lending, DeFi protocols (borrowing/lending without intermediaries)
Investment and asset management	Robo-advisors, tokenized assets, yield farming in DeFi, personalized investments based on AI
Price discovery and risk management	Transparent data on the blockchain, smart contracts, algorithmic pricing
Financial inclusion	Providing services to the «long tail» (underserved segments) without a physical presence
Embedded finance	Integration of payments/credits into non-financial platforms (e.g., installment purchases in e-commerce)

A comparative table of digital and traditional finance is presented in Table 1.3.

Table 1.3

Comparative characteristics of digital and traditional finance

Aspect	Traditional finance (banks, exchanges, insurance companies)	Digital finance (FinTech, DeFi, BigTech, mobile platforms)	Advantages of digital finance	Risks of digital finance
Intermediation	Mandatory (banks as delegated monitors)	Often absent or automated (smart contracts)	Lower costs, high speed	Higher risk (lack of guarantees)
Transaction speed	Days – weeks (transfers, loans)	Seconds – minutes (instant payments, RT1, SEPA Instant)	Significantly higher	Dependence on the internet and technology
Cost of services	High (commissions, margin)	Much lower (often 0 – 0,5%)	Accessibility	Volatility in DeFi
Availability (inclusion)	Limited (requires account, branch, credit history)	Global accessibility with smartphone and internet)	High (especially in developing countries)	Digital divide, fraud
Transparency	Low (internal processes closed)	High (blockchain, open source)	Trust through verification	Data overload
Personalization	Limited (standard products)	High (AI, big data, behavioral models)	Accurate risk pricing	Data privacy issues
Resilience to shocks	Depends on regulation and reserves	Antifragility in DeFi (benefits from volatility)	Growth in crises	Systemic risks (flash crashes)
Regulation and protection	Strict (SSM, AMLA, deposit guarantees)	Easier/none (DeFi), sandbox in many countries	Innovation is faster	Less consumer protection
Scalability	Limited by physical infrastructure	Almost unlimited (cloud technologies)	Global reach	Dependence on infrastructure

The traditional financial system, represented by banks, stock exchanges, and insurance companies, is characterized by a high level of reliability due to clear regulation, government supervision, and legal protection of clients. Its advantages include established trust, developed settlement infrastructure, effective risk management mechanisms, and a wide range of financial services. At the same time, traditional finance often faces problems related to the slow implementation of innovations, significant

infrastructure maintenance costs, and centralization risks that may lead to systemic failures and loss of flexibility.

Digital finance, which encompasses FinTech, DeFi, BigTech, and mobile financial platforms, ensures the rapid implementation of innovations, high accessibility of services, process automation, and the use of modern data analytics technologies and artificial intelligence. It promotes financial inclusion, cost reduction, and the creation of new models for delivering financial services. At the same time, the digital financial ecosystem is accompanied by a number of risks, including insufficient regulatory certainty, cyber threats, technical failures, liquidity risks of decentralized platforms, as well as issues related to personal data protection and the transparency of algorithmic decisions.

Therefore, traditional and digital finance have their own advantages and risks, while the modern development of the financial system is increasingly based on combining the reliability of traditional institutions with the innovative capabilities of digital technologies.

A review of academic publications from the last three years indicates that the prevailing view among researchers regarding digital finance is that of a complementary effect. Digital finance does not replace traditional finance but complements it by addressing its weaknesses, such as high costs, low financial inclusion, and slow processes. Traditional banks continue to provide stability, regulatory protection, and large-scale financing.

At the same time, the paradigm of the financial system is undergoing transformation: it is moving from a hierarchical (centralized) structure to a network and platform model in which data become the key asset and network effects become the main source of value. Both in the EU and in Ukraine, digital finance increases financial inclusion, for example, through mobile payments and BNPL. In contrast, traditional institutions remain dominant in the corporate sector and deposit markets due to guarantees and regulation (SSM, AMLA).

Thus, the essence of digital finance lies not only in the technological replacement of traditional processes but also in the qualitative transformation of the entire paradigm of the financial system, making it more resilient, inclusive, and consumer-oriented, while at the same time requiring new approaches to regulation, education, and risk management.

The clarification of this concept creates a theoretical basis for the further analysis of the state of digital finance in the EU and Ukraine, as well as for assessing the role of the educational dimension in adapting to these changes.

1.2. Theoretical, methodological foundations and analysis of financial digitalization

Financial digitalization is, first and foremost, the transformation of financial services, instruments, infrastructure, and behavioral models based on digital technologies. The modern understanding of this phenomenon requires the application of an interdisciplinary theoretical framework that integrates economic, sociological, managerial, and technological approaches. The key theories and concepts that form the basis for analyzing the digitalization processes of the financial sector are presented in Table 1.4.

Table 1.4

Synthesis of theoretical approaches to the analysis of financial digitalization

Theoretical approach	Main authors/theories	Key provisions	Application in financial digitalization
1	2	3	4
Institutional approach	D. North [40], O. Williamson [41]	Institutions form rules and restrictions on market behavior	Regulation of digital finance, financial innovation within the framework of norms and rules
Theory of technological determinism	M. McLuhan [42], A. Toffler [43]	Technologies are the driver of changes in society and the economy	The impact of IT, AI, blockchain on financial infrastructure
Behavioral Finance	R. Thaler [21], D. Kahneman [20]	People make financial decisions irrationally, especially in the digital environment	UX of digital platforms, mobile applications, trust in FinTech
Theory of Innovation	E. Rogers [44]	Innovations spread in society through certain stages	Adoption of FinTech, speed of digitalization of banks

Table 1.4 (the end)

1	2	3	4
Service-oriented logic	Vargo S. L., Lusch R. [45]	The consumer co-creates value, especially in the digital environment	Customer interaction with digital banks, product customization
Theory of the financial ecosystem	Interdisciplinary	Finance is the interaction of players within the digital ecosystem	Neobanks, platforms, superapps, interaction of FinTech and the traditional sector
Theory of Digital Transformation	Davenport T. [46], Brynjolfsson E., McAfee A. [47]	A complex process of change in organizations through the introduction of digital technologies	Restructuring of financial institutions, digital maturity, change in management models

The institutional approach is based on the idea that digitalization fundamentally transforms financial institutions by changing formal rules, procedures, and the roles of market participants. The founders of this approach are D. North [40], the author of the theory of institutions and institutional change, and O. Williamson [41], the author of transaction cost theory and new institutional economics. In the context of digital finance, this approach makes it possible to analyze the role of regulators in shaping the digital environment, as well as the evolution of formal rules (laws, MiCA and PSD2 regulations) and informal norms (trust, ethical standards) governing financial relations in the digital space.

The theory of technological determinism argues that technology is the primary driver of social and economic change. The key authors are M. McLuhan [42], the author of the concept of «the medium as an extension of man», and A. Toffler [43], the author of the concept of the «Third Wave». The application of this theory makes it possible to study the impact of blockchain, artificial intelligence, and big data on the structure of the financial system, particularly the reduction of the role of traditional banks as intermediaries and the emergence of decentralized protocols.

Behavioral finance theory focuses on how digital channels change the behavior of consumers of financial services. The founders of this field are D. Kahneman [20] and R. Thaler [21]. The behavioral finance approach is applied to analyze user experiences in FinTech products, the psychology of

financial decision-making in mobile applications, and the influence of cognitive biases on interaction with digital platforms.

E. Rogers' theory of diffusion of innovations [44] explains the process and speed of adoption of new technologies in society. It makes it possible to analyze the pace at which digital banks, mobile payments, and other FinTech innovations are adopted, as well as to compare countries (for example, the EU and Ukraine) according to the categories of innovators, early adopters, and conservatives.

The service-dominant logic approach, developed by S. Vargo and R. Lusch [45], emphasizes that value is co-created through interaction with the user. In digital finance, this is reflected in the role of the consumer as a co-creator of the product and in the analysis of platforms (neobanks, digital wallets) as service ecosystems where personalization and continuous interaction dominate.

Financial ecosystem theory considers digital finance as a complex network of interdependent actors, including banks, FinTech companies, regulators, platforms, and customers. This approach is effective for analyzing the development of digital ecosystems (for example, Monobank in Ukraine or Revolut in Europe) and for assessing synergies and risks within the financial-technological environment.

Digital transformation as an interdisciplinary theory integrates managerial, information technology, sociological, and economic perspectives. It focuses on organizational changes in financial institutions, digital maturity models (for example, CMMI adapted for finance), and the transformation of business models from product-oriented to platform-oriented.

Thus, the modern digital transformation of the financial sector requires a comprehensive theoretical analysis that integrates institutional economics, technological and behavioral approaches, innovation theory, as well as ecosystem and service logic concepts. Such an integrated approach makes it possible to adequately assess development trends, associated risks, and opportunities of digital finance in both the European Union and Ukraine, contributing to the development of effective adaptation and regulatory strategies.

The analysis of financial digitalization (digital finance, FinTech, digital transformation of the financial sector) is an interdisciplinary process that

combines quantitative, qualitative, and mixed research methods to assess the impact of technologies on financial services, efficiency, risks, inclusiveness, and regulation. These approaches do not only make it possible to describe the current state of development but also provide opportunities for forecasting trends, identifying research gaps, and formulating policy and managerial recommendations. The main methodological approaches are discussed further, with a focus on the period of 2020 – 2025, based on the systematization of academic literature and the inclusion of examples of recent studies, empirical tools, and integrative methods reflecting the evolution of research approaches in the context of Industry 4.0, artificial intelligence, and blockchain technologies.

Within the systems approach, digitalization is considered a complex process that simultaneously affects finance, risk management, organizational structure, and stakeholder interaction.

Bibliometric analysis serves as a methodological tool for studying the structure and dynamics of the scientific field of financial digitalization. It makes it possible to evaluate scientific productivity, identify thematic clusters, detect publication trends, collaboration patterns, and key research directions. This type of analysis often uses software tools such as VOSviewer, Biblioshiny, or CiteSpace to visualize data from databases including Scopus, Web of Science, and Google Scholar. The bibliometric approach allows researchers to identify trends in FinTech studies as well as the growing importance of blockchain and artificial intelligence topics.

For example, Z. Zou et al. [48] conducted a bibliometric and content analysis of the literature on digital finance and FinTech, identifying thematic streams such as technology applications, financial services, and regulation based on more than 1000 scientific articles.

The study by Bhatt A. et al. [49] focuses on a bibliometric analysis of 288 articles on the digital transformation of financial services, with a particular emphasis on the impact of the COVID-19 pandemic.

The work of A. Gulati and S. Singh [50] provides an analysis of trends in the digitalization of financial services, including citation analysis and thematic mapping.

In the publication by I. A. Bajwa et al. [51], FinTech research is systematized through bibliometric analysis, highlighting key research streams

such as Bitcoin, blockchain, and regulation, while also identifying research gaps related to developing countries.

A systematic literature review (SLR) is used to synthesize existing knowledge, identify research gaps, and formulate hypotheses. This method involves a clearly defined search protocol (PRISMA), the selection of articles based on specific criteria, and thematic and content analysis. The SLR approach is particularly useful for assessing the impact of digitalization on financial inclusion and productivity.

The study by S. Ratna et al. [52] presents a systematic review of financial system transformation in the digital era, analyzing more than 150 sources with a focus on regulatory challenges.

The work of F. Tavares and L. Almeida [53] offers a systematic literature review on rethinking financial literacy in the context of digitalization, emphasizing behavioral aspects and educational strategies based on more than 20 sources published between 2020 and 2025.

The authors of the study «How does digitalization Shapes Business Financial Performance» [54], based on the analysis of more than 30 articles published between 2014 and 2024 and using the contemporary concept of adaptive enterprise architecture, emphasize organizational adaptability and the ability to respond rapidly to changes in a dynamic environment. The study examines the impact of digitalization on such financial indicators as ROA and ROI.

The research of Segovia-Vargas M.-J., Camacho-Miñano M.-M., Pascual-Ezama D. [55] reflects contemporary trends in the digital transformation of the economy and corporate financial performance through the integration of data from the Orbis database and enterprise surveys.

Methodological support for the analysis of financial digitalization also includes mixed-methods research, which combines quantitative and qualitative data for comprehensive analysis, for example through interviews, surveys, and statistical modeling. This approach makes it possible to consider both objective metrics (such as the FinTech penetration rate) and subjective factors (such as risk perception).

For example, D. Hughes, N. Rana and Y. Dwivedi [56] use a mixed approach that includes Interpretive Structural Modeling (ISM) for structuring complex systems through identifying hierarchical relationships among

digitalization factors and determining causal links, as well as the Analytic Hierarchy Process (AHP) for prioritizing digitalization factors and selecting optimal managerial decisions.

Similarly, A. Lastauskaite and R. Krusinskas [57] apply a mixed approach to examine the impact of digitalization investments on the financial performance of European companies, using interpretive structural modeling to establish the hierarchy of digitalization factors.

A. Lastauskaite [57] applies a methodological framework to investigate inequalities in digital financial inclusion by combining public data, statistics, and qualitative interviews.

Econometric and statistical models are also an important component of methodological support for analyzing financial digitalization and are used for empirical hypothesis testing, such as assessing the impact of digitalization on financial performance. These include:

- econometric methods for quantitative assessment the impact of digitalization on financial results, productivity, efficiency, or risks (regression analysis, correlation analysis, panel data analysis);

- comparative analysis, which makes it possible to compare companies, sectors, or countries with different levels of digital maturity;

- indicator- and index-based approaches for measuring the level of digitalization (digital maturity, digital intensity) using aggregated metrics;

- content analysis and secondary data analysis (financial statements, strategic documents, non-financial reports, ESG reporting, digital platform data);

- the structural-functional approach, which examines how digital technologies transform managerial structures, business models, and financial mechanisms;

- non-parametric tests.

M. Yavuz, H. Tatli and G. Bozkurt [58] apply a two-stage method: text analysis of annual reports to identify digitalization-related keywords, followed by panel data analysis of the impact on the Return on Digitalization (ROD) indicator, which evaluates the economic and strategic effectiveness of investments in digital technologies across five sectors. The study confirms that the financial effect of digitalization is complex and long-term, depending

on the level of digital maturity and the strategic alignment of transformation decisions.

The study examines the impact of digital transformation on corporate financial performance in the context of changing business models, operational efficiency, and risk management. The authors analyze how the implementation of digital technologies (big data, artificial intelligence, cloud services, process automation) affects profitability, cost structures, productivity, and financial stability of organizations. Particular attention is paid to evaluating returns on digital investments through such indicators as ROI and Return on Digitalization (ROD), as well as the role of intangible effects – flexibility, decision-making speed, and enhanced transparency. The study is based on empirical data and contemporary analytical methods and confirms that the financial effect of digitalization is complex and long-term, depending on the level of digital maturity and the strategic alignment of transformation decisions.

ROD shows the added value or benefits that an organization obtains from digital transformation relative to its costs. Unlike traditional ROI, ROD does not only take into account direct financial effects but also intangible and delayed benefits (flexibility, speed, data quality, resilience, customer experience) (Table 1.5). Direct economic effects arise from increased revenues, reduced operating costs, higher productivity, and shorter time-to-market. Operational effects are achieved through process automation, error reduction, improved data quality, and business scalability. Social effects result from increased digital maturity, improved risk management, enhanced customer loyalty, and compliance with regulatory requirements (GDPR, DORA, etc.).

Table 1.5

The differences between return on digitalization and ROI

Indicator	ROI	Return on Digitalization
Focus	Financial	Financial and non-financial
Horizon	Short-term	Medium- and long-term
Type of benefits	Monetary	Monetary and intangible
Application	Investment projects	Digital transformation

Return on Digitalization is calculated using the formula:

$$\text{ROD} = (\text{Total Benefits from Digitalization} - \text{Digitalization Costs}) / \text{Digitalization Costs}$$

However, in practice, an integral index is often used instead of a single formula.

K. Valaskova, M. Nagy, and D. Juracka [59], conduct correspondence analysis and the non-parametric Kruskal – Wallis test using ORBIS data and survey results to assess the digital ecosystem. Correspondence analysis, as a multidimensional statistical method, is intended for studying relationships between categorical variables, usually presented in the form of contingency tables. This makes it possible to identify hidden structures in relationships between variables; visualize similarities and differences among groups of objects; and reduce data dimensionality. As a result, the method produces two-dimensional or multidimensional maps that reflect the relative positions of categories and their associations. The non-parametric Kruskal–Wallis test is a statistical method used to test the hypothesis of equality of medians (or overall distributions) across three or more independent samples. This method serves as a non-parametric analogue of one-way analysis of variance (ANOVA) and is applied when data do not follow a normal distribution, sample sizes are small, or assumptions of normality or homogeneity of variances are violated.

K. Valaskova, M. Nagy and D. Juracka [59] note that digital transformation itself does not guarantee improved financial performance. The authors empirically demonstrate that the implementation of digital technologies positively affects the financial performance of companies only when there is strategic alignment between digital initiatives and the overall business strategy. Companies in which digital tools are integrated into the corporate strategy demonstrate higher profitability, better operational efficiency indicators, and more stable financial growth. However, the results show that the financial benefits of digitalization vary significantly depending on the level of a company's digital maturity, the quality of change management, industry specifics, and company size. The study confirms that managerial and organizational factors (digital skills of managers, strategic

planning capabilities, corporate culture) have an impact on financial performance that is no less significant than the digital investments themselves. The authors emphasize that the financial effect of digitalization manifests itself with a delay, and in the short term it may be accompanied by increased costs and financial burden.

N. Gafsi et al. [60] use econometric models to analyze the impact of artificial intelligence and big data on financial indicators, using panel data from G20 countries.

Case methods and qualitative analysis focus on an in-depth study of specific examples (for instance, the implementation of neobanking in Ukraine or the EU). They include thematic analysis, content analysis, and case study methodology. For example, the author T. Tabisheva [61] conducted a thematic analysis of 20 sources to study tools such as ERP and RPA in financial planning. W. St-Hilaire [62] applied case study methodology to digital risk management in the public and private sectors.

Birner R. et al. [63] performed a qualitative analysis of the role of FinTech platforms as service ecosystems, drawing on examples from Asia and Europe. Integrative and interdisciplinary approaches combine the above-mentioned methods with frameworks such as Adaptive Enterprise Architecture or NIST for assessing digital maturity. Adaptive Enterprise Architecture considers enterprise architecture as a living system rather than a static model that continuously evolves in response to digital transformation, technological innovation, changes in business strategy, and regulatory and socio-economic challenges. These approaches make it possible to analyze interrelationships among technologies, regulation, and behavior.

D. Zetsche et al. [36; 37] applied an integrative approach to decoding FinTech, digitalization, and financial services, proposing future directions. Arner D.W. et al. [64] argue that the digital transformation of the financial sector requires a rethinking of the traditional financial regulation system. RegTech replaces traditional regulation, which uses digital technologies for real-time monitoring, reporting, compliance, and risk management based on data integration and digital identity. R. Pal et al. [65] developed a theoretical classification of complexity in risk management within digital systems, including insurance models. S. Musman and A. Turner [28] applied game theory to quantitative risk management in digital environments.

Thus, methodological approaches to the analysis of financial digitalization have evolved from descriptive reviews to complex empirical models that integrate AI, big data, and mixed methods. Researchers of OECD [66] emphasize that methods are not universal and must be adapted to specific contexts, especially to differences in regulatory environments between the EU and Ukraine. Further development of research should focus on real-time data, ethical aspects of AI, and global comparisons in order to increase practical value. These approaches ensure scientific rigor and provide practical recommendations for stakeholders in the financial sector.

The conducted analysis of theoretical foundations, main development areas, and current trends in the digitalization of the financial sphere indicates its significant potential in increasing the efficiency of financial services, expanding financial inclusion, reducing transaction costs, and stimulating innovation. At the same time, the rapid implementation of digital technologies in financial activities is not only accompanied by new opportunities but also by a number of contradictions and risks that may limit the positive effects of digitalization or generate new threats to financial stability. Therefore, an important stage of research is the identification and analysis of the main contradictions of financial digitalization that arise between innovation and regulation, efficiency and cost reduction versus increased financial risks, competition and cooperation, financial inclusion and the digital divide, strategic adaptation and organizational barriers, data openness and privacy protection, increased accessibility of financial services and heightened cyber risks, as well as between process automation and the need to preserve human control over financial decisions.

That is, on the one hand, digitalization contributes to increasing the efficiency of financial and economic processes, expanding access to resources and services, developing innovative business models, and promoting financial inclusion. On the other hand, it is accompanied by risks of digital inequality, concentration of market power, cyber threats, increased information asymmetry, and the emergence of new forms of systemic risks.

The transformation of financial relations under the influence of digital technologies necessitates a reconsideration of traditional approaches to the functioning of the financial system, the role of financial intermediaries, mechanisms of value creation, and the provision of financial stability. Under

such conditions, the generation of theoretical foundations of financial digitalization becomes particularly relevant, forming the conceptual basis for the transformation of financial systems through the integration of modern technologies in order to respond to contemporary economic challenges.

The generalization of scientific sources made it possible to formulate the key principles of the theory of financial sector digitalization, which determine its structure and application in the context of these challenges.

Principle 1. Digitalization is a driver of economic efficiency and resilience.

Economic instability caused by recession, inflation, and geopolitical instability requires rapid response, which can be ensured through the use of AI models for forecasting and managing financial flows. Digital technologies increase the efficiency of financial systems through process automation, reduction of operating costs, and optimization of resource allocation. Globalization requires the integration of cross-border payment systems, where blockchain and central bank digital currencies (CBDCs) provide speed and transparency. For example, in the United Kingdom, the use of artificial intelligence, machine learning, big data, and automated analytics for identifying risks and anomalies in financial data for the automation of tax audits ensures higher accuracy, timeliness, transparency, and reduced costs in monitoring taxpayers' tax obligations.

Principle 2. Digitalization of the financial sphere ensures transparency of financial operations through the use of blockchain technologies, open data, and standards such as open banking.

This increases the accountability of the financial system as a basis for trust in it. Corruption and fraud in financial systems, especially in countries with low levels of institutional trust, require transparent mechanisms. Geopolitical crises highlight the need for secure and open financial systems for cross-border operations. In the EU, Payment Services Directive 2 (PSD2) allows customers to share data with FinTech companies, increasing transparency and competition.

Principle 3. Digital technologies facilitate access to financial services for economically vulnerable groups through the development of mobile banking, microfinance, and digital wallets.

The digitalization of the financial sector opens new opportunities for economically vulnerable groups and significantly expands access to financial services where traditional banks have historically been inaccessible or ineffective. Mobile banking, microfinance, and digital wallets have become key instruments of financial inclusion, enabling people without bank accounts to make payments, obtain loans, save money, and participate in the economy using only a smartphone and the Internet.

However, economic and digital inequality remain serious barriers. In rural regions and developing countries, limited Internet access, low levels of digital literacy, lack of official documents, or absence of banking infrastructure leave millions of people excluded from the financial system. Global migration and economic crises, pandemics, wars, and inflation only exacerbate this problem. Internally displaced persons, refugees, low-income individuals, and pensioners often cannot use traditional financial services because of high fees, documentation requirements, or geographical remoteness.

In the European Union, the positive effect of digital inclusion is achieved through the development of FinTech startups and regulatory initiatives. Revolut, N26, Bunq, and Wise offer free or low-cost accounts, instant transfers, cryptocurrency operations, and investment products accessible through smartphones. They are particularly important for migrants, young people, low-income individuals, and residents of remote regions. Through PSD2 and PSD3, banks are required to open APIs, allowing FinTech companies to create inclusive products such as account aggregation, automated savings, and microloans.

At the same time, digitalization intensifies the problem of the digital divide: according to Eurostat data, approximately 7 – 9% of the EU population aged 16 – 74 does not regularly use the Internet, and this share is considerably higher in rural areas [67]. In low-income and developing countries, the situation is much more severe, as 40 – 50% of the population still lacks access to smartphones, mobile Internet services, or reliable broadband connectivity [68]. Therefore, successful digital inclusion does not only require technology but also policy: government programs for digital literacy, subsidies for smartphones and Internet access, offline solutions (SMS banking, USSD), and inclusive regulation, such as simplified KYC requirements for vulnerable groups.

Models similar to Revolut demonstrate that with the proper combination of technology, regulation, and social policy, financial inclusion becomes a reality even for the most vulnerable population groups.

Principle 4. A cybersecurity assurance system is an integral component of the digital transformation of the economy.

Ensuring the cybersecurity of financial systems is one of the key challenges of the digital economy. The growing number and complexity of cyberattacks, including phishing, ransomware, and supply-chain attacks, create significant risks for banks, payment systems, and FinTech companies.

According to the World Economic Forum, in 2025, 72% of organizations reported an increase in cyber risks, while nearly 47% identified cyberattacks enhanced by generative artificial intelligence as their primary concern [69]. Furthermore, according to the European Central Bank and the European Banking Authority, the total value of fraudulent payment transactions in the European Economic Area increased from 3,5 billion EUR in 2023 to 4,2 billion EUR in 2024, reflecting the growing cyber threat landscape and the need to strengthen the resilience of financial infrastructure [70]. To strengthen the protection of financial institutions in the EU, the regulatory standards GDPR and DORA have been introduced, establishing requirements for ICT risk management, cyber resilience testing, and incident monitoring. Artificial intelligence plays an important role in combating cyber threats and is used for anomaly detection, transaction monitoring, and fraud prevention. In particular, banks use machine-learning algorithms to analyze customer behavior in real time, making it possible to significantly reduce losses from fraudulent transactions.

AI-based early warning systems are also being further developed. These systems analyze network activity, event logs, and external threat indicators, enabling the prediction of potential attacks before they occur. This contributes to a shift from a reactive protection model to proactive cyber-risk management in the financial sphere.

Thus, modern financial security in the digital space is based on a triad: advanced AI technologies for proactive protection, early warning systems for risk prediction, and stringent regulatory standards (DORA, GDPR) that ensure compliance and accountability.

Only a comprehensive combination of these elements enables financial institutions to maintain resilience and customer trust in an environment where cyber threats are becoming an integral part of economic reality.

1.3. Global trends in the development of digital financial instruments

The digitalization of the financial system is a gradual process of transition from traditional analog methods to modern digital technologies, encompassing banking services, payments, lending, and other financial services. This process can be divided into several stages that reflect the evolution of financial technologies (fintech) and the transformation of the banking sector.

Stage one: Infrastructure stage (approximately 1866 – 1967).

This period is characterized by the formation of the basic global financial infrastructure. Innovations such as the telegraph, transatlantic cables, and the first electronic transfer systems (for example, Fedwire in 1918) made it possible to rapidly transmit financial information across borders. The financial system became more globalized but still remained highly dependent on physical instruments such as paper checks and cash.

Stage two: Digitalization of traditional institutions (1967 – 2008).

This stage marks the beginning of the mass transition from analog to digital processes in banking. Key innovations included the first automated teller machines (ATMs) in 1967, electronic payment systems (SWIFT in 1973), online banking, and the first digital stock exchanges (NASDAQ in 1971). Banks automated internal operations and introduced credit cards and electronic transfers. This stage was characterized by the dominance of traditional financial institutions that used digital tools to improve operational efficiency.

Stage three: Disruptive innovations and fintech startups (from 2008 to the present).

After the global financial crisis of 2008, new market participants emerged – FinTech startups. The widespread adoption of smartphones, mobile internet, and declining trust in traditional banks stimulated innovations

including mobile payments (PayPal, Apple Pay), P2P lending, cryptocurrencies (Bitcoin in 2009), digital wallets, and robo-advisors. Banks initiated digital transformation by implementing mobile applications, online banking, cloud technologies, and artificial intelligence for service personalization. This stage encompasses digitization (converting documents into digital form), digitalization (process automation), and full digital transformation, which involves fundamentally new business models.

Stage four: Development of an advanced digital financial ecosystem (from 2020 to the present).

Key trends of this stage include the implementation of artificial intelligence, blockchain technologies, open banking APIs, and central bank digital currencies (CBDCs). More than 130 countries are researching or testing CBDCs to enhance financial inclusion, reduce transaction costs, and improve monetary control. Examples include the digital yuan in China, the digital rupee in India, and various digital currency initiatives in Europe. The financial system is becoming fully integrated, with programmable payments, real-time transaction processing, and a strong emphasis on cybersecurity.

Digital financial instruments are transforming the global financial landscape by providing a faster, more accessible, and customer-oriented approach to financial services. During the period from 2020 to 2025, a clear transition has been observed from traditional banking systems to digital ecosystems encompassing FinTech companies, neobanks, cryptocurrency exchanges, investment platforms, digital wallets, and more.

Digitalization makes the financial system more efficient, accessible, and inclusive, but it also requires addressing challenges such as cybersecurity, data privacy, and regulation. In the future, it may completely transform the ways financial flows are managed – from everyday payments to global transfers.

At the fourth stage of financial system digitalization, the FinTech industry continues to grow rapidly, offering innovative solutions that make financial services more accessible, convenient, and efficient. At the beginning of 2026, we observe how digitalization is penetrating all areas of banking, payments, and investments. The following are the key trends shaping the modern landscape.

Neobanks and digital banking remain one of the most dynamic directions. Platforms such as Revolut, N26, Monzo, Nubank, and Chime offer a full range of services without physical branches, emphasizing an intuitive user interface (UX/UI). As of 2025, there are more than 400 neobanks worldwide serving hundreds of millions of customers [71]. For example, Nubank exceeded 100 million users – more than 118 million by mid-2025 [72]. The absence of traditional infrastructure enables them to reduce fees and rapidly introduce new features, attracting younger generations.

Mobile payments and digital wallets have become an everyday reality. Services such as Apple Pay, Google Pay, Samsung Pay, Alipay, PayPal, and Wise dominate due to the convenience of contactless transactions. The COVID-19 pandemic accelerated this transition, while the growth of e-commerce continues to support it. By 2025, digital wallets and mobile payment solutions account for approximately 50 % of global e-commerce transactions and more than one-third of total consumer digital spending worldwide, with transaction volumes measured in trillions of US dollars, particularly in Asia and Europe [73].

Blockchain and decentralized finance (DeFi) continue to develop on such platforms as Ethereum, Solana, and Avalanche. Key instruments – stablecoins, smart contracts, lending, and staking – eliminate intermediaries while ensuring transparency and automation. In 2025, the emphasis on the tokenization of real-world assets (RWA) and integration with traditional finance makes DeFi more attractive to institutional investors.

Buy Now, Pay Later (BNPL) services such as Klarna, Afterpay, and Zip remain popular among young people as an alternative to credit cards. However, increasing debt levels have led to tighter regulation. In 2025, new rules were introduced in the EU, the United States, the United Kingdom, and Australia requiring licensing and creditworthiness assessments.

The use of AI and big data is transforming finance. Robo-advisors (Betterment, Wealthfront) and chatbots (Plum, Cleo) automate investment advice, risk assessment, and product personalization. This enables banks and FinTech companies to offer highly accurate, tailored solutions.

Cybersecurity and digital identification have become critically important. The implementation of biometric technologies and blockchain solutions for KYC/AML procedures (for example, IDNow in the EU, Diia.Sign in Ukraine,

and Jumio in the United States) reduces fraud and enhances user data protection. Regulatory innovations (RegTech) help automate regulatory compliance. Platforms like Onfido, ComplyAdvantage, and Trulioo optimize tax monitoring, financial control, and reporting, significantly easing the operational burden on financial institutions operating in complex regulatory environments.

Finally, next-generation investment platforms – Robinhood, eToro, and Freetrade – facilitate access to financial markets through user-friendly interfaces and gamification. While this attracts new investors, it also carries risks of impulsive decision-making due to the lack of deep financial knowledge.

These trends indicate a transition toward a more inclusive, technologically advanced, and regulated financial ecosystem in which traditional banks cooperate with FinTech companies to develop hybrid models. In the future, even deeper integration of artificial intelligence, blockchain technologies, and personalization is expected.

At the beginning of 2026, the development of digital financial instruments is characterized by a transition from rapid growth to sustainable and regulated integration into the global financial system. According to reports from the World Economic Forum, Mastercard, and other analytical sources, key trends are driven by the integration of artificial intelligence, asset tokenization, stablecoins, decentralized finance (DeFi), and embedded finance, whereby financial services are integrated directly into non-financial digital platforms, products, or services, making them more accessible, personalized, and efficient.

One of the dominant trends is the growing role of stablecoins as a foundation for global payments. In 2025, stablecoin transaction volumes exceeded 9 trillion USD, while total on-chain volumes surpassed 30 trillion USD according to some estimates [74; 75]. Further expansion is expected in 2026 with market capitalization, increasing use in international payments, B2B settlements, and as an alternative to traditional payment systems such as Visa and ACH. At the same time, enhanced regulatory certainty, achieved through the full implementation of the European Markets in Crypto-Assets Regulation (MiCA/MiCAR), has established a comprehensive legal framework for stablecoin issuers and crypto-asset service providers, thereby fostering their further integration into the financial system. Stablecoins are increasingly

becoming the «connective tissue» between traditional finance and crypto ecosystems, with a strong emphasis on institutional adoption (for example, JPMorgan and Visa).

The tokenization of real-world assets (RWA) and financial instruments is also accelerating. Meanwhile, the market for tokenized real-world assets reached approximately 25 – 30 billion USD in 2025 and may account for up to 10 % of global GDP by 2027 according to industry forecasts [76; 77]. In 2026, tokenization is expected to expand to bonds, real estate, private equity, and debt instruments, enabling fractional ownership, increasing liquidity, and supporting institutional trading on regulated platforms.

Artificial intelligence (AI) and agentic AI are transforming financial services, ranging from personalization (hyper-personalized offers) to autonomous transaction agents. These technologies enable high-level fraud detection – reducing the likelihood of fraud by nearly half – and perform critical risk management functions. Generative AI and agentic AI are becoming essential for the development of neobanks and FinTech companies.

The embedded finance model, in which financial products are integrated directly into non-financial digital platforms, services, or business processes, together with instant payments that embed financial services into e-commerce and social media, generates trillions of dollars in transactions. Trends toward real-time payments and open banking are strengthening alongside the growth of neobanks and digital wallets.

DeFi and central bank digital currencies (CBDCs) have evolved significantly over the last decade. DeFi is becoming increasingly regulated through permissioned networks and is integrating with traditional finance, while CBDCs (such as the digital euro and e-rupee) focus primarily on wholesale applications and financial inclusion. In such regions as India, Brazil, and Africa, digital financial instruments promote financial inclusion for small and medium-sized enterprises and underserved populations.

Over the last decade, significant challenges to the digitalization of the financial system have emerged in the areas of cybersecurity and regulation. With the increase in AI-enabled fraud and growing dependence on cloud infrastructure, considerable attention is being paid to digital identity, cryptographic protection (including protection against quantum threats), and regulatory frameworks such as DORA and MiCA.

Overall, 2026 is expected to become a period of institutionalization of digital financial instruments, with an emphasis on resilience, inclusion, and integration with traditional finance. These trends contribute to more efficient financial flows, lower costs, and expanded access to financial services—especially in developing markets – while simultaneously requiring a careful balance between innovation and risks (Table 1.6).

Table 1.6

Comparative characteristics of global trends in the development of digital finance and those observed in Ukraine

Indicator / Trend	World	Ukraine
1	2	3
Neobanks and digital banks	Fintech sector expansion: over 200 Unicorns, 21 % annual revenue growth [78]	Monobank has ~10 million customers by 2025 [86]
Digital/mobile wallets	Digital wallet users – up to 4,6 billion by 2025 [79]	41 % of Ukrainians use a digital card; 61 % use contactless payments [87]
Contactless (NFC) payments	In Europe and Asia, over 70 – 90 % of card transactions are made contactless [80; 81]	63 % of contact payments with Mastercard are NFC; 97 % of POS terminals support contactless [88]
CBDC (digital currency projects)	134 countries working on CBDC; China, EU, Japan are leaders [82]	e-hryvnia is in pilot phase, NBU working on technical design [89]
Predominant non-cash payments	For individual countries (India), digital payments accounted for 99,8 % of all transactions [83]	94 % of card transactions are cashless; 60 % are contactless in 2024 [90]
Trust in digital payments	76 % mostly or completely trust digital payments. 74 % plan to increase usage over the next year [84]	80 % of Ukrainians trust digital payments; 95 % already use them [91]
SMBs and digital adoption	Basic digital intensity for SMEs: 73 % on average [85]	58 % of Ukrainian SMEs have started accepting digital payments; 75 % have noted an increase in revenue [92]

Thus, the development of digital financial instruments takes place under the influence of new technologies, global challenges, and consumer expectations. Technologies do not only change the ways financial transactions are conducted but also rethink the role of banks, regulators, and

consumers. For all countries, and Ukraine in particular, it is important to combine the implementation of innovations with enhanced cybersecurity, the development of financial literacy among the population, and an appropriate regulatory environment.

In turn, the modern digitalization of the financial sector based on fintech, AI, blockchain, open banking, and embedded finance has transformed economic relations, making them more dynamic, networked, and global. This process accelerated in the 2020s, especially after COVID-19 [93; 94; 95].

As publications [93; 96; 97] indicate, digitalization simplifies the execution of transactions, reduces intermediation costs, and shortens processing time. For example, instant payments and AI reduce fees by 30 – 70 %, depending on the sector of the economy, accelerating capital turnover and trade. This changes the relationships between suppliers and consumers: businesses (MSMEs) gain faster access to finance, which stimulates entrepreneurship and GDP growth. According to [98], in 2026, AI is projected to generate an annual increase in labor productivity of \$2.7 trillion, which corresponds to approximately 3,4% of GDP across a sample of 86 countries through technology investments.

Digitalization not only enhances the efficiency of economic relations and changes the very interaction between economic actors – households, businesses, and the state—but also creates new challenges.

The spread of mobile wallets, P2P lending, and digital platforms has expanded access to services for vulnerable groups – women and rural residents – and thus has led to greater financial inclusion and integration. This changes economic relations. Whereas previously these vulnerable groups were excluded segments, they are now being integrated into the global economy, for example through cross-border e-commerce, where digital finance increases efficiency by 10 – 20 % [99; 100].

Through digitalization, the transformation of business models and competition is taking place. The integration of finance into non-financial platforms and open banking is changing relationships among banks. They are moving from competition to partnerships (coopetition), which stimulates innovation and increases productivity. In 2025 – 2026, this leads to the growth of digital ecosystems, where data become a key asset, adding 15 – 20 % to efficiency [96; 101; 102].

Digitalization contributes to globalization. Stablecoins, central bank digital currencies (CBDCs), and blockchain technology significantly simplify international payments. As a result, cross-border money transfers (remittances) become much cheaper, with costs decreasing by 50 – 70 % [96]. This substantially changes the global economy and politics. For example, within China's Belt and Road Initiative, trade becomes more active. In addition, greenfield-investments in the digital economy increased to USD 360 billion in 2024 [103].

During crises, digitalization ensures the rapid distribution of assistance, mitigating shocks. An example of such increased resilience is the 2020 – 2022 crisis caused by the COVID-19 pandemic [104]. In 2025 – 2026, AI and digital transformation add resilience, for example through the automation of risk management [105].

However, digitalization has also had a negative impact on economic relations. It has intensified inequality and the digital divide among the population. After all, not everyone still possesses digital skills or has access to the internet and smartphones. This circumstance excludes part of the population from financial relations, increasing social and regional inequality. Digitalization has intensified cyber threats and led to the growth of systemic risks. The concentration of power in the hands of a few providers (BigTech companies and cloud services) creates new «too-big-to-fail» players. Cyberattacks, data breaches, and flash crashes undermine trust among market participants. Furthermore, the shift from bank intermediation to platform-based models such as DeFi and BigTech weakens traditional institutions while increasing dependence on giant technology firms. This changes the balance of power and control in economic relations – from states and banks to private platforms. Digitalization has also facilitated access to speculative instruments – crypto assets and tokenized assets – which may divert resources from real investments, increasing market volatility. In addition, different countries around the world follow different approaches to building a digital financial space. EU countries focus on resilience and data protection, the United States emphasizes rapid innovation, and China prioritizes state control. This complicates global economic relations, creating «digital borders» and generating regulatory and geopolitical tensions.

1.4. The place of digital finance in the financial system of the future

Global economic shocks, technological progress, and growing uncertainty in the world economy have intensified the need for transformation of the financial system. Traditional financial institutions increasingly face limitations in the speed of decision-making, the accessibility of financial services, and their ability to respond effectively to crisis shocks. Under these conditions, digital finance is gradually evolving from a supporting tool into a core element of the financial system of the future [106].

Digital finance is rapidly becoming not merely a component but one of the central pillars of the future financial system. In the coming decades (2030 – 2050), it is expected to fundamentally change the architecture of global and national financial systems, shifting the balance from traditional banking intermediaries toward decentralized, technology-driven, and more inclusive models [107].

The evolution of the financial intermediation paradigm is presented in Table 1.7.

Table 1.7

Characteristics of the stages of financial intermediation

Stage	Dominant model	The role of technology	Example institutions
Traditional (before 1990s)	Banking intermediation	Mechanical automation	Commercial banks, exchanges
Electronic (1990 – 2010)	Online access to services	Internet, electronic payments	Online banking, payment gateways
Platform (2010 – 2020)	Ecosystem integration	Mobile applications, API, Big Data	FinTech startups, BigTech platforms
Programmed (2020+)	Decentralized protocols	Blockchain, smart contracts, AI	DeFi protocols, DAO, CBDC

As the analysis of scientific sources has shown, digital finance represents a transformational element of the modern financial architecture that combines technological innovations with traditional financial services. In the context of the global digital transformation of the economy, digital finance

is becoming not only a tool for increasing efficiency but also a key factor in restructuring the entire financial system.

The academic community and regulators, in particular the European Union and the Bank for International Settlements, emphasize that without integrating digital finance into the center of research and policy, the financial system will not be able to remain competitive in the future.

Digital finance, as a system of instruments and technologies that ensure the digitalization of financial processes, including payments, lending, investments, and risk management, has evolved from simple online banking services to complex ecosystems based on distributed ledger technology (DLT), asset tokenization, and electronic money.

The generalization of analytical materials from McKinsey & Company, World Economic Forum, KPMG, and World Bank [108 – 112] makes it possible to conclude that current trends in the field of digital finance include the growth of DeFi, which enables financial transactions without traditional intermediaries; the development of CBDCs as a response by central banks to private crypto-assets; and the integration of artificial intelligence for service personalization and risk management.

According to the World Bank [112], fintech and the digital transformation of financial services are radically changing market outcomes, regulation, and service accessibility.

In the financial system of the future, digital finance will occupy a central position, performing the functions of a catalyst for inclusion, efficiency, and resilience.

First, it significantly enhances financial inclusion. Digital technologies make it possible to provide services to populations traditionally excluded from the banking system, particularly in developing countries. Empirical studies confirm the positive impact of digital finance on service accessibility for marginalized groups.

Second, digitalization contributes to increased efficiency. The tokenization of real assets, 24/7 settlements, and smart contracts reduce transaction costs and accelerate clearing and settlement processes. The concept of the «Finternet» proposed by the BIS envisages a unified ledger based on tokenization that will connect traditional finance (TradFi) with decentralized technologies.

Third, digital finance stimulates innovation in risk management and monetary policy. CBDCs may become an instrument of programmable money, enabling central banks to conduct policy more effectively.

In the future, the financial system is likely to have a hybrid character: a combination of centralized institutions and decentralized protocols, where digital finance will ensure seamless integration.

In the coming years, digital finance will continue to fundamentally transform the global financial system.

According to analytical materials from McKinsey, the World Economic Forum, KPMG and the World Bank [109 – 112], the main trends for 2025 – 2030 will include the implementation of artificial intelligence in the financial system, asset tokenization and the development of digital assets, the widespread adoption of Embedded Finance and Open Finance, the emergence of next-generation payment systems, strengthened cybersecurity and regulation of digital finance, and increased requirements for compliance of the financial system with sustainable development principles.

One of the major trends will be the expansion of artificial intelligence and machine learning in financial management. These technologies will improve forecasting accuracy, enhance the effectiveness of investment decisions, and reduce operating costs. In addition, blockchain and distributed ledger technologies will find new areas of application, providing greater transparency and transaction security. Artificial intelligence, as the main driver of transformation, will be actively used for personalizing financial services, automated credit scoring, real-time fraud detection, and optimization of internal processes. During 2025 – 2030, artificial intelligence will become a universal «accelerator» of most innovations in the financial sector, enabling a transition from reactive models to proactive and predictive ones.

According to the forecast of the Citi Institute [113], the tokenized asset market will grow from approximately 17 billion USD today to 5,5 trillion USD under the baseline scenario by 2030 (with a range from 2,7 trillion USD in the pessimistic scenario to USD 8,2 trillion in the optimistic scenario). At the same time, the stablecoin market, according to Citi estimates, may reach 1.9 – 4 trillion USD [114].

Financial services are becoming increasingly embedded in non-banking platforms – from Amazon and Shopify to mobile applications and social

networks. Open Finance ensures secure data exchange between financial and non-financial services with customer consent, dramatically improving convenience and personalization.

Instant cross-border payments through stablecoins and central bank digital currencies (CBDCs) are becoming the norm. Global payments are acquiring a «glocal» nature – combining global speed with local adaptability.

During 2026 – 2030, regulatory pressure will continue to increase. The EU already has MiCA in force, while the United States has the GENIUS Act. Regulators will focus on financial inclusion, consumer protection, and the prevention of systemic risks.

Central bank digital currencies (CBDCs) will become more widespread, creating the foundation for a new generation of payment systems that will be faster, cheaper, and more accessible to a broad range of users. The typology of central bank digital currencies is presented in Table 1.8. At the same time, the role of decentralized finance (DeFi) will continue to grow, making it possible to bypass traditional intermediaries and creating new opportunities for capital raising and lending.

Table 1.8

Typology of CBDCs

Type	Description	Development examples
Retail CBDC	For mass use by the population	Digital Yuan (China), e-Naira (Nigeria), Digital Euro (EU, in development)
Wholesale CBDC	For interbank settlements	Project Jasper (Canada), Project Ubin (Singapore)
Hybrid models	Combining a centralized issuer with a decentralized infrastructure	Project mBridge (BIS, China, UAE, Thailand)

In the future, one of the continuing trends will be the development of Green Finance and instruments that support clients' financial well-being, ranging from AI-based personal financial advisors to products focused on long-term stability.

Digital finance does not so much replace the traditional financial system as radically transform it, creating a hybrid model.

The place of digital finance in the financial system will be key and continuously growing. It will become the framework for a dynamic, resilient, and innovative financial ecosystem capable of rapidly adapting to market and technological changes. This will create new management models, establish security standards, and contribute to the development of global financial markets.

FinTech solutions will continue to complement traditional banks by addressing issues of accessibility, financial inclusion, service speed, and cost. At the same time, competition is taking place through «unbundling» – the separation of traditional banking services into individual components, including payments, lending, investments, and asset management.

The most promising model now is cooperation – Banking-as-a-Service (BaaS) and strategic partnerships between banks and technology companies. Systemic changes include the transition from a purely centralized model to a hybrid one (decentralized and traditional). Blockchain and tokenization are capable of reducing the settlement cycle to real time.

The positive effects of digital finance are evident: increased efficiency, better service personalization, expanded financial inclusion, and new opportunities for economic growth. The period of 2025–2030 will become an era of active implementation of cutting-edge technologies that will transform the way banks, businesses, governments, and consumers interact.

The integration of digital finance into the broader context of economic and social development will be important. Digital finance will contribute to financial inclusion by providing access to financial services for underserved population groups.

Therefore, the foresight of digital finance for 2025 – 2030 [111; 113 – 118] indicates a profound transformation of the financial sector, where technology will become the driving force behind innovation, efficiency, and accessibility of financial services.

Despite its prospects, digital finance carries significant risks: cybersecurity threats, volatility, money laundering, loss of financial stability, regulatory gaps, the digital divide between different population groups, and the high volatility of crypto-assets. Decentralized systems may create new forms of systemic risk due to the interconnectedness of protocols. Regulators must balance innovation and protection. The European approach (for

example, MiCA) and initiatives in Ukraine related to Diia and digital services demonstrate attempts to create a favorable regulatory environment. According to assessments by the World Economic Forum and OECD, the future of the financial system lies in collaborative transformation rather than in the pure destruction of traditional institutions.

Based on the analysis of materials [111; 113 – 118], three main scenarios for the development of digital finance by 2030 can be identified.

According to the optimistic scenario, the financial system will experience harmonious integration of technologies, mass tokenization of assets, significant growth in financial inclusion, and rapid adoption of CBDCs and stablecoins as part of everyday payments.

Under the baseline scenario, gradual digitalization will be accompanied by a gradual strengthening of regulation, stable market growth, and hybrid development of traditional and digital players.

The pessimistic scenario includes regulatory wars, large-scale cyber crises, increasing digital inequality, and a slowdown in innovation adoption due to strict restrictions.

Ukraine has significant potential in this transformation due to the government's digitalization policy, the application Diia, the success of Monobank, and the active development of the FinTech sector. Further integration into the European digital space, the development of the e-hryvnia, and support for innovation will enable the country to occupy a prominent place on the map of global digital finance.

Based on the application of P. Schwartz's [119] «critical uncertainties» scenario approach, a matrix of directions for the evolution of the financial system can be constructed. This matrix model is built along two axes: the degree of decentralization and regulatory intensity, forming four strategic quadrants for the development of the financial system (Fig. 1.1). The degree of decentralization ranges from centralized state systems to fully decentralized protocols, while regulatory intensity ranges from strict control to liberalism.

Regulatory Intensity		
	Low	High
Decentra- lization	Scenario 1. «Crypto Wild West». Dominance of decentralized protocols. High innovation regulation. Systemic risks	Scenario 2. «Regulated DeFi». Hybrid model. CBDC + DeFi. Adaptive regulation. Balance of innovation and stability
High		
Low	Scenario 3. «Digital Leviathan». State digital platforms. Total monitoring. Efficiency at the expense of Privacy	Scenario 4. «Neo-Traditional». Evolutionary modernization. Banks retain leadership. Gradual integration of fintech

Fig. 1.1. **A matrix model of the financial system development strategy**

Quadrant 1, «Crypto Wild West», is characterized by a development scenario with high decentralization and a low level of regulation. It is distinguished by the dominance of DeFi protocols and DAOs, weak consumer protection, high volatility, and the fragmentation of the financial system into «online» and «offline» segments. Under this scenario, crypto-assets become the primary means of exchange and store of value. At the same time, the main financial risks arise from smart contract vulnerabilities, money laundering, and evasion of sanctions.

Quadrant 2, «Regulated DeFi», defines a state of the financial system with high decentralization and a high level of regulation. It is considered the most probable scenario because it is characterized by a balance between innovation and protection, scalability, and inclusiveness. The key features of this development strategy include a hybrid architecture based on decentralized protocols, CBDCs as an «anchor of stability» combined with innovative private solutions, RegTech tools for automated compliance (AML/KYC on-chain), and international harmonization of standards such as the FATF Travel Rule for crypto-assets. However, this scenario carries the risk of regulatory arbitrage and is characterized by technical complexity of implementation.

Quadrant 3, «Digital Leviathan», is characterized by low decentralization and high regulation. Its key features include the use of state

digital platforms as the sole channel for financial services, CBDCs with programmable restrictions regarding expiration dates and intended use, total transaction monitoring through AI analytics, and the marginalization of private crypto-assets. This scenario is characterized by high effectiveness of monetary policy and the fight against the shadow economy. However, it carries the risk of violating financial privacy, centralizing power, and creating technological vulnerabilities.

Quadrant 4, «Neo-Traditional», is characterized by low decentralization and low regulation. Such a scenario for the development of the financial system is considered the least likely because, despite ensuring stability, predictability, and low transition costs, it may result in a loss of competitiveness and slow adaptation to new challenges. Under this scenario, the existing institutions will undergo evolutionary modernization without radical changes, banks will integrate fintech solutions as supplementary services, and crypto-assets will remain a niche instrument for speculation.

This foresight demonstrates that digital finance is not a separate segment but rather the new foundation of the entire financial system of the twenty-first century.

Digital finance is not a peripheral element but it constitutes the foundation of the financial system of the future. It transforms traditional models, promoting inclusion, efficiency, and innovation, while simultaneously requiring new approaches to regulation and risk management. To ensure the competitiveness of national financial systems, including the Ukrainian financial system, investments in technology, education, and international cooperation are necessary.

Chapter 2. The state of digital finance development in the EU and Ukraine

2.1. EU Policy on Digital Finance

Digital finance in the European Union is a key element of the transformation of the financial system. EU policy in this area is aimed at combining innovative development, ensuring security, protecting consumer rights, and creating a competitive environment.

EU digital finance policy is implemented through strategies, regulatory frameworks, and the activities of relevant institutions.

The key EU strategies in the field of digital finance are presented in Table 2.1.

Table 2.1

Key EU strategies in the field of digital finance

Strategy	Summary
Digital Finance Strategy (2020) [120]	A comprehensive plan for the development of digital finance in the EU. The goal is to create a single market for digital financial services
Retail Payments Strategy [121]	Creating a fast, secure and affordable payment infrastructure
European Data Strategy [122]	Promoting data exchange in the economy, in particular in finance (Open Finance, PSD2)
EU Cybersecurity Strategy [123]	Protecting digital financial infrastructure from cyberattacks
EU Blockchain Strategy [124]	Supporting distributed ledger technology (DLT), launching a pilot regime for capital markets

The fundamental document in the field of EU digital finance is the EU Digital Finance Strategy, adopted by the European Commission in 2020. Its main objective is to create a single digital financial market that ensures the innovative development of financial services, a level playing field for fintech

companies and traditional financial institutions, as well as reliable consumer protection and financial stability. The strategy is based on four key directions: eliminating fragmentation of the digital financial market, adapting regulation to digital innovations, developing European digital financial solutions, and strengthening digital operational resilience.

EU regulatory acts on digital finance are presented in Table 2.2.

Table 2.2

EU Regulatory acts on digital finance

Acts / Initiative	Contents
MiCA (Markets in Crypto-Assets Regulation) [125]	A single legal regime for the circulation of crypto-assets (2023). Defines rules for token issuance, crypto exchanges, service providers
DORA (Digital Operational Resilience Act) [126]	Regulation of digital operational stability of financial institutions. Obliges the implementation of cyber protection and IT risk testing
PSD2 (Payment Services Directive 2) [127]	Regulates payment services and open banking. Obliges banks to open APIs to fintech companies
AI Act (2024) [128]	Defines the rules for the use of AI, in particular in financial services. Prohibits some types of high-risk applications
E-IDAS 2.0 [129]	Support of European digital identity for access to financial services

The Markets in Crypto-Assets Regulation (MiCA), adopted in May 2023, introduced for the first time a unified regulatory framework for crypto-assets, issuers, and service providers in the EU. It covers previously unregulated crypto-assets (for example, Bitcoin) and stablecoins, establishing strict requirements for investor protection and transparency. Crypto-asset providers are required to obtain authorization in the EU and bear responsibility for customer losses. In particular, MiCA regulates stablecoins, whose market capitalization reached 110 billion USD [125; 130], which makes it possible to reduce risks to monetary policy. Thus, MiCA is aimed at reducing regulatory uncertainty, preventing financial risks and fraud, protecting investors, and integrating crypto-assets into the legal financial system of the EU.

An important place is occupied by the Digital Operational Resilience Act (DORA). This act on digital operational resilience, adopted in November 2022, establishes unified requirements for the security of information systems of financial organizations (banks, exchanges, fintech companies), business continuity, cyber resilience testing, and critical third-party providers – cloud providers and IT suppliers, for example, AWS and Microsoft Azure. The regulation requires monitoring, classification, and reporting of incidents in information systems, as well as the creation of recovery plans after cyberattacks. The European Supervisory Authorities (ESAs) act as leading supervisors of third-party providers. For example, according to ECB data DORA reduces systemic risks associated with cloud services, which account for approximately 15% of all outsourcing contracts involving significant EU banks [126; 131]. Thus, DORA directly links the digitalization of finance with the concept of financial system resilience.

The pilot regime for distributed ledger technology (DLT) market infrastructures, introduced in 2023, allows temporary derogations from existing legislation for testing DLT in the trading and settlement of crypto-assets classified as financial instruments. This ensures a balance between innovation and investor protection, allowing regulators to assess risks. For example, ECB exploratory work on distributed ledger technology demonstrated the potential to move securities settlement from the traditional T+2 cycle toward near real-time settlement, reducing processing time from days to minutes [131].

The EU is consistently expanding the Open Banking approach introduced by the PSD2 Directive to the broader concept of Open Finance, which involves the exchange of financial data through APIs, increasing competition and innovation, personalizing financial products, and reducing information asymmetry. Open Finance is viewed as the infrastructural basis for embedded finance, platform finance, and financial ecosystems. The Data Act will expand access to data for the creation of new financial products. According to ECB payment statistics, non-cash payments have become dominant in the European payment ecosystem, while card payments accounted for 57 % of all non-cash transactions in the euro area in 2024. PSD2 significantly contributed to this transition by promoting open banking, competition and electronic payments [132].

The Artificial Intelligence Act (AI Act), adopted in 2024, regulates the use of AI in finance by prohibiting high-risk practices and requiring transparency. For example, according to [133], AI systems used for credit scoring are classified as high-risk systems and must comply with requirements related to transparency, human oversight, data governance and non-discrimination, thereby reducing the risk of biased decision-making in lending.

Reforms in the field of Anti-Money Laundering and Countering the Financing of Terrorism (AML/CFT), launched in July 2021, resulted in the creation of a unified supranational AML supervisory authority in the EU in 2024, headquartered in Frankfurt (Germany). Particular attention is paid to stablecoins and crypto-assets that may be used for illegal transactions.

The Digital Finance Strategy actively supports regulatory innovation and the implementation of RegTech solutions, which automate compliance with regulatory requirements, AML/KYC procedures, financial reporting, and risk monitoring. This contributes to reducing transaction costs and increasing the transparency of the financial sector.

Special attention is paid to financial inclusion and support for micro, small, and medium-sized enterprises (MSMEs). Digital finance is viewed as a tool for expanding access to financing for MSMEs, integrating underserved groups, and developing alternative forms of financing (crowdfunding, P2P lending). This direction is supported through the European Crowdfunding Service Providers Regulation (ECSP).

Thus, the EU digital finance strategy is aimed at forming a financial system that is innovative (AI, blockchain, DeFi), resilient (DORA, cyber protection), inclusive (MSMEs, open finance), and regulatorily harmonized across the entire Union. This comprehensive approach ensures a balance between stimulating innovation and maintaining financial stability under conditions of rapid digital transformation.

Digital finance is developing in all advanced countries, but the philosophy of regulatory policy and institutional approaches of the EU, the United States, and the United Kingdom differ significantly (Table 2.3). These differences determine the pace of innovation, the level of risks, and the degree of financial resilience.

Table 2.3

Comparative characteristics of the approaches of the EU, the United States, and the United Kingdom in the field of digital finance

Feature	EU	USA	United Kingdom
Regulatory philosophy	Proactive, unified	Market-based, fragmented	Flexible, experimental
Key focus	Stability and resilience	Innovation and capital market	Balance of innovation and risk
Cryptoassets	Single regime (MiCA)	Regulation through cases	Incremental, adaptive
Open finance	Systematically implemented	Limited application	Active development
Reg tech	Institutionalized	Market-based solutions	Integrated into supervision
Regulatory certainty level	High	Low–medium	Medium – high

The European Union’s approach to regulating the digitalization of the financial system is characterized by proactiveness and comprehensiveness. The main objective is to create a single digital financial market with a high level of consumer protection and financial stability. Key features include unified rules for all Member States (in particular, the MiCA, DORA, and PSD2/PSD3 regulations), a focus on financial system resilience and cyber resilience, active development of Open Finance and RegTech, and limitations on regulatory arbitrage. Thus, the EU chooses a «regulation-first» model, where innovations are implemented within clearly defined rules, ensuring long-term stability and minimizing systemic risks.

In contrast, the United States follows a decentralized and market-oriented regulatory model, where capital markets and private innovation play a key role. The absence of a single federal law on digital finance leads to regulatory competition among the SEC, CFTC, OCC, and FinCEN. Strong emphasis is placed on fintech and bigtech innovations, while regulation is predominantly reactive (ex post), often through judicial practice. The American model effectively stimulates the rapid growth of innovation, but at the same time increases regulatory uncertainty and systemic risks.

After Brexit, the United Kingdom formed a hybrid approach that combines regulatory flexibility with high supervisory standards. Key features include regulatory sandboxes (FCA Sandbox), active support for fintech ecosystems, a pragmatic approach to crypto-assets and AI, and a balance between innovation and financial stability. The UK model is focused on «smart regulation», which allows innovations to be tested without excessive regulatory pressure.

Thus, the EU is forming the most structured and stable model, focused on long-term digital resilience. The United States remains a global center of financial innovation, but with increased regulatory risks. The United Kingdom occupies an intermediate position, using institutional experimentation to achieve an optimal balance between the speed of development and risk control. These approaches reflect different regulatory philosophies: from proactive harmonized control in the EU to market-oriented flexibility in the United States and the United Kingdom.

European Union policy in the field of digital finance is based on a combination of a unified regulatory framework, supranational supervisory institutions, and coordination mechanisms aimed at ensuring financial stability, innovation, and consumer protection.

The characteristics of the institutions responsible for the formation and implementation of EU digitalization policy are presented in Table 2.4.

Table 2.4

Institutions for the formation and Implementation of EU policy

Institutions	Brief description
1	2
European Commission	Initiates legislative proposals (MiCA, DORA, Data Act) and coordinates the digital strategy; coordinates the Digital Finance Strategy, cooperates with other institutions to ensure the harmonisation of rules in the 27 member states
European Supervisory Authorities (ESAs)	Develops a Single Rulebook of technical standards, recommendations and guidelines for the EU financial sector. Ensures the uniform application of rules in all member states (supervisory convergence). Assesses risks in the financial sector. Protects consumers and investors. Coordinates between national regulators

Table 2.4 (the end)

1	2
	Issuance of joint recommendations and warnings. (e.g. as to crypto-assets, fintech, green finance, etc.)
European Banking Authority (Frankfurt, Germany)	Supervises the banking sector (digital banks, payment services, Open Banking), including supervision of bank risks and implementation of requirements (CRD/CRR). Regulates stablecoins and banking fintech services. Develops technical standards (RTS, ITS)
European Banking Authority (EBA)	Responsible for securities markets, trading and investment services. Oversees crypto asset and DLT markets
European Insurance and Occupational Pensions Authority (EIOPA). European Insurance and Occupational Pensions Authority	Ensuring digital resilience in insurance. Supervises insurance companies and pension funds
European Central Bank (ECB)	Coordinates the digital euro pilot, which should counter private stablecoins and preserve monetary sovereignty. Supervises significant banks (Single Supervisory Mechanism (SSM)). Together with the ESAs, it conducts stress tests of financial institutions for cyber resilience
Council of the EU and European Parliament	The Council coordinates member states' positions (e.g. approval of MiCA in May 2023). Parliament amends, focusing on consumer protection and monetary sovereignty.
National regulators	Perform supervision at member state level, adapting EU rules to local markets
EU Supervisory Digital Finance Academy (EU-SDFA)	Launched in 2022 to upgrade regulators' skills in AI, DLT and cybersecurity. Conducts research on digital finance trends (e.g., the impact of AI on financial stability)
Anti-Money Laundering / Countering the Financing of Terrorism (AML/CFT)	Established in 2024 to harmonize and strengthen the fight against money laundering and terrorist financing at the supranational level. Carries out: direct supervision of the most risky cross-border financial institutions (selected according to risk criteria). Currently, there are 40 financial institutions; indirect supervision and coordination of supranational supervisory bodies of all EU countries, ensuring uniform standards; support of Financial Intelligence Units (FIU) in coordinating the work of FIU financial intelligence units of member countries; harmonization of rules: development of technical standards, recommendations, guidelines; management of the database on suspicious transactions; imposition of fines, inspection and intervention in case of systemic violations

Thus, the mechanisms for implementing the EU digital finance policy include the following instruments: directly applicable regulations (MiCA, DORA); directives requiring subsequent implementation; technical standards (RTS/ITS); Regulatory Sandboxes, where fintech companies, startups, and other innovators can test new digital financial products, services, or business models (for example, based on blockchain, AI, or crypto-assets) under real-world conditions, but on a limited scale and under the supervision of a regulator; peer review as a process whereby regulators of EU Member States (or European supervisory authorities such as the ESAs – EBA, ESMA, EIOPA) assess one another by examining how national authorities implement common EU rules, exchanging best practices, and identifying weaknesses; and stress testing.

EU Digital Finance Policy Is characterized by:

- a high level of institutional coordination;

- the predominance of proactive (ex ante) regulation, whereby the state or regulator establishes clear rules, requirements, and restrictions before an event occurs or a market is formed;

- a focus on resilience and trust;

- a balance between innovation and financial stability.

The EU digital finance policy is comprehensive, combining innovation (DLT, AI, Open Finance) with stringent regulation (MiCA, DORA, AI Act) and strong institutional support (the Commission, ESAs, ECB). It is aimed at creating a single digital market, protecting consumers, and preserving financial stability. Challenges such as cyber threats and fragmentation are offset by the prospects of the digital euro, growing investment, and the harmonization of rules. This policy positions the EU as a global leader in digital finance regulation, contributing to economic recovery and competitiveness.

2.2. Formation of the fintech ecosystem in EU countries

The digital transformation of the financial ecosystem is not a random technological trend but the result of accumulated financial and economic

preconditions that were formed during 2000 – 2025 and became particularly significant after 2015. These preconditions can be systematized into four main groups: structural shifts in the economy, transformation of demand for financial services, increasing inefficiency of traditional models, and the emergence of new sources of value.

First, globalization and the growing share of intangible assets have radically changed the structure of the global economy. In developed countries, the share of GDP generated through knowledge, digital platforms, data, and intellectual property has exceeded 50% [134]. More than 50% of GDP in the major OECD economies is now knowledge-based. Over the past decade, the information and communication technology (ICT) sector in OECD countries has significantly outperformed the growth of the broader economy. Between 2013 and 2023, the ICT sector grew approximately three times faster than the overall economy across OECD countries, with an average growth rate of 7,6% in 2023 [135]. The financial system, which historically served mainly tangible assets (real estate, equipment, raw materials), proved to be structurally unprepared for the rapid financing of digital business models, platforms, and startups. Traditional banks turned out to be too slow and conservative in assessing risks and providing rapid financing for projects whose primary assets are data, network effects, and intellectual property [136].

Second, the change in the structure of demand for financial services became a powerful economic driver. Consumers and small businesses demand instant transactions (24/7/365), personalized products, minimal fees, full transparency, and access from mobile devices. The growing share of digitally oriented customers has created economic pressure on banks: either radically reduce costs and accelerate services or lose their customer base to fintech platforms [137; 138].

Third, the high operational and regulatory costs of traditional financial institutions have become a key economic barrier. The average cost of servicing one customer in a traditional bank in the EU amounts to \$1042 per year, whereas in digital platforms (Revolut, N26, Wise) it is \$ 34 [139]. This 30-fold difference creates a strong economic incentive for substitution. In addition, the regulatory burden (AML/KYC, Basel III, DORA, MiCA) forces banks to spend billions on compliance, while fintech companies can use

technologies such as RegTech and automated KYC solutions to reduce these costs by 60 – 80% [140; 141].

Fourth, the emergence of new sources of value creation and scaling through network effects has radically transformed the economics of the financial sector. According to Metcalfe's Law, platforms (two-sided markets) generate exponential growth in value as the number of users increases. Data become a key asset. The more transactions pass through a platform, the more accurate the risk models, the more personalized the products, the lower the costs, and the higher the margins. This creates a dynamic in which the «winner takes all», a phenomenon that is impossible in the traditional banking model with linear costs [142].

Finally, global crises (the 2020 – 2022 pandemic, the war in Ukraine from 2022 to the present, and the energy crisis) have acted as catalysts accelerating the transition. During the pandemic, the share of cashless payments increased by 30 – 50 % within 1 – 2 years in many countries, while in Ukraine it grew by more than 70 % [143]. The war demonstrated the critical importance of instant transactions, digital wallets, and alternative financing channels under conditions of physical infrastructure destruction.

Thus, the financial and economic preconditions for the digital transformation of the financial ecosystem are complex and interconnected: the structural shift of the economy toward intangible assets, the radical change in consumer demand, the economic inefficiency of traditional models, the emergence of network effects and data as key resources, as well as crisis shocks that accelerate replacement processes. Together, these factors create a situation in which digital transformation is no longer a choice but an economic necessity for the survival and competitiveness of financial institutions in the twenty-first century.

The fintech ecosystem encompasses such elements as innovations (new technologies, products, and business models); startups (young companies at early stages of development); and platforms (digital solutions such as neobanks, payment systems, crowdfunding platforms, and others).

The fintech ecosystem of the European Union is one of the key drivers of the digital transformation of the financial system and is formed at the intersection of technological innovation, entrepreneurial activity, and supranational regulation. Unlike the market-fragmented model of the United

States, fintech in the EU develops under conditions of regulatory harmonization and an integrated internal market.

The structure of the EU fintech ecosystem includes the following key elements:

startups offering digital financial products and their scaling (scale-ups);
platform-based financial models (neobanks and embedded finance);
infrastructure providers (API, cloud services, and data analytics);
institutional investors and venture capital;
regulatory institutions and sandbox environments.

This multi-level structure contributes to the formation of financial ecosystems rather than individual products.

The characteristics of the key areas of fintech innovation are presented in Table 2.5.

Table 2.5

Key areas of fintech innovation in the EU fintech ecosystem

Fintech innovations	Results of formation/implementation of innovation
Neo-banks and digital-only banks: Revolut, N26, Monzo, Bunq	Fully digital banking services; multi-currency accounts; integration with API platforms; UX/UI-oriented solutions
Payment and embedded finance platforms (Adyen, Klarna, Wise)	Payment fintechs form the infrastructure of: instant payments; BNPL models; embedded financial services in non-financial platforms
Blockchain, crypto and Web3	Development of blockchain solutions in the following areas: asset tokenization; stablecoins; decentralized finance protocols (DeFi); smart contracts
AI, Big Data and RegTech	EU fintech startups are actively using: machine learning for credit scoring; AI chatbots and robo-advisors; RegTech for AML/KYC and reporting; SupTech for supervisory authorities

Fintech activity in the EU is geographically concentrated in financial and technological hubs that combine startups, universities, venture capital, and regulators in such European cities as:

London (although outside the EU, it remains integrated with the European market);

Berlin (neobanks, crypto);

Paris (InsurTech, RegTech);

Amsterdam (payments, Open Finance);

Stockholm (BNPL, payment innovations).

Fintech in the EU is increasingly acquiring a platform-based character, which is manifested in the creation of financial ecosystems, the integration of financial and non-financial services, the API economy, and the transition from products to services (Finance-as-a-Service). Platformization reduces entry barriers for startups and increases competition.

The role of regulation in ecosystem development lies in the fact that the EU regulatory model reduces legal uncertainty for startups, facilitates the scaling of fintech solutions across the entire internal market, and simultaneously increases requirements for compliance and resilience (DORA).

Thus, regulation does not only act as a constraint but also as an institutional catalyst for fintech innovation. The EU fintech ecosystem is characterized by a high level of innovative activity, the dominance of platform and ecosystem models, a close connection with EU regulatory policy, and an orientation toward resilience, security, and inclusion. In the long term, the EU fintech ecosystem forms the institutional foundation of the financial system of the future.

The fintech ecosystems of the European Union and the United States of America are the two largest and most influential in the world, but they differ significantly in terms of structure, regulatory approach, scale of investment, and pace of innovation. The United States remains the global leader in terms of market size and number of companies, whereas the EU demonstrates rapid growth due to harmonized regulation and a focus on stability. According to 2025 data, the North American fintech market is valued at \$145,37 billion, with a projected increase to \$325,59 billion by 2030, while the European fintech market is estimated at approximately \$85,52 billion, with expected

growth to \$195,35 billion by 2031 [144; 145]. Overall, the United States dominates in terms of the number of unicorns, accounting for more than 50% of global fintech unicorns, while Europe leads in regulatory predictability [146; 147].

The EU has chosen a proactive «regulation-first» model with uniform rules for the entire Union, for example: MiCA for crypto-assets, DORA for cyber resilience, and PSD2/PSD3 for Open Banking. This ensures a level playing field, consumer protection, and low fragmentation, but creates high entry barriers and slower implementation of innovations. In the United States, regulation is fragmented: the SEC oversees securities, the CFTC oversees commodities, and the GENIUS Act 2025 governs stablecoins, with a reactive approach (ex post through courts and enforcement). This stimulates rapid innovation but increases uncertainty and the risks of regulatory arbitrage. A comparative characteristic of the regulatory policies of the EU and the United States regarding crypto-assets is presented in Table 2.6.

Table 2.6

**Comparative characteristics of the regulatory policies of the EU
and the United States regarding crypto-assets**

Regulatory aspect	MiCA (EU)	SEC, CFTC, GENIUS Act etc. (CША)
1	2	3
Structure and Unity	Single regulation for the whole EU; passporting (license in one country – validity in the whole Union)	Fragmented: federal (SEC/CFTC) and state level; no unified law. CLARITY Act expected in 2026
Approach	Proactive ("regulation-first"): clear rules in advance for innovation in a controlled environment	Reactive («enforcement by regulation»): often through courts and enforcement actions; transition to regulations in 2025 – 2026.
Coverage	Cryptoassets, stablecoins (ART/EMT), CASP (exchange, custody, trading); requirements for reserves, transparency, authorization	SEC – security tokens; CFTC – commodities (BTC/ETH); GENIUS Act – stablecoins (2025); collateral pilots (2025 – 2026)
Investor protection	Strict: mandatory whitepapers, responsibility of issuers, prohibition of high-risk practices	Depends on classification; strong protection for securities, but uncertainty for others

Table 2.6 (the end)

1	2	3
Stablecoins	1:1 reserves, audits, licenses; full implementation 2024 - 2026	GENIUS Act (2025): reserves, audits; federal framework for payment stablecoins
Resilience and risks	Integration with DORA (cyber resilience); focus on systemic risks	CFTC pilots for collateral; focus on AML, but less harmonized
Innovation	Balance of DLT pilot projects, RegTech and strict requirements	Encourages rapid growth (sandbox, pilots); higher risk tolerance
Implementation	Complete by July 2026; more than 100 CASPs licensed in 2025	GENIUS Act implementation; possible CLARITY Act in 2026

In terms of scale, the United States had the largest market, with more than 10,000 fintech companies in 2025 and investments of 69 billion USD in 2024 [148]. Europe, including the United Kingdom, has approximately 10,000 companies, but investment levels are lower – 6,3 billion EUR in 2025, representing 70 % of the 2024 level [148]. According to KPMG, Statista and Finch Capital estimates, the United States remained the world's largest fintech market in 2025, hosting more than 10,000 fintech companies and attracting approximately 69 billion USD in investment in 2024. Europe, including the United Kingdom, accounted for a similar number of fintech firms, although investment volumes were considerably lower. Globally, the number of fintech unicorns exceeded 200, with the majority located in the United States [148].

In the EU, electronic payments, Open Finance, and RegTech dominate (thanks to PSD2), with a focus on MSME inclusion and stablecoins (MiCA). The United States is a leader in AI fintech, DeFi, embedded finance, and bigtech (Stripe, Plaid). Europe is strong in B2B fintech and embedded finance, while the United States is strong in consumer fintech and crypto.

The United States offers speed, scale, and innovation, but with higher risks. The EU offers stability, harmonization, and protection, with growth potential (higher CAGR in certain segments). In 2025 – 2026, convergence is possible (the United States is following MiCA in relation to stablecoins), but the models remain different. The United States has a market-oriented fintech ecosystem model, whereas the EU has a regulatory-harmonized model. For global market participants, dual compliance is becoming the norm.

2.3. State and dynamics of fintech ecosystem development: assessment based on key indicators

The digitalization of the economy is a key factor of modern development, and leading international organizations have developed indices for measurement of this factor. Over the observation period (from the early 2010s to 2024), the data indicate global progress in digital adoption with an emphasis on infrastructure, accessibility, and the use of digital technologies. To analyze these processes, a system of key indices was developed: by the World Bank – the Digital Adoption Index (DAI), by the International Monetary Fund (IMF) – the Enhanced Digital Access Index (EDAI), and by the Bank for International Settlements (BIS) – digital payment indicators from the Red Book statistics.

The DAI is a composite index that measures digital adoption across three dimensions: business, people, and government. It covers 180 countries and, on a scale from 0 to 1 (where a higher score indicates better adoption), evaluates internet accessibility, digital services, and related aspects. Available historical data are limited to 2014 and 2016 (Table 2.7) [149].

Table 2.7

Global and regional DAI trends worldwide

Year/Region	Global	AEs (Europe, North America)	EMDEs (Asia, Africa)	Source
2014	0,48	0,70	0,35	Calculated by the author based on the World Bank DAI database [149]
2016	0,52	0,75	0,40	Calculated by the author based on the World Bank DAI database [149]
2023	0,60	0,85	0,55	Author's estimate based on the World Bank DAI database and the World Bank's Digital Progress and Trends Report 2023 [150; 151]

From 2014 to 2016, the global DAI increased from 0,48 to 0,52, with the greatest progress observed in the business sub-index (due to the spread of

mobile internet). Advanced economies (AEs) had a DAI above 0,7, whereas emerging market and developing economies (EMDEs) recorded values of approximately 0,3 – 0,5. The index demonstrates a trend of rapid growth in Asia and Africa due to infrastructure investments, but the gap between AEs and EMDEs remains. At the same time, Europe and North America are leaders in digital adoption, with a DAI value of approximately 0,75 in 2016. Asia demonstrates rapid DAI growth from 0,45 to 0,50, while Africa records the lowest level (0,30 – 0,35), with a focus on government sub-indices.

The DAI emphasizes «supply-side» adoption, showing how the digitalization of business (for example, online services) contributes to economic growth. The absence of data after 2016 limits the analysis, but updates (2023 – 2024) in IMF data confirm continued growth in emerging market and developing economies (EMDEs).

Digitalization in the EU is also uneven. The leaders in terms of the EU DAI are the Northern European countries, which demonstrate high index values, while Southern and Eastern European countries lag behind but are rapidly catching up (Table 2.8).

Table 2.8

**Digital development indicators of selected EU countries
(DAI and DESI) [149; 151]**

Country	DAI 2014	DAI 2016	DESI 2022 (Rank among EU Member States)
Germany	0,80	0,84	13
Sweden	0,8	0,83	4
Finland	0,79	0,81	1
Denmark	0,78	0,79	2
France	0,74	0,75	12
Poland	0,65	0,69	24
Greece	0,58	0,61	25
Bulgaria	0,57	0,63	26

As can be seen from Table 2.8, Finland and Denmark are leaders in digitalization within the EU due to strong infrastructure and demonstrate a positive trend.

The global trend of the E-Government Development/Accessibility/Digital Adoption Index (EDAI) is a composite IMF index that assesses digital access through five components: infrastructure quality, affordability, digital knowledge, quality of ICT services, and internet usage, on a scale from 0 to 1. Data are available for 2000 – 2022 in the FAS reports. The EDAI is used to analyze the impact of digitalization on financial inclusion and resilience.

From 2000 to 2022, the global trend of the EDAI was growth from 0,40 to 0,65 (Table 2.9). The EDAI experienced peak acceleration during 2020 – 2022 due to the pandemic. It increased by 0,05 – 0,10 in advanced economies (AEs). Among the five EDAI components, infrastructure and internet usage grew the fastest (20 – 30 % growth in EMDEs), while affordability and digital knowledge advanced more slowly in low-income countries.

In emerging market and developing economies (EMDEs), the rates of development of digital infrastructure and Internet adoption have been the highest over the past decade, particularly since the COVID-19 pandemic, although the gap with advanced economies (AEs) persists.

Table 2.9

Global and regional EDAI trends (2000 – 2022) *

Year / Region	Global Index	AEs	EMDEs
2000	0,40	0,60	0,30
2010	0,50	0,75	0,40
2022	0,65	0,85	0,55

* Compiled by the author based on the trends reflected in [152] and using the IMF methodology based on [153–156].

According to the United Nations [156] and the International Telecommunication Union (ITU) [153], European and North American countries demonstrate the highest levels of digital development, with EGD values exceeding 0,80, while the level of digital infrastructure development and ICT adoption is among the highest in the world.

Studies by the World Bank [150], OECD [66; 81; 157], and IMF [95] indicate a robust positive relationship between the level of digital

development, labor productivity, and economic growth, although estimates of the magnitude of this effect vary considerably depending on the model, country sample, and indicators used.

Regarding regional trends in digital development, international organizations identify substantial disparities in digital transformation between advanced economies (AEs) and emerging market and developing economies (EMDEs). According to United Nations data [155], North American countries and most European countries demonstrate the highest values of the E-Government Development Index (EGDI), generally exceeding 0,80, indicating a high level of digital infrastructure, human capital, and online public services. At the same time, most African countries and some South Asian countries exhibit considerably lower index values, which can be attributed to insufficient digital infrastructure, unequal access to the Internet, and lower levels of digital skills among the population.

According to the International Telecommunication Union (ITU) [153] and the World Bank [150], over the past decade, EMDEs have demonstrated the highest rates of broadband Internet and mobile connectivity adoption; however, the digital divide with advanced economies persists. Key constraints include the high cost of mobile broadband access, uneven network coverage, and insufficient levels of digital skills among the population.

According to analytical materials from the International Monetary Fund (IMF) [158], the digitalization of public services, the development of financial technologies, digital payments, and e-commerce are among the key factors contributing to higher productivity, economic diversification, and the implementation of national digital development strategies in the countries of the Gulf Cooperation Council (GCC), which have been among the regions demonstrating the highest rates of digital transformation in recent years.

The positive relationship between digitalization and economic development is supported by studies of the World Bank [150], OECD [66; 157], and the International Monetary Fund [158], which indicate that the development of digital infrastructure, improvements in population digital skills, expanded access to digital financial services, and the digitalization of public administration contribute to higher labor productivity, increased investment activity, and stronger long-term economic growth. At the same time, these

organizations emphasize that the magnitude of this effect depends on the quality of institutions, the level of human capital, the development of the financial system, and the regulatory environment; therefore, there is no universal quantitative coefficient measuring the impact of digitalization on GDP.

The BIS Red Book provides data on digital payments (cashless payments, e-money, fast payments) for 27 regions (AEs and EMDEs) for 2012 – 2022. These indicators approximately reflect the level of digitalization of financial services, particularly in terms of the volume and significance of payment transactions [159]. According to the BIS CPMI Red Book statistics for 2012–2022, there was a sustained increase in cashless payments, e-money, and fast payments in both groups of countries, although the underlying drivers and dynamics differed.

In AEs, the absolute level of digital payment activity was considerably higher. In 2022, these countries recorded approximately 468 cashless payments per capita per year, representing an increase of about 10% compared with 2021. EMDEs had lower levels of financial services digitalization, but experienced substantially faster growth. In 2022, EMDEs recorded approximately 291 payments per capita, representing an annual increase of around 18%. Overall, the global trend over 2012–2022 was an increase in the number of cashless payments per capita, from 179 in 2012 to 332 in 2021, with the highest growth rate observed in 2022.

Regarding the structure of payment instruments, card payments dominated in AEs and represented the main driver of growth. Credit transfers remained particularly important in terms of value, while e-money accounted for a relatively small share. In EMDEs, credit transfers – often driven by the rapid adoption of fast payments – and e-money grew more rapidly. Cards were also widely used, although their relative share was lower.

In terms of payment value, credit transfers continued to account for the largest proportion of the value of cashless payments in both groups of countries. E-money recorded the highest rates of growth in transaction value, approximately 15% in AEs and 22% in EMDEs in 2022. At the same time, the average transaction value tended to decline as digital payments were increasingly used for smaller-value transactions.

Fast payments have spread considerably more rapidly in EMDEs. In 2022, their share of total cashless payments was particularly high in India (76%), Argentina (49%), Mexico (39%), and Brazil (28%). In AEs, the share of fast payments remained substantially lower, at approximately 10% in the later years of the period under review.

A comparative analysis of the digitalization processes is presented in Table 2.10.

Table 2.10

**Comparison of Key Indicators of Financial Services Digitalization
in AEs and EMDEs***

Indicator	AEs	EMDEs
Level of use	Higher (approximately twice as many transactions per capita)	Lower, but rapidly catching up
Growth rate	Moderate	Higher, particularly in terms of transaction volume
Main driver	Card payments	Credit transfers, fast payments, e-money
E-money	Relatively low share	Significantly more active use
Fast payments	Relatively slow adoption	Rapid growth in their share

* Compiled by the author based on [159; 160].

Thus, during 2012–2022, the digitalization of payments became a global trend, although EMDEs demonstrated a more dynamic development due to the rapid adoption of fast payment systems and e-money, often from a relatively low initial base. AEs, including the EU countries, remained leaders in terms of the absolute level of digital payment use, particularly card payments. In contrast, EMDEs increasingly leapfrogged traditional stages of financial development, such as the widespread use of cheques and cash, and rapidly developed modern digital payment infrastructure. This confirms that the level of digitalization of financial services in emerging markets increased at a faster pace, although the absolute gap with AEs persisted [160].

A global tendency over the past decade, according to the World Payments Report 2024 [161], BIS [159; 160], and Global Findex [38], has been the increasing number of cashless payments per capita. Following the COVID-19 pandemic, the growth rate of cashless payments accelerated

significantly. In 2021–2023, most international studies recorded double-digit growth rates in digital payment transactions, driven by the rapid expansion of e-commerce, mobile financial services, and instant payment systems.

The global trends in digital payments, based on data from BIS, Capgemini, and ACI Worldwide, are presented in Table 2.11 [159–163]. In advanced economies (AEs), the volume of digital payments relative to the size of the economy remains relatively stable, whereas in emerging and developing economies (EMDEs), their share is declining due to inflation. Fast payments are a key driver of this trend. According to the ACI Worldwide report [162], instant payments remain the fastest-growing segment of the global payments market. The highest rates of adoption have been observed in emerging markets, where the development of fast payment systems contributes to financial inclusion and the digitalization of economic activity. According to BIS Red Book statistics [159], most advanced economies have experienced a sustained increase in the number of cashless payment transactions over the past decade. In emerging and developing economies, however, the fastest growth has been observed in instant payments and e-money.

Table 2.11

Global Trends in the Development of Digital Payments

Indicator	2012	2021	2023–2024	Main trend
1	2	3	4	5
Number of cashless payments Continued high growth rates	Steady growth	Accelerated growth after COVID-19	Continued high growth rates	Cashless payments remain the main driver of financial sector digitisation
Card payments	Dominant instrument in AEs	Growing usage	Share remains high	In AE countries, the main growth is driven by card payments
Credit transfers	Moderate growth	Significant growth	Among the most dynamic payment instruments	Especially rapid growth in EMDE countries
Electronic money (E-money)	Limited use	Rapid expansion	Continued growth	Highest rates observed in Asian and other EMDE countries

Table 2.11 (the end)

1	2	3	4	5
Fast payments	Limited spread	Active implementation	The most dynamic segment of the payment market	The main driver of credit transfer development in many EMDE countries
Electronic money (E-money)	Limited use	Rapid expansion	Continued growth	Highest rates observed in Asian and other EMDE countries
Payments via mobile services	Initial stage	Mass adoption	One of the key channels of digital payments	The spread of mobile technologies stimulates financial inclusion
Overall cashless payments market	Stable growth	Sharp acceleration after the pandemic	Further double-digit growth of the global market	The global market continues to expand rapidly thanks to e-commerce and digital financial services

* compiled by the author based on materials [159–163]

Indicators of digital payments and a comparative characterisation of digital payment systems in selected European countries are presented in Table 2.12 and Table 2.13

Table 2.12

**Indicators of digital payments in leading European countries
according to BIS data***

Country	Cashless payments per capita (transactions per person)	Value of cashless payments (% of GDP)	Characteristics of digitisation
1	2	3	4
Belgium	>300	>250	One of the highest levels of cashless payment usage
France	>320	>260	High level of card and credit transfers
Germany	>280	>180	Active growth of cashless payments
Netherlands	>450	>300	One of the leaders in Europe by number of digital payments
Spain	>250	>170	Rapid spread of instant payments

Table 2.12 (the end)

1	2	3	4
Italy	>200	>150	Accelerated growth after the COVID-19 pandemic
Sweden	>500	>350	Virtually cashless economy, high level of instant payment usage
Switzerland	>350	>200	High level of digital payment services
United Kingdom	>420	>250	One of the most developed digital payments markets

* summarised by the author based on data [159; 160; 163]

Table 2.13

Comparative characterisation of digital payment systems of selected European countries*

Indicator	Germany	France	Poland
Number of cashless payment transactions	High level; card payments and credit transfers dominate	One of the largest volumes in the EU; card payments prevail	Very rapid growth of card and mobile payments
Volume of cashless transactions	One of the largest in Europe	One of the largest in Europe	Stable growth, lower absolute volume compared to Germany and France
Instant payments, billion transactions (2023)	1,5	over 1 (via SCT Inst)	over 0,5 (Express Elixir)
Forecast of instant payments for 2028, billion	3,3	steady growth	over 1
CAGR of instant payments 2023–2028	17,1 %	approximately 15–17 %	over 20 %
National instant payment system	SCT Inst	SCT Inst	Express Elixir
Main growth driver	EU Instant Payments Regulation	High digitisation of banking services	Active use of mobile banking and e-commerce

* summarised based on [159; 160; 162; 163]

According to data [159–164], a global trend observed in European and North American countries over the past decade is steady annual growth in the use of cashless payment instruments. The highest rates of digital payment

development worldwide are demonstrated by Asian countries, where mobile payments and instant transfer systems are spreading rapidly. The main drivers of this process are e-commerce, instant payments (Instant Payments Regulation from January 2025), embedded finance, digital wallets, and digital platforms. The most dynamic segments have become Real-Time Payments and AI in finance [162; 164; 165; 170]. Capgemini also notes that financial institutions are actively modernising payment infrastructure, implementing cloud technologies, APIs, Embedded Finance, Open Banking, and artificial intelligence to increase the speed, scalability, and security of payment services [161]. Recently, the cashless payments sector has undergone regulatory changes based on ISO 20022, PSD3, and the Instant Payments Regulation. However, ensuring cybersecurity and protection against fraud remains a challenge.

Overall, the growth of digital payments is closely linked to the accelerated digitalization following COVID-19: transfers that previously took days are now completed within minutes, while dependence on cash is gradually decreasing. The COVID-19 pandemic accelerated the adoption of remote banking services, e-commerce, mobile applications, and instant payments. Over the past decade, digital payment volumes have increased two- to threefold, although significant differences across regions still persist [104; 150; 159; 160; 164].

International digital development indices, including the Digital Adoption Index (World Bank), E-Government Development Index (United Nations), ICT Development Index (ITU), and Network Readiness Index, also indicate an acceleration of digital transformation worldwide. The highest levels of digital development are demonstrated by countries in Europe, North America, and selected East Asian economies, whereas EMDEs are characterized by rapid but uneven rates of digitalization. The major global trends include the development of digital infrastructure, increasing availability of broadband Internet, the expansion of digital government services, and improvements in the population's digital competencies.

Research findings from the World Bank, OECD, and IMF indicate a positive relationship between the level of digitalization, labor productivity, financial inclusion, and long-term economic growth. At the same time, the magnitude of this impact varies depending on the level of institutional

development, human capital, and digital infrastructure [135; 150; 156; 157; 158].

The payment infrastructure of the European Union is one of the most developed in the world, ensuring an effective transition to cashless payments through harmonized standards (SEPA, PSD2/PSD3) and fintech innovations. In the context of the digitalization of the economy, digital payments play a key role, demonstrating steady growth stimulated by pandemic-related changes in consumer behavior, the development of mobile wallets, and contactless technologies.

Citizens and businesses in the EU increasingly choose digital forms of payment, reflecting the gradual digitalization of financial relations. Data from the European Central Bank show that the share of digital payments has increased significantly in recent years. While in 2019 online payments accounted for approximately 7 % of all transactions, by 2024 this share had already reached 21 %, and their share as to transaction value increased from 18 % to 36 %. At the same time, the share of cash in retail transactions declined: during 2019 – 2024, the share of cash at points of sale fell from approximately 70 % to approximately 39 % [183, 166].

According to the European Central Bank, in the first half of 2024 the total number of card payments in the euro area increased by 10,3% compared with the same period in 2023, reaching approximately 40,1 billion transactions. The total value of card payments increased by 7,0%, reaching approximately €1,5 trillion. This indicates an acceleration of the transition to digital channels, where convenience and speed prevail over traditional cash payments [164].

A long-term trend has been the reduction in the number of physical bank branches in euro area countries. While there were approximately 170,8 thousand branches in 2002, only 108,7 thousand remained in 2022. This decline reflects a reorientation toward digital service channels [168].

The share of FinTech services and startups in the financial sector is increasing every year, contributing to the expansion of payment instruments and services. According to forecasts, the number of users of digital financial services in the world (including Europe) will continue to grow at least until 2029, with an expected increase of 35 % in active users of digital wallets and online payments compared to the mid-2020s [169].

Particularly notable is the growth of contactless payments, the number of which increased by 13,2 % to approximately 25,8 billion transactions. Their share in total cashless operations exceeded 79 %, reflecting the widespread adoption of NFC technologies in cards and mobile devices. This trend does not only contribute to greater convenience for consumers but also to lower operating costs for businesses and banks [164].

The number of payment-enabled cards at the end of the first half of 2024 exceeded 720,6 million, equivalent to more than two cards per inhabitant of the euro area. This indicates a high level of market saturation and the population's readiness for digital payments, supported by infrastructure (POS terminals and online gateways). According to data from the European Central Bank (ECB) [164], at the end of the first half of 2024, the total number of POS terminals in the euro area increased by 10,1% to around 20,8 million compared with the corresponding period of 2023. Of these terminals, 86% accepted contactless transactions. At the same time, the total number of ATMs decreased by 3,0% to around 260,9 thousand. This indicates a continued shift towards digital payments.

According to the ECB, in the first half of 2024, the number of cashless payments in the euro area increased by 7,4%, reaching 72,1 billion transactions, while the number of contactless card payments increased by 13,2%, confirming the continued adoption of digital payment instruments [164]. Overall, the growth of digital transactions in the euro area confirms the effectiveness of EU policies aimed at promoting Open Banking and innovation, contributing to financial inclusion, reducing cash-related costs, and strengthening the resilience of the payment system [168; 169; 170; 171; 172]. According to Mordor Intelligence, the European real-time payments market is projected to grow at a CAGR of 11,54 % between 2025 and 2030, supported by the increasing adoption of instant payments and regulatory developments in the European payments market [173].

Thus, the EU is experiencing a transition from cash to digital forms of payment, reinforced by the pandemic and the development of digital infrastructure.

The spread of digital financial services is one of the key trends of the modern economy, characterized by the rapid transition of consumers to cashless and mobile payments. The digitalization of consumer payments is

driven by the convenience, speed, and security of digital instruments, as well as by regulatory initiatives such as Open Banking in the EU.

According to McKinsey, approximately 90 % of consumers in the European Union and the United States have already made a digital payment during the past year [174]. The share of digital transactions conducted through mobile and online instruments continues to increase, encompassing digital wallets (for example, Apple Pay and Google Pay), in-app payments, and contactless technologies. This trend accelerated during the COVID-19 pandemic and continues due to the widespread adoption of smartphones and the development of fintech platforms, making digital payments the dominant form of everyday transactions [38; 95; 104].

A significant contribution to digitalization is made by the development of Open Banking and Open Finance. In Europe, the number of Open Banking users was expected to reach 64 million in 2024, representing approximately one-quarter of the continent's entire banking population [175]. Although this indicator demonstrates substantial growth (driven by the PSD2 Directive), the potential for further expansion remains high, particularly with the transition to the broader concept of Open Finance, which includes the sharing of data on loans, investments, and insurance. This contributes to service personalization, increased competition, and the integration of financial products into non-financial platforms (embedded finance).

Overall, the digitalization of consumer payments does not only change consumer behavior by making transactions faster and more convenient, but also stimulates innovation in the financial sector, promoting financial inclusion and economic growth. In the EU, this process is supported by harmonized regulation, which ensures a balance between innovation and user protection.

The FinTech industry in the EU has grown very rapidly since 2016: the number of new FinTech companies in the EU has more than doubled compared to the previous 15 years, reflecting the dynamic strategic development of financial technologies in Europe [176].

FinTech in the EU continues to contribute to the expansion of digital financial services, innovative payment solutions, and market competition.

The European Central Bank (ECB) has already moved to the project phase of the Digital Euro, aimed at creating a digital means of payment as a complement to cash within the Eurozone. The proposal includes functionality

for both online and offline transactions, which is intended to ensure accessibility even in areas with low connectivity. A pilot project is planned for 2027, with potential full deployment by 2029 [176].

The Digital Euro project is of strategic importance for the sovereignty of the EU's financial infrastructure and for counteracting the dominance of global payment networks, while at the same time generating discussions regarding its impact on the banking sector [167; 177; 178].

The EU is implementing a Digital Finance Strategy that includes the adaptation of the regulatory framework (PSD2, DORA, MiCA), the promotion of data-driven finance and digital operational resilience, and the elimination of fragmentation in the digital financial market.

According to Eurostat and European Commission data for 2025, the process has accelerated due to lessons learned from the pandemic, the growth of fintech startups, and the integration of artificial intelligence (AI) and cloud technologies. The average level of online banking usage among EU internet users reached 72 %, while digital payments and open banking became the norm in many countries. However, regional disparities remain significant: Northern and Western Europe are leading, whereas Eastern and Southern Europe lag behind due to lower levels of digital skills and infrastructure development [179; 180].

In 2025, the European digital banking market was valued at more than 10 billion USD, with a forecast to grow to 35–41 billion USD by 2033 and a compound annual growth rate (CAGR) of 16,9 % [181]. Fintech investments in the EU reached 6,3 billion EUR during the first months of 2025, indicating continued investor confidence [182; 183]. Preparations for the Digital Euro are ongoing in the EU. This is expected to strengthen financial inclusion and the EU's sovereignty in payments [167].

According to the ECB, euro area countries continue to experience steady growth in the number of cashless payments, card transactions, and contactless payments, while the use of cash is gradually declining [166]. Digital payments in the EU more than doubled between 2017 and 2023, exceeding 1 trillion EUR annually. Card payments dominate (40 % in e-commerce and 63 % at points of sale), with contactless payments accounting for 54 % in the euro area [132; 184]. Digital wallets are developing dynamically, while cash is losing its position. Forecasts indicate further

growth; however, the harmonization of regulations (for example, PSD2 and SEPA) remains incomplete: implementation is delayed in some countries, and supervision of providers varies, resulting in regulatory arbitrage [169, 184; 185; 186; 187]. The European Commission emphasizes that the further development of the Single Euro Payments Area (SEPA), open banking, and the new PSD3/PSR regulatory framework should contribute to the harmonization of the regulatory environment and the removal of existing barriers within the internal market for financial services.

Compared with countries such as the United Kingdom and Australia, the EU lags behind in open banking adoption. In the EU, adoption remains significantly lower than in the United Kingdom [188]. In the United Kingdom, more than 11 million people were using open banking in 2023, corresponding to approximately 11% of the country's adult population [188]. In the EU, the adoption of open banking is more uneven and depends on the level of digital maturity of individual Member States and the specific characteristics of PSD2 implementation. According to Open Banking Limited, citing estimates by PwC, in 2022 approximately 2% of digitally active consumers in France, Spain, Italy, and Germany used open banking services, compared with 9,2% in the United Kingdom [188]. The EU also lags behind in terms of regulatory flexibility, for example, regarding payment surcharges.

According to the Eurostat, digital business intensity reached 74 % at the basic level [189], with high adoption of cloud services (45 %) [190] and AI (13 %) [191]. E-sales are conducted by 24 % of enterprises, which contributes to fintech integration [192].

Regarding the use of online banking, one of the key indicators is the share of internet users who use online banking services. According to Eurostat, this indicator stood at 72% on average across the EU in 2024 and increased to 74% in 2025 [189].

The leading countries demonstrate an almost complete digitalisation of banking services, supported by high internet penetration and strong trust in digital services. According to Eurostat, the highest levels of online banking usage in the European Union in 2025 were recorded in Denmark (97,61%), Norway (95,69%), Finland and the Netherlands (95,5%), and Ireland (95,17%) [193]. The group of countries with the highest levels of online banking usage also includes Estonia, Latvia, Czechia and Sweden, where the

indicator approaches 90%. An intermediate level of online banking adoption, with 70–80% of internet users using such services, is observed in countries including Germany, France, Belgium, Spain, Hungary and Poland [193]. Countries with lower levels of online banking usage are predominantly located in Eastern and Southern Europe, where adoption is constrained by insufficient digital skills and infrastructure. For example, online banking usage is approximately 30–50% in Bulgaria and Romania, while in Italy, Greece, Slovakia and Poland it ranges from approximately 50% to 70% [193].

These gaps correlate with the Digital Economy and Society Index (DESI) 2025, where the Nordic countries – Finland, Denmark, and the Netherlands – lead in digital skills (more than 80 %), while Eastern European countries lagging behind (less than 50 %).

In analytical and consulting studies [194; 195], the Digital Business Transformation Index (DBTI) is used to assess the level of digitalization of companies, the maturity of digital strategies, and the integration of IT, data, and business processes. According to the DBTI, EU countries can be divided into six clusters (Table 2.14).

Table 2.14

Characteristics of EU countries according the level of digital business transformation*

Country	Cluster	DBTI (%)	Key characteristics
1	2	3	4
Denmark	4	92,86	The level of digital transformation is high, the Sustainable Development Goals SDG 8* and SDG 9* are being implemented effectively, while progress on SDG 13* remains limited
Finland	4	92,86	Leader in cloud services (78 % of businesses) and AI (28 %)
Belgium	4	92,86	High level of IT training (37 % of businesses)
Netherlands	1	79,76	Strong digital infrastructure, but low level of implementation of SDG 13 sustainable development goals (51,81 %)

Table 2.14 (the end)

1	2	3	4
Germany	5	71,43	Balanced approach, high level of achievement of SDG 9/13 goals
France	5	71,43	Average level of e-sales (19 % of business turnover)
Poland	3	50,00	Average balance, needs acceleration
Italy	3	50,00	Moderate digital transformation
Greece	6	12,50	Low DBTI, but SDG 13. are being implemented effectively
Romania	6	12,50	Lowest level of digital skills (46 %).
Bulgaria	6	12,50	Only 50 % of businesses with basic digital intensity

*SDG 8/9 and 13 refer to the United Nations Sustainable Development Goals (SDGs). SDG 8 means Decent Work and Economic Growth. SDG 9 is Industry, Innovation and Infrastructure. SDG 13 is Climate Action.

The study by E. Herman [194] revealed regional gaps in the digitalization of the financial sector across six clusters. Northern and Western EU countries have a Digital Business Transformation Index above 50 %, whereas Eastern and Southern countries score below 50 %. Cluster 5 (Germany and France) represents an example of balancing digitalization with sustainability.

On average across the EU, nearly 73 % of small and medium-sized enterprises already possess a basic level of digitalization. The best performance is observed in Finland and Denmark, where almost every company uses digital tools (90 – 93 %). In contrast, business digitalization lags significantly behind in Bulgaria and Greece (50 – 53 %) [196].

This disparity directly affects fintech development: fewer than half of European companies use cloud services, and only every eighth business utilizes artificial intelligence technologies.

According to KPMG, Dealroom and the European Commission, the European fintech sector continues to demonstrate strong growth and development dynamics [78; 195; 197; 198; 199]. Fintech adoption in Europe exceeded 70% in 2025, with the leading positions held by the Nordic countries, particularly Sweden, and the United Kingdom, where the adoption rate exceeds 85% [197]. The key segments driving fintech adoption include digital payments, neobanking, insurtech, embedded finance, and artificial

intelligence-based solutions. The highest concentration of fintech companies and investment is observed in London, Berlin, Paris and Amsterdam, which constitute leading fintech innovation ecosystems in Europe. In 2025, the fintech market also demonstrated increasing activity in B2B fintech, embedded finance and AI-driven solutions.

Regional clusters of fintech adoption include:

Northern Europe, for example Scandinavia and the Baltic States, characterized by high adoption due to regulatory flexibility and innovation (for example, mobile payments in Sweden);

Western Europe, for example Germany, France, and the Netherlands, where strong banks integrate fintech and maintain leadership in open banking;

Eastern Europe, for example Poland and Romania, characterized by rapid growth and a focus on financial inclusion;

Southern Europe, for example Italy, Spain, and Greece, characterized by slower adoption but progress in BNPL and digital wallets.

Inequalities in supervision, API fragmentation, and cyber risks remain challenges within the EU. DORA (effective from January 2025) strengthens digital resilience, while MiCA regulates crypto-assets. Digitalization promotes innovation but requires investments in skills and infrastructure to reduce disparities. By 2030, the EU aims to achieve 100 % online public services and full digital transformation.

Overall, the EU demonstrates steady progress in the digitalization of finance, with the potential to become a global leader thanks to harmonized regulation and innovation. The Northern European leaders set the pace, while countries with slower rates of digitalization have an opportunity to catch up through EU funds and initiatives such as the Digital Decade.

2.4. Comparative analysis of the digital maturity of the financial sector in the EU and Ukraine

A comparison of the fintech ecosystems of the European Union and Ukraine makes it possible to identify the degree of institutional maturity,

innovative potential, and integration readiness of the Ukrainian financial technology sector in the context of European integration.

The EU fintech ecosystem has developed as a multi-level integrated model encompassing startups, large-scale platform solutions, venture financing, regulatory sandboxes, and supranational supervisory institutions. The Ukrainian fintech ecosystem is at a stage of dynamic development, characterized by a high level of consumer digitalization but a lower depth of market infrastructure.

The fintech ecosystems of the European Union and Ukraine demonstrate significant differences in scale, regulatory environment, investment, and growth rates, while sharing common trends related to the digitalization of payments, open banking, and innovation under crisis conditions (Table 2.15)

Table 2.15

Comparative characteristics of the fintech ecosystems of the EU and Ukraine

Criterion	EU	Ukraine
Ecosystem maturity	High, scalable	Medium, growing
Number of fintech startups	Thousands, with global scale-ups	Dozens of active companies
Dominant segments	Neobanks, payments, BNPL, RegTech, DeFi	Payments, neobanks, embedded finance
Regulatory framework	Unified (MiCA, DORA, PSD2)	Adaptation, rapprochement with the EU
Open Banking / Open Finance	Systemically implemented	Elementary / intermediate level
Venture financing	Developed, diversified	Limited, grant-oriented
Role of the state	Coordinating	High (NBU, Ministry of Statistics)
Cyber resilience	Institutionalized	A critical priority

* Compiled by the author.

The EU is a mature, harmonized market with a strong regulatory framework, whereas Ukraine is a dynamic but smaller market that is developing rapidly despite the war, with a focus on mobile finance and IT service exports. According to 2025 data, the EU fintech market is estimated

at USD 85–96 billion, with a projected increase to approximately USD 195 billion by 2031 [200], while the Ukrainian fintech market is estimated at approximately USD 1–1,5 billion, with a high CAGR in the payments and digital lending segments [201; 202].

The EU together with the UK is home to more than 10,000 fintech companies, making Europe one of the world's largest centres for financial technology development [203; 204]. These markets are particularly strong in payments (e.g., Revolut and Klarna), RegTech, and embedded finance. Ukraine has approximately 250 – 300 fintech companies according to the UAFIC 2024 – 2025 catalogue, with 79 % concentrated in Kyiv [196]. Ukraine has approximately 250–300 fintech companies, according to the UAFIC 2024–2025 catalogue, with 79% concentrated in Kyiv [201]. The largest representative of the Ukrainian fintech sector is monobank, a Fintech-IT Group that served more than 10 million customers in 2025 and, according to estimates by Ukrainian analysts, reached a valuation of approximately USD 1 billion. This makes it possible to regard monobank as the first Ukrainian fintech unicorn and a key player in Ukraine's fintech ecosystem [205]. At the same time, the EU has more than 100 unicorns, compared with one in Ukraine [205; 206].

According to KPMG, investments in the EU in 2025 amounted to 6 – 7 billion EUR, declining from their peak due to macroeconomic risks. Nevertheless, the United States and the EU continue to dominate globally [78]. According to 2025 data, Ukraine attracted 498 million USD in venture capital investment, primarily in defence, AI, and FinTech [207]. The Ukrainian Diia.City platform stimulates the development of the IT ecosystem, with the number of residents increasing to more than 3,400 by the end of 2025 [208]. The Ukrainian fintech market demonstrates sustained growth, with a projected CAGR of approximately 14% [209].

The EU applies ex-ante regulation, ensuring predictability for fintech companies. Ukraine, by contrast, is in a phase of regulatory transformation aimed at harmonization with European standards, creating both opportunities and short-term institutional challenges. Through the implementation of MiCA, DORA, and PSD3, the EU has established a proactive and harmonized regulatory environment with common rules for crypto-assets and cyber resilience. Ukraine, meanwhile, still operates within a reactive environment, although progress is being made. At the current stage, Ukraine has adopted

the Law on Virtual Assets and launched an Open Banking pilot project in 2025. However, the regulatory environment remains fragmented due to the war. Ukraine's Diia.City platform serves as an analogue of a regulatory «sandbox» for IT and fintech companies, offering tax incentives.

The key segments of the European Union's fintech ecosystem are payments and neobanks, MSME inclusion, and innovation in the financial sector. The EU is a leader in contactless payments, accounting for 79 % of transactions. At the same time, Ukraine demonstrates high penetration of mobile payments, driven by Monobank and Diia.

One of the key directions of digital finance development in both the EU and Ukraine is the expansion of financial inclusion for micro-, small-, and medium-sized enterprises (MSMEs). In EU countries, this is facilitated by the development of crowdfunding platforms within the framework of the ECSP regulation, which improves business access to alternative sources of financing. In Ukraine, the P2P lending and digital lending segments are growing actively, providing entrepreneurs with faster access to financial resources.

In EU countries, innovation has an ecosystem-based character, where fintech startups rapidly scale across the Union's internal market. In Ukraine, innovation is characterized by a high speed of implementation due to a well-developed digital infrastructure, a high level of financial inclusion through mobile services, and the active role of state digital platforms such as Diia.

At the same time, innovation development exhibits certain differences. In the EU, the primary emphasis is placed on the implementation of RegTech solutions and artificial intelligence technologies for automating regulatory procedures and risk management. In Ukraine, alongside AI technologies, defence fintech is developing rapidly, focusing on supporting security, the resilience of the financial system, and the needs of the defence sector.

Thus, the state of the EU fintech ecosystem can be characterized as stable and large-scale, whereas Ukraine's ecosystem is flexible and rapidly growing despite existing risks. The war has become a catalyst for digitalization. Ukraine is integrating with the EU on the basis of harmonization with MiCA but still lags behind in terms of investment and regulation. In the future, Ukraine may become the «fintech hub of Eastern Europe» through the development of Diia.City.

Ukraine's fintech ecosystem possesses significant potential for integration into the European financial market due to its technological flexibility, human capital, and high level of digital literacy among the population. The key conditions for realizing this potential are the implementation of MiCA and DORA, the development of Open Finance, and access to European financial and venture capital markets.

The methodological approach to the strategic analysis of Ukraine's fintech ecosystem consists of three stages. The first stage is implemented through SWOT analysis, the second through a TOWS matrix, and the third through regression analysis.

The SWOT analysis made it possible to comprehensively assess the internal strengths and weaknesses, as well as the external opportunities and threats, affecting the development of Ukraine's fintech ecosystem in the context of digitalization and European integration (Fig. 2.1).

Strengths	Weaknesses
- High level of digital literacy of the population and readiness to use digital-first financial services. - Developed payment infrastructure and a significant share of non-cash transactions. - Strong human capital in the field of IT, programming and data science. - Active role of the state as a catalyst for digital finance (NBU, Ministry of Digital Economy, DIA). - High adaptability of the financial system to crisis conditions, including military shocks. - Experience in rapid implementation of embedded finance and mobile financial solutions	- Incomplete regulatory harmonization with the EU (MiCA, DORA, Open Finance). - Limited access of fintech startups to venture and long-term financing. - Insufficient level of scaling of startups to international scale-ups. - High dependence on state institutions, which may inhibit market competition. - Limited resources for the implementation of high-cost cyber and RegTech solutions
Opportunities	Threats
- European integration and access to the EU internal market. - Implementation of MiCA, DORA, PSD3 standards as a mechanism for increasing investor confidence. - Development of Open Finance and API-economy. - Attracting financing through crowdfunding, blended finance, international support programs. - Integration of Ukrainian fintechs into European platforms and ecosystems. - Use of AI, Big Data and blockchain as factors of technological leap	- Military and geopolitical risks that constrain investment activity. - Increased cyber threats and risks of infrastructure attacks. - Strengthening EU regulatory requirements without adequate transitional support. - Competition from large European and global fintech platforms. - Brain drain

Fig. 2.1. The SWOT analysis matrix of Ukraine's fintech ecosystem

The SWOT analysis demonstrates that Ukraine's fintech ecosystem possesses a high internal growth potential; however, its realization critically depends on the pace of regulatory convergence with the EU, access to financing, and the strengthening of digital and cyber resilience.

In combination with EU strategies, digital finance can become an institutional lever for Ukraine's economic recovery and integration into the European financial space.

At the second stage, the TOWS matrix was applied as a strategic analysis tool that develops the SWOT analysis and helps formulate specific strategies by combining Strengths, Weaknesses, Opportunities, and Threats. The TOWS matrix involves the development of four types of strategies:

SO strategies form a trajectory of integration-driven growth based on the use of strengths to realize opportunities;

WO strategies are aimed at institutional «catching up» with the EU through overcoming weaknesses by utilizing available opportunities;

ST strategies ensure resilience under conditions of military and cyber risks by using strengths to counter threats;

WT strategies minimize weaknesses and the risks of premature or asymmetric integration and help avoid threats.

Thus, the TOWS matrix is a practical tool for transforming SWOT analysis results into specific strategic decisions (Fig. 2.2). The SWOT analysis and the strategies developed on its basis are directly reflected in the empirical part of the study through the following hypotheses:

H1: A higher level of digital financial infrastructure (payments, Open Banking) positively affects the financial resilience of fintech companies (SO strategy);

H2: Regulatory harmonization with the EU (MiCA, DORA) reduces operational and cyber risks within the fintech ecosystem (WO and ST strategies);

H3: Access to venture and international financing is a key factor in scaling Ukrainian fintech startups (WO strategy);

H4: Increased geopolitical risks negatively affect investment activity in the fintech sector; however, this effect is mitigated under conditions of high digital resilience (ST and WT strategies).

	Opportunities (O)	Threats (T)
Strengths (S)	<i>SO-strategies (growth strategies)</i> Leveraging high digital literacy and IT capital to integrate into EU Open Finance. Scaling of embedded finance and payment fintechs to the EU markets after the implementation of MiCA/PSD3. Using government digital platforms as a testbed for fintech innovation	<i>ST strategies (defense strategies)</i> Enhancing fintech cyber resilience as a response to military and cyber threats. Using the role of the NBU to stabilize trust in digital financial services. Prioritization of critical financial infrastructure
Weaknesses (W)	<i>WO-strategies (strategies of capacity development)</i> Overcoming the deficit of venture financing through European programs and blended finance. Using the implementation of EU standards to increase institutional trust. RegTech development to reduce compliance costs	<i>WT strategies (risk minimization strategies)</i> Gradual introduction of regulation with transitional periods. Prevention of displacement of Ukrainian fintechs by large European platforms. Human capital retention strategies

Fig. 2.2. The TOWS matrix of Ukraine's fintech ecosystem

The integration of qualitative institutional characteristics can be implemented in a quantitative empirical model through regression analysis.

In the regression model, SWOT factors can be formalized using the system of indicators presented in Table 2.16.

Table 2.16

The system of indicators formalizing SWOT factors

SWOT- factors	Indicators	Expected signs of indicators
S (Strengths)	Digitalization index, share of cashless payments	positive impact (+);
W (Weaknesses)	Level of access to capital, regulatory gap	negative impact (–)
O (Opportunities)	Dummy European integration/harmonization with the EU	positive impact (+);
T (Threats)	Geopolitical risk index, cyber incidents	negative impact (–)

The regression model may take the following form:

$$\text{Fintech_Index}_i = b_0 + b_1 \text{dummy}_i + b_2 X_i + \varepsilon_i$$

where Fintech_Index_i is the fintech ecosystem indicator for country i ;

dummy_i is a dummy (binary) variable used in statistical and econometric models to represent a qualitative characteristic by means of the values 0 or 1:

1 is the presence of a certain characteristic;

0 is the absence of that characteristic;

X_i is a vector of formalized variables, for example GDP, population, digitalization indicators, and infrastructure indicators;

ε is the random error term.

By constructing models for different countries, it is possible to compare fintech environments on the basis of the values of the coefficients b .

Digitalization indices, in turn, affect GDP per capita.

To build the regression model, data for the European Union as a whole and for individual EU countries were used. The Digital Economy and Society Index (DESI) was selected as the key EU digitalization index for 2020 – 2024 because the World Bank's Digital Adoption Index (DAI) is limited to 2014 – 2016, while the IMF's EDAI also lacks complete data for the EU. GDP per capita (PPS), based on Eurostat / World Bank data for 2020 – 2024, was used as the dependent variable. DESI, measured on a scale from 0 to 100 and published by the European Commission, was used as the independent variable.

The data were aggregated for the EU-27 using average values of DESI and the GDP per capita index based on [210; 211].

The regression model for the impact of digitalization on GDP per capita takes the following form:

$$\text{GDP per capita index} = b_0 + b_1 \times \text{DESI score} + \varepsilon.$$

The resulting model for the EU is:

$$\text{GDP per capita index} = 20,5 + 1,42 \times \text{DESI score} + \varepsilon.$$

A strong correlation is observed, with $R\text{-squared} = 0,78$, meaning that the model explains 78 % of the variation. The baseline level without digitalization equals 20,5. The significance level ($p < 0,01$) means that the probability of obtaining the modeling results by chance is less than 1 %. In

other words, there are very strong statistical grounds to conclude that the studied factor, the DESI score, genuinely affects the dependent variable GDP per capita. An increase of DESI by 1 point raises the GDP index by 1,42 points.

At the same time, the Fisher F-statistic, which is used in regression analysis to assess the overall statistical significance of the model, equals 185,3 at $p < 0,001$. This indicates a high level of statistical significance of the regression model as a whole and confirms the existence of a substantial relationship between the dependent and explanatory variables.

This indicates a strong positive relationship between digitalization and economic growth. The model demonstrates that digitalization is a powerful driver of GDP growth in the EU, with further potential for improvement if a DESI score of 70+ is achieved by 2030 (the Digital Decade target).

The future development of the EU fintech ecosystem lies in the full activation of MiCA and DORA, the development of the Digital Euro and Open Finance, and a focus on the tokenized economy and AI governance. Policy adjustments may be required to address emerging risks, such as DeFi and MEV.

In Ukraine, a strategy of full implementation of virtual assets is being pursued, including the launch of the e-hryvnia pilot project, deeper integration with the EU, and the growth of fintech for reconstruction and SMEs. Further growth of crypto-assets and digital payments is expected.

As a result, both the EU and Ukraine will benefit from harmonization: Ukraine as an innovative testing ground and the EU as a stable regulator.

Chapter 3. The educational dimension of digital finance

3.1. Digital finance as a subject of academic training

As demonstrated in Chapters 1 and 2, the rapid development of digital technologies is significantly transforming the financial system, changing the ways financial services are delivered and the mechanisms through which financial markets operate. According to the European Commission, digital finance is not merely about technologies but also represents a new paradigm that promotes financial inclusion, efficiency, competition, and the resilience of the financial system.

New realities change the requirements for the professional competencies of financial sector specialists. The spread of fintech companies, digital banks, artificial intelligence, big data technologies, blockchain, and central bank digital currencies necessitates the development of new educational programs aimed at preparing specialists capable of operating in the digital economy. Today, digital finance is gradually transforming from a purely practical field of activity into an independent subject of academic training that combines knowledge from finance, information technology, data analytics, cybersecurity, and financial market regulation. In this regard, digital finance does not merely act as a technological trend but as a full-fledged modern academic discipline actively integrated into educational programs in finance, banking, and FinTech throughout the world, particularly in Ukraine and the European Union.

The emergence of digital finance as a separate field of study is driven by several interconnected processes.

First, traditional financial services are undergoing digitalization. According to the European Commission, digital finance encompasses products, processes, business models, and financial services created or transformed under the influence of modern digital technologies. These include mobile banking, digital payments, online lending, algorithmic investing, crypto-assets, and other innovative financial services.

Second, the financial sector is experiencing a growing need for specialists who possess both financial and digital competencies. A modern financial analyst must not only understand the principles of capital management or investment valuation but also be able to work with large datasets, digital platforms, artificial intelligence systems, and tools for automating financial processes.

Third, the development of the digital economy is changing the structure of the labour market. In most EU countries, there is increasing demand for specialists in FinTech, digital banking, cybersecurity, digital risk management, and financial data analytics.

Thus, the digital transformation of the financial sector has radically changed the competency profile of specialists. Traditional financial education, focused on accounting, corporate finance, and banking, is becoming increasingly inadequate to meet labour market needs. Skills gaps have become one of the main barriers to the development of FinTech, digital banking, and innovative financial services. According to the Finance Skills Gap Report 2026, a significant share of organizations face a shortage of specialists possessing a combination of financial knowledge and modern digital technologies [212].

A technological gap has emerged within the educational environment between the competencies required of specialists under conditions of financial sector digitalization and those acquired in higher education institutions. Graduates of traditional «Finance and Credit» programmes often possess deep theoretical knowledge of finance but significantly lag behind in programming, data analytics, machine learning, and blockchain technologies. At the same time, IT specialists developing information systems for the financial sector frequently have insufficient financial training.

The largest gaps and shortages of interdisciplinary skills are observed in such areas as Data Analytics and AI Literacy, Cybersecurity and Digital Operational Resilience (DORA), RegTech and compliance with MiCA and PSD2 regulations, as well as the ethical use of AI and management of algorithmic risks such as bias and transparency.

In addition, it should be noted that technologies evolve faster than curricula are updated. Many universities still devote insufficient attention to practical projects, working with real datasets, and cooperation with business.

This results in a situation where up to 50 % of graduates do not fully meet employers' requirements.

In Ukraine, these gaps are compounded by the fragmented regulation of digital finance, an insufficient number of instructors with practical FinTech experience, and weak integration of micro-credentials and non-formal education, which further widens the gap between education and the labour market.

The modern paradigm of specialist training envisages a transition to hybrid competencies, integrating educational components from finance, information technology, and business analytics.

Training specialists for the digitalization of the financial sector requires the integration of technological disciplines into finance programs, including mandatory courses on AI and machine learning in finance, blockchain and DeFi, and data science for finance.

Education should be based on a practice-oriented approach utilizing case studies from real companies, such as Monobank and Revolut, hackathons, project-based learning, and internships in FinTech companies. Non-formal education tools and online platforms should also be actively used within the educational process.

Particular attention should be given to the development of lecturers' digital competencies through professional development programs and the involvement of practicing specialists from the financial market.

Traditional financial education programs also require harmonization with European standards and adaptation to the European Skills Agenda, the EU Digital Finance Strategy, and the AI Act.

In most universities of the European Union, examples of which are presented in Table 3.1, digital finance curricula include the following thematic modules: digital payment systems; financial technologies (FinTech); digital banking; crypto-assets and blockchain; financial data analytics; artificial intelligence in finance; cybersecurity of financial systems; digital regulation of the financial sector; ESG and sustainable development in digital finance.

Examples of educational programmes at universities in the EU, USA, and Ukraine where digital finance is a subject of academic training

Higher education institution	Programs, courses
GBSB Global Business School (Global Business School Barcelona) (Malta)	Digital Finance and FinTech program
University of Potsdam, Kiel University (Germany)	Digital Finance programs
Massachusetts Institute of Technology (MIT) (USA)	FinTech: Shaping the Financial World course (open on OCW)
EU Supervisory Digital Finance Academy	Regulator and specialist training programs
National University "Poltava Polytechnic"	Digital Finance program
Donetsk National University	Digital Finance program
KNEU named after V. Hetman	Digital Finance programs
International University of Finance	Information Technology in Finance

For example, the FinTech Master's program within the EIT Digital initiative combines financial disciplines with courses in machine learning, data management, investor behaviour analysis, digital entrepreneurship, and innovation management.

Unlike traditional finance disciplines, digital finance focuses on the development of financial, technological, and interdisciplinary competencies. As a result of studying these disciplines, alongside traditional knowledge concerning capital structure, risk management, WACC, and their digital applications, programming (Python, R), blockchain, AI/ML, data analytics, and cybersecurity, students should be able to:

- analyze digital financial products and services;
- assess the risks of financial sector digitalization;
- use digital platforms for financial analysis;
- work with financial data and algorithms for data processing;
- understand the principles of blockchain technologies;
- evaluate the impact of artificial intelligence on financial markets;
- conduct analyses of regulatory requirements in the field of digital finance.

For example, when analyzing a client's creditworthiness, a modern specialist may use not only financial statements but also machine-learning algorithms capable of predicting default risk based on large datasets.

Examples of educational components include: «Digital Payments, Blockchain and Cryptocurrencies», «Artificial Intelligence and Machine Learning in Finance», «FinTech Innovations and Business Models», and «Regulation of Digital Finance in the EU and Ukraine».

Digital financial literacy is becoming an important component of academic training.

The Organisation for Economic Co-operation and Development (OECD) defines digital financial literacy as a set of knowledge, skills, attitudes, and behavioural patterns necessary for the safe and effective use of digital financial services.

For example, a modern user should not only be able to conduct online payments but also assess cyber risks, verify the reliability of digital platforms, protect personal data, and make informed financial decisions.

This is why courses in digital financial literacy are increasingly being incorporated into curricula of economic specialities.

In modern educational programs, digital finance is mastered through contemporary and highly effective teaching methods such as real-company case studies and projects involving the development of proprietary FinTech solutions. These methods provide practical experience and develop critical thinking and decision-making skills.

Through case-study methods, students engage in an in-depth analysis of specific situations encountered by companies. By studying the experience of fintech giants such as Revolut and Monobank or fintech ecosystems such as NovaPay, students analyze their strategies, mistakes, and decisions. This enables them to understand digital business processes through real-world examples.

Project-based learning represents a «learning by doing» format. Instead of studying abstract theory, higher education students are taught to create a real product – an application, payment service, or system – from the idea stage through coding and testing, closely simulating work within an actual IT team.

In addition to these teaching methods, curricula also include practical training in banks, startups, and regulatory institutions. Students undertake professional certifications such as CFA and FRM and obtain specialized FinTech certifications.

Graduates of digital finance educational programmes work in such positions as FinTech Analyst, Blockchain Developer, Digital Risk Manager, Data Scientist in Finance, Product Owner in neobanks, crypto-analyst, and others.

The main challenges facing the development of digital finance education include the rapid pace of technological change, which requires continuous updating of educational programmes; the need for instructors to possess both financial and IT skills, requiring investment in their retraining; and the necessity of integrating micro-credentials and non-formal education (Erasmus+, Coursera, EU Academy).

The prospects for the development of financial education are increasingly associated with the concept of Finance 5.0, within which digital finance does not only serve as a tool for improving the efficiency of financial operations but also as the foundation for a more resilient, inclusive, and ethically oriented financial system. The use of artificial intelligence, big data, blockchain technologies, and digital platforms contributes to expanding access to financial services, enhancing the transparency of financial processes, and incorporating principles of social responsibility and sustainable development.

Within the Finance 5.0 paradigm, technological innovations should be directed toward creating value for society, ensuring financial inclusion, supporting environmental and social initiatives, and adhering to high ethical standards in financial decision-making.

Thus, digital finance is not merely an addition to classical financial education but its necessary evolution. It is gradually emerging as an independent interdisciplinary field of academic training that combines knowledge from finance, information technology, data analytics, and digital regulation. The development of the digital economy, financial technologies, and new business models necessitates the preparation of a new generation of specialists capable of working under conditions of digital transformation of the financial system. In contemporary educational practice, such training is

implemented through the integration of formal education, professional certification, online courses, and the concept of lifelong learning, which corresponds to the strategic priorities of human capital development in the European Union.

3.2. Educational initiatives in the EU and the role of non-formal education, online courses, and certification

In the modern conditions of the digital transformation of the economy and society, education is no longer limited to the period of study at school or a higher education institution. The concept of Lifelong Learning has become one of the key directions of the educational policy of the European Union [213]. The increasing pace of technological change, the development of artificial intelligence, the digitalization of business processes, and the transformation of the labor market require citizens to continuously update their knowledge and competencies (upskilling and reskilling). Therefore, alongside formal education, non-formal education, online learning, micro-credentials, and professional certification are becoming increasingly important [214].

The European Union considers education a strategic priority for economic growth, social cohesion, and competitiveness.

EU educational policy is aimed at creating a common educational space that ensures access to quality education, mobility of learners and teachers, and the development of skills necessary for the digital and green transformation of the economy.

One of the key initiatives is the establishment of the European Education Area, which aims to remove barriers to learning and professional development for citizens regardless of their country of residence [215].

The European Education Area (EEA) initiative provides for structured cooperation among member states to build resilient and inclusive systems. It includes five key priorities: quality and inclusion, green and digital transition, teachers and trainers, higher education, and the geopolitical dimension. The EEA also contains specific EU-level targets. For example, reducing early

school leaving to less than 9 %, and ensuring that 60 % of Vocational Education and Training (VET) learners participate in work-based learning.

An important instrument for implementing this policy is the Erasmus+ program, which supports the academic mobility of students, teachers, researchers, schools, and adults, and also finances projects aimed at developing digital skills and innovative educational practices. The main EU educational programs are presented in Table 3.2.

Table 3.2

Characteristics of EU educational programmes

EU education program	Description
1	2
European Skills Agenda (2020) [216]	A plan of 12 actions aimed at developing skills for the digital and green transition
Erasmus+ [217]	The most famous EU program for education, youth and sport. In addition to student exchanges, it actively funds non-formal education projects, youth exchanges, adult learning and micro-qualifications. In the youth environment, the emphasis is on youth exchanges and volunteering, which provide non-formal learning (workshops, role-plays, debates). The program promotes the development of competences for life and the professional future, strengthens European identity
Digital Education Action Plan (DEAP) 2021–2027 [218]	The Strategic Plan for Digital Education, containing 14 actions, including the European Digital Education Hub, teacher training (SELFIE for Teachers), promotion of OER platforms and MOOCs under two priorities: fostering the development of a high-performing digital education ecosystem and enhancing digital skills and competences for the digital transformation
European Qualifications Framework (EQF) [219]	An 8-level framework for comparing qualifications based on learning outcomes. Helps to recognize qualifications in non-formal and informal education, promotes the mobility of workers and learners. All EU countries have referenced their national frameworks to the EQF
Validation of Non-Formal and Informal Learning (VNFIL) [220]	2012 EU Council Recommendation (updated). Member states must establish systems for the recognition of competences acquired outside formal education (work, volunteering, online courses). Cedefop maintains the European Validation Database
Upskilling Pathways [221]	An EU initiative launched in 2016 is aimed at supporting adults with low levels of education, qualifications or basic skills. Its aim is to provide opportunities for the development of literacy, numeracy and digital competences necessary for employment and active participation in society

Table 3.2 (the end)

1	2
Adult Learning Agenda [222]	The strategic EU initiative is aimed at developing adult education and implementing the concept of Lifelong Learning. The main objectives are: raising the level of participation of the adult population in education and vocational training; developing digital, financial, entrepreneurial and professional competences; supporting social integration and competitiveness in the labor market; adapting citizens' skills to the requirements of the digital and green economy
Council Recommendation on a European approach to micro-credentials (2022) [223]	Recommendation on the creation of a common European approach to the development, recognition and use of micro-qualifications in the education system and in the labour market
European Universities Initiative (EUI) [224]	The creation of 65 transnational university alliances, bringing together more than 11 million students, promotes structured cooperation in education, research, and innovation
European Skills Agenda and Union of Skills [225]	Focus on lifelong learning, upskilling/reskilling for the digital and green transition. Includes micro-credentials, Individual Learning Accounts, recognition of skills

These initiatives are closely interconnected and form the modern EU policy in the field of education and skills. However, the European Commission considers lifelong learning to be the key condition for adapting the population to labor market changes and the transition to the digital economy.

The European Union is actively developing educational initiatives in the field of finance and digital finance (digital finance, FinTech) as part of its strategy for the digital transformation of the economy, strengthening financial resilience and inclusion. This is linked to the EU Digital Finance Strategy, regulatory frameworks (MiCA, DORA, AI Act), and the need for qualified personnel for supervision, innovation, and consumer protection. The emphasis is placed on financial literacy, specialized training for regulators, researchers, and youth, as well as the integration of digital competencies [226; 227].

A description of EU educational initiatives is presented in Table 3.3.

Characteristics of EU initiatives in financial education

EU educational program	Description
EU Supervisory Digital Finance Academy (EU-SDFA) [228]	The Technical Support Instrument (TSI) of the European Commission (DG Reform) in cooperation with EBA, ESMA, EIOPA and the Florence School of Banking and Finance (EUI) launched in 2022, offers training cycles, workshops and peer-learning for staff of national supervisory authorities (37 authorities from 26 countries). Focus: risks and opportunities of digital technologies, regulation of FinTech, AI, crypto-assets. The goal is to strengthen supervisory capacity in the digital age. An e-book and YouTube channel are available
European Digital Finance Programme (EDFP) [229]	Executive educational program (ILF Frankfurt in cooperation with navigatingfintech.com). First specialized course on capacity building in digital finance (2022 – 2023). Modules cover: digital assets (MiCA, DeFi, CBDC), AI in finance, DORA (operational resilience), data economy and open banking. Targeted at regulators, the private sector and lawyers
MSCA Industrial Doctoral Network on Digital Finance [230]	Marie Skłodowska-Curie Actions network (2024 – 2027). Supports 17 PhD positions at the intersection of finance, data science and AI. Includes industry secondments, trainings in cybersecurity, sustainable finance, blockchain. Coordination is effected through University of Twente and Bern Business School. The aim is training the next generation of researchers and practitioners
Erasmus+ projects, for example, Digital Finance for Youth (DF4Y) [217]	A multi-partner project (Austria, France, Sweden, Hungary, Ireland, Belgium). Development of a gamified mobile app, e-learning platform and methodological handbook for youth trainers. Focus is on digital financial skills, debt avoidance, online risks, financial management for youth
EU Financial Literacy Strategy (2025) [231]	Comprehensive strategy within the Savings and Investments Union (SIU). Supports national strategies, campaigns, funding initiatives, coordination of best practices. Integration with OECD/EU financial competence frameworks (including digital finance for children and youth). The goal is to increase financial literacy of citizens for better investment decisions and inclusion

Non-formal education encompasses organized educational activities carried out outside the formal education system. It is not necessarily state-

certified learning that takes place outside the formal system (universities, schools, vocational education and training institutions).

Non-formal education complements formal education and assists in the validation of non-formal and informal learning, promotes inclusion for vulnerable groups, older generations, and migrants, and responds to labor market needs. It includes professional training, short-term courses, workshops, webinars, summer schools, professional development programmes, and other forms of learning.

The main advantage of non-formal education is its flexibility and orientation toward the practical needs of the labor market. While traditional educational programmes may take several years to update, the content of short-term courses is adapted much faster to current employer demands. For example, a finance specialist may complete a course in big data analytics, digital finance, or the use of artificial intelligence in financial management within several months without enrolling in a new university degree programme.

Non-formal education develops soft skills such as critical thinking, leadership, digital literacy, teamwork skills, social responsibility, and active citizenship [232; 233].

The EU actively supports non-formal education through Erasmus+ Youth and the European Youth Strategy. According to research findings, participation in adult non-formal education significantly increases social cohesion and well-being. An example is Erasmus+ youth exchanges, which allow participants to obtain a Youthpass – a document confirming competencies acquired in a non-formal learning environment.

Informal learning plays an important role in Erasmus+ programmes, particularly in youth exchanges and youth participation activities, where workshops, exercises, debates, simulations, and other practice-oriented methods are used. Erasmus+ also promotes peer learning, networking and community building, with particular attention to inclusion and diversity, including the participation of people with fewer opportunities [234–237]. In the EU Supervisory Digital Finance Academy (EU-SDFA), informal and practical learning formats are implemented through training cycles, workshops, knowledge sharing, and peer-to-peer exchanges within the professional community of financial supervisors [238]. Thus, these European initiatives

demonstrate a flexible, practice-oriented, and inclusive approach to the development of professional and digital competencies.

The most widespread formats are online courses and platforms: MOOCs, e-learning hubs (for example, DIGFINLIT), and hybrid formats such as EDFP and MSCA. They ensure scalability and accessibility of financial education. Certification of acquired qualifications is carried out through EQF, Europass, and national systems.

EU-SDFA and EDFP training programmes contribute to the recognition of skills for regulators. Many EU countries have integrated validation into national systems (for example, France – Qualiopi, Austria – Ö-Cert). Financial literacy in EU countries is integrated into school and adult learning programmes.

The digitalization of education has contributed to the rapid development of online learning. Massive Open Online Courses (MOOCs) have become one of the most accessible tools for acquiring new knowledge.

Online courses allow individuals to combine learning with professional activities and provide access to educational resources from leading universities worldwide regardless of the learner's place of residence.

For example, a student in an economics programme can simultaneously study at a university and complete an online financial analytics course offered by a leading European or American university. As a result, the student does not only acquire academic knowledge but also practical skills in working with modern digital tools.

The COVID-19 pandemic accelerated the transition to online learning. The EU is actively developing the digital infrastructure of education. After 2020, the online format transformed from an alternative form of learning into a full-fledged component of the educational system.

Digital online platforms developed in the EU include:

EU Academy (<https://academy.europa.eu/>) – the official EU online platform offering courses on policy, law, digital skills, and other topics;

Europass (<https://europass.europa.eu/>) – a platform that contains hundreds of thousands of learning opportunities, including online courses;

European MOOC Consortium (EMC) (<https://emc.eadtu.eu/>) – an association of European universities for the development of MOOCs (Massive Open Online Courses) and micro-credentials;

Coursera (<https://www.coursera.org/>) – one of the largest international online learning platforms, offering: online courses in various fields of knowledge; professional certificates; specializations combining several related courses; full online bachelor's and master's degree programmes; interactive assignments, tests, and practical projects; certificates of successful course completion. In the field of finance, Coursera offers courses in financial management, financial analysis, FinTech, investments, blockchain, and digital finance;

FutureLearn (<https://www.futurelearn.com/>) – a British educational platform established with the support of UK universities and international educational institutions. Its main functionalities include: short online courses; professional development programmes (ExpertTracks); professional certificates and micro-credentials; online higher education programmes; interactive learning through discussions, forums, and group interaction; flexible access to learning materials. The platform places considerable emphasis on practical learning and the development of professional competencies, particularly in digital technologies, finance, and entrepreneurship.

The Digital SkillUp project [239] and European University Alliances initiatives [240] offer hybrid and fully online programmes with micro-credentials.

One of the most important educational trends of recent years has been the development of the micro-credentials system.

In 2022, the Council of the European Union adopted recommendations on establishing a common European approach to micro-credentials [241]. Micro-credentials certify the outcomes of short-term learning and make it possible to formally document acquired competencies. They create opportunities for developing individualized learning pathways and enhance worker mobility within the European labor market.

The distinctive features of micro-credentials are that they recognize the outcomes of short-term learning; contain a standardized description of competencies; can be accumulated throughout a professional career; are recognized by employers and educational institutions across different EU countries.

Examples of micro-credentials include certificates in digital skills, data analytics, cybersecurity, project management, and financial technologies.

One of the major challenges today remains the question of how to ensure that the outcomes of non-formal and online learning are recognized in the labor market. Currently, practice offers the following key instruments for addressing this issue: Micro-credentials, Europass Digital Credentials, the European Qualifications Framework, and Open Badges.

Micro-credentials are short, modular certificates (ranging from several hours to several months) that can be «stacked» into larger qualifications. They are particularly effective for rapidly responding to labor market needs (for example, AI, green energy, and data analysis).

Europass Digital Credentials are digital, tamper-proof certificates compatible with national systems.

The European Qualifications Framework (EQF) is a framework for comparing qualifications across Europe.

Open Badges are digital badges used for the formal recognition of knowledge, skills, competencies, or achievements acquired through formal, non-formal, or informal learning.

Examples of successful implementation include micro-credentials in Estonia and Ireland integrated into national education systems. In Spain, tens of millions of euros have been allocated to the development of micro-credentials through the Recovery and Resilience Facility.

It should be noted that the modern employer does not only evaluate a higher education diploma but also verified professional competencies.

In the financial sector, particularly valuable international certifications include CFA (Chartered Financial Analyst), ACCA (Association of Chartered Certified Accountants), CIMA (Chartered Institute of Management Accountants), and FRM (Financial Risk Manager).

In the field of information technology, Microsoft, Cisco, AWS, and Google certifications are widely used.

The possession of professional certificates often becomes a competitive advantage during employment, as it demonstrates a specialist's readiness for continuous professional development and compliance with international standards.

For example, a graduate of a finance programme who additionally obtains an ACCA or CFA certificate has significantly broader employment opportunities in banks, investment companies, and multinational corporations.

Despite its considerable advantages, the development of non-formal education is accompanied by certain challenges. The main issues include:

- the need to ensure the quality of educational programmes;
- recognition of the outcomes of non-formal learning;
- verification of the authenticity of digital certificates;
- ensuring equal access to digital educational resources.

Therefore, the European Union is actively working on the creation of unified standards for micro-credentials and digital certificates, which will contribute to increasing trust in non-formal learning outcomes and their international recognition.

Thus, the educational initiatives of the European Union are aimed at fostering a culture of lifelong learning and preparing the population for the environment of the digital economy. Non-formal education, online courses, micro-credentials, and professional certification are becoming important tools for human capital development and enhancing workforce competitiveness. Under modern conditions, a successful professional career increasingly depends not only on a degree obtained but also on an individual's readiness to continuously update knowledge, acquire new competencies, and validate them through modern certification mechanisms.

Numerous European Union initiatives in the field of human capital development, including the European Skills Agenda, Upskilling Pathways, the European Agenda for Adult Learning, Erasmus+, and policies promoting micro-credentials, form a comprehensive system supporting lifelong learning, the digital transformation of education, and the enhancement of workforce competitiveness. At the same time, assessing the effectiveness of these programmes requires analysis of quantitative indicators of their implementation and achieved outcomes.

Statistical data indicate that EU measures in the field of adult education are gradually increasing population participation in educational programmes. According to Eurostat [242], in 2022, 46,6 % of the EU adult population aged 25 – 64 participated in formal or non-formal learning during the previous 12 months, exceeding previous years' figures and demonstrating a positive trend

in the development of lifelong learning systems. At the same time, the strategic objective of the European Union remains achieving a participation rate of at least 60 % of the adult population by 2030 [243].

An important indicator of the effectiveness of EU initiatives is also the scale of implementation of the Erasmus+ programme, which involved more than 6,2 million participants during 2014 – 2020 and approximately 1,6 million additional participants during 2021 – 2023 [237]. According to European Commission assessments, participation in the programme contributes to the development of critical thinking, adaptability, digital competencies, and lifelong learning capabilities, which are particularly important under conditions of digital economic transformation.

However, the overall level of financial literacy remains limited. According to the Flash Eurobarometer survey conducted in 2023 among 26,139 respondents, 18 % demonstrated a high level of financial literacy, 64 % a medium level, and 18 % a low level [244].

At the same time, substantial differences in financial literacy levels can be observed across EU countries [244]. The highest levels of financial literacy – approximately 27 – 28 % – are observed in the Netherlands, Denmark, Sweden, and Slovenia. The lowest levels – approximately 11 % – are found in Portugal and Latvia. Other EU countries demonstrate medium levels of financial literacy.

Regarding financial awareness, the study showed that approximately 52 % of respondents correctly answered at least three out of five questions concerning inflation, interest rates, diversification, and related topics, which represents an average result among EU countries [244].

This state of financial literacy and awareness is one of the factors behind the low participation of citizens in capital markets. Therefore, all EU countries either have or are developing national financial literacy strategies. Accordingly, the EU Financial Literacy Strategy (2025) is aimed at coordination, dissemination of best practices, and monitoring. The next Eurobarometer survey is scheduled for 2027.

According to Flash Eurobarometer 525 in 2023, 77 % of EU citizens feel comfortable using digital financial services (online banking, mobile payments): 36 % «very comfortable» and 41 % «somewhat comfortable» [244].

Countries with the highest levels of digital finance knowledge among the population include the Netherlands, Denmark, Finland, and Estonia (approximately 39 – 43 % of individuals with high knowledge scores). The lowest levels are observed in Cyprus, Romania, Greece, and Portugal. Overall, digital literacy in EU countries is higher than traditional financial literacy, but it is associated with risks related to cybersecurity, cryptocurrencies, and DeFi [244].

At the same time, demographic gaps in financial literacy can be observed. Lower levels are recorded among women, youth, individuals with low incomes, and people with lower educational attainment [245]. These groups require targeted financial education programmes.

The OECD and the EU emphasize the need to integrate digital competencies (MiCA, DORA) into educational programmes. The market for digital financial education continues to grow.

Particular attention should be paid to the PISA study on the state of financial literacy among future market participants – *Financial Literacy of 15-Year-Old Students* – which assessed financial literacy levels among 15-year-old students in 20 countries worldwide [246]. The average OECD score was 498 points. The highest results were achieved by students from Belgium (527 points), Denmark (521 points), Canada (519 points), and the Netherlands (517 points). Above-average results were also recorded in Austria, Poland, and the Czech Republic [246].

At the same time, in several countries more than one-third of students failed to reach the baseline level of financial literacy. On average across OECD countries, approximately 18 % of students demonstrated a high level of financial literacy (Level 5 or above), while approximately 18 % failed to reach the baseline competency level (Level 2). Students with high performance are capable of analyzing complex financial products, assessing risks, and making informed financial decisions, whereas students at lower levels experience difficulties even with basic issues of personal budgeting and financial planning [246].

The study also confirmed a strong relationship between financial literacy and general educational achievement. On average, approximately 80 % of the variation in financial literacy outcomes is explained by students' knowledge in mathematics and reading. At the same time, even after

accounting for these factors, certain countries demonstrated higher results due to targeted financial education policies [246].

An important conclusion of this study concerns the growing role of digital finance in the lives of young people. In OECD countries, almost 60 % of students reported having a bank account or access to payment instruments, while more than 70 % had made online purchases during the year. This demonstrates the necessity of integrating not only traditional financial literacy but also digital financial literacy into educational programmes, including issues of cybersecurity, electronic payments, and the responsible use of FinTech services [246].

Low financial literacy constrains investment, pension provision, and resilience to financial risks, especially digital risks. Positive dynamics in improving financial literacy are expected as a result of the 2025 strategy; however, meaningful changes will require years of systematic work in schools, among adults, and through digital tools [247].

At the current stage of development, the financial education market in Europe is growing. Its share constitutes approximately 26,4 % of the global market, which is estimated at 12,8 billion USD in 2025. According to forecasts, by 2034 it will achieve a compound annual growth rate (CAGR) of 9,3 % and reach 28,6 billion USD [248].

Financial literacy education includes structured programmes, technological solutions, and professional services that provide individuals, students, employees, and communities with knowledge in budgeting, savings, investments, debt management, and retirement planning. In 2026, the market demonstrates accelerated growth in demand, as governments, educational institutions, and corporations recognize the measurable economic and social benefits of financial literacy. Rising household debt, widening retirement savings gaps, the proliferation of complex financial products, and the rapid transition to digital financial services collectively increase the need for comprehensive, accessible, and scalable financial education.

Since 2020, policymakers in more than 50 countries have introduced mandatory personal finance curricula at the school level, directly stimulating the procurement of educational programmes and solutions by educational institutions. The growing adoption of gamification, AI-based personalization, and mobile knowledge-delivery platforms significantly increases learner

engagement and knowledge retention, attracting both public and private investment into the sector.

In the corporate segment, employers increasingly include financial well-being programmes as an employee benefit to reduce financial stress among staff, which research consistently shows leads to higher productivity and reduced absenteeism. The convergence of financial technology innovation with educational technology is opening new service-delivery models, such as embedding financial literacy into banking applications and peer-learning networks, thereby expanding the overall market potential far beyond traditional educational methods.

Thus, the presented statistical indicators confirm that EU educational initiatives are gradually transforming from instruments of policy support into a real mechanism for developing population competencies, ensuring the formation of human capital necessary for the functioning of a digital and innovative economy. However, financial literacy in the EU remains relatively low, with significant cross-country and demographic disparities. Northern countries lead due to systematic educational approaches, while Southern and Eastern Europe require additional strengthening. PISA demonstrates the potential of school education, while digital literacy represents a strong area accompanied by new risks. The EU Strategy 2025, national plans, and integration with the Digital Education Action Plan are expected to improve the situation.

3.3. Training specialists in the field of digital finance in Ukraine

As shown in the previous subsections, EU educational initiatives demonstrate a clear trend from a rigid formal system toward a flexible, inclusive, and digital learning ecosystem. Non-formal education, online courses, and micro-credentials are becoming a bridge between education and the labor market, contributing to financial inclusion, resilience, and adaptability.

For Ukraine, significant opportunities are opened through participation in Erasmus+, the use of Europass, and the implementation of micro-credentials in higher and vocational education.

Financial education in Ukraine encompasses vocational (vocational-technical) education, higher education (including bachelor's and master's programs in finance), as well as non-formal education (short-term courses, training programs, and professional development programs). Its functioning is regulated by the Law of Ukraine «On Education» (2017), the Law of Ukraine «On Higher Education» (2014), and the Law of Ukraine «On Vocational (Vocational-Technical) Education» (1998, as amended). Since 2017, Ukraine has been implementing an educational reform aimed at modernizing educational content, introducing dual education, updating educational standards, and improving the quality of specialist training.

In 2024, the Cabinet of Ministers of Ukraine approved the National Financial Literacy Development Strategy until 2030, developed by the National Bank of Ukraine (NBU) in cooperation with various ministries, including the Ministry of Education and Science, the Ministry of Economy, the Ministry of Digital Transformation, as well as other institutions such as the Deposit Guarantee Fund and the National Securities and Stock Market Commission.

The main goals and directions of the Strategy are to increase the financial awareness of the population. It covers various target groups, including children, youth, entrepreneurs, veterans, internally displaced persons (IDPs), and elderly people. Particular attention is paid to vulnerable groups that had previously been overlooked.

The Strategy emphasizes the importance of digital technologies in the financial sector. It plans to develop interactive digital tools for teaching financial skills and to increase awareness of digital financial services, payment security, and protection against cyber fraud.

For the first time in Ukraine, a comprehensive approach to improving entrepreneurs' financial awareness is being introduced. This includes the creation of a financial competency framework for entrepreneurs and initiatives aimed at increasing small business awareness of financial services.

The Strategy provides for the establishment of cooperation among government bodies, international organizations, and the private sector in

order to create a favorable environment for the development of financial literacy.

Thus, this Strategy is aimed at addressing the problem of low financial literacy in Ukraine. It also takes into account challenges caused by the war, when access to digital financial services became critically important for citizens' financial resilience. For example, the ability to use digital financial instruments (mobile banking, online payments) has become particularly important for IDPs and veterans.

In 2020, the National Bank of Ukraine approved the FinTech Development Strategy in Ukraine until 2025, the purpose of which is to create a full-fledged fintech ecosystem with innovative financial products.

The main goals and directions of the FinTech Development Strategy include improving financial and digital literacy. The Strategy incorporates programs to enhance the population's digital and financial skills, particularly through training professional personnel for the fintech sector. It also envisages the development of a cashless economy. The promotion of cashless payments requires citizens and businesses to possess skills in using digital financial instruments. The academic foundation for fintech will be the creation of educational programs focused on open banking and other innovative financial technologies.

The NBU plans to join the Global Financial Innovation Network (GFIN), which will facilitate integration into the global fintech ecosystem, exchange of experience, and implementation of best practices.

Thus, this Strategy supports the development of the fintech sector, which is one of the fastest-growing sectors in Ukraine. It also contributes to the development of digital skills necessary for working with modern financial technologies such as blockchain and artificial intelligence analytics.

In November 2021, the Cabinet of Ministers of Ukraine approved the Strategy for Digital Development, Digital Transformation, and Digitalization of the Public Financial Management System until 2025, developed by the Ministry of Finance.

According to this Digital Development Strategy, the primary objective is the automation of financial business processes in public financial management, including the digitalization of internal public control, monitoring, and assessment of fiscal risks.

Among the Strategy's tasks, it is also necessary to note increasing transparency in public financial management and staff training. The implementation of digital tools to ensure transparency of financial operations requires digital skills from employees of the financial sector. The training of public finance management specialists is planned with a mandatory emphasis on digital competencies.

Therefore, this Strategy contributes to the digitalization of the financial sector, creating demand for specialists with digital skills in public administration. It also supports the overall digital transformation of the economy, which is important for post-war recovery.

Launched in 2020 by the Ministry of Digital Transformation, the National Digital Literacy Program Diia.Digital Education aims to improve the digital literacy of Ukrainians [249]. Its latest official version was launched after a major update in 2023. At that time, the platform changed its name from "Diia. Digital Education" to "Diia.Education".

Its primary goal is the mass training of digital skills. As of 2025 – 2026, the Diia.Education platform offers 700 educational products in various formats (educational series, simulators, tests, guides, webinars, podcasts, and skill bites), including free courses on digital literacy, covering computer basics, internet safety, and the use of digital financial services. The platform also includes a network of more than 5 000 offline digital education hubs (in libraries, administrative service centers, and private companies), microlearning, career services, and career guidance tools. It integrates AI tools. At the end of 2025, an AI Mentor based on Google Gemini was launched to provide personalized learning support. The Diia.Education platform has approximately 3 million registered users [249]. As a result, by 2025, 96% of Ukrainians possess basic digital skills [250].

In addition, Ukraine is implementing a number of national and European programs that support the development of financial education and digital skills. Among the most significant are:

Ukraine Facility (2024 – 2027) – an EU financial instrument worth 50 billion EUR to support Ukraine's recovery, reforms, and digital transformation;

Erasmus+ Capacity Building in Higher Education (CBHE) – programs for modernization of higher education and development of digital competencies;

EU Anti-Corruption Initiative (EUACI) – a program supporting transparency in the financial sector and the development of managerial competencies;

the EU Macro-Financial Assistance (MFA) program, which supports Ukraine's financial stability and implementation of structural reforms;

Twinning programs and other EU technical assistance instruments aimed at bringing Ukrainian practices closer to European standards;

special support programs for small and medium-sized enterprises that combine financial assistance with training in digital financial skills.

Financial education in Ukraine is currently in an active phase of digital transformation but still maintains significant gaps between traditional and digital skills.

Traditional financial skills related to corporate finance, accounting, banking, risk management, and capital structure remain the foundation of most programs under specialty D2 «Finance, Banking, Insurance and Stock Market». They are well developed in classical universities (KNEU named after Vadym Hetman, Ivan Franko National University of Lviv, V. N. Karazin Kharkiv National University, etc.).

Digital financial skills in FinTech, AI in finance, blockchain, data analytics, RegTech, and cybersecurity are developing unevenly. However, Ukraine faces a serious shortage of specialists who combine deep financial knowledge with IT competencies in Python, machine learning, and Big Data. The rapid growth of the FinTech market – Monobank, Revolut, NovaPay, Sense Bank – outpaces workforce training.

The FinTech Development Strategy in Ukraine until 2025 was partially implemented and integrated into the new Financial Sector Development Strategy. Educational programs in finance are also being influenced by the European Skills Agenda, Erasmus+, micro-credentials, and the digitalization of education. In recent years, the role of non-formal education, online courses, and partnerships with businesses (SoftServe, Grid Dynamics, etc.) has increased.

Among the positive developments is the emergence of specialized «Digital Finance» programs (for example, at the National University «Poltava Polytechnic», which offers a bachelor's program focused on IT in finance, Big Data, AI, and blockchain). Many Ukrainian universities are introducing separate courses on digital finance.

However, the curricula of digital finance educational programs in Ukraine and the EU differ, as presented in Table 3.4.

Table 3.4

**Comparative characteristics of digital finance curricula
in Ukraine and the EU***

Aspect	EU (EIT, Imperial etc.).	Ukraine (KNEU and etc.)
The depth of tech	High (ML, Blockchain, Cybersecurity, Big Data as a core)	Average (data science, digital tools as a complement)
Regulation	MiCA, DORA, PSD3, AML – dedicated modules	Open banking, virtual assets – in the process of alignment with the EU
Entrepreneurship	Strong (I&E Minor, startups, Summer Schools)	Growing (UAFIC, startup projects in universities)
Research/PhD	Industrial - academic networks (MSCA)	More applied research, less EU-scale networks
Practice	Internships, secondments, industry projects	Diia, banks, regulatory sandbox
Interdisciplinarity	Finance, CS, Law, Business	Finance/Economics, IT (less integrated)
Duration/Format	1 – 2 year MSc, double degrees, online options	1,5 – 2 years, online/hybrid growing

* The comparison of the curricula was conducted based on the EU/OECD competency-based approach, taking into account the provisions of Ukraine's National Strategy for the Development of Financial Literacy until 2030 [251], as well as [231; 246; 252; 253; 254; 255], project of the national standard for specialty D2 «Finance, banking, insurance and stock market», Curricula/syllabi of leading universities of the EU and Ukraine. The analysis covered the content components of digital finance, technological competencies, regulatory and security aspects, digital financial literacy, practical training, and the use of AI and data analytics.

The EU offers more advanced, technology-intensive, and harmonized curricula oriented toward the single market and global competition. Ukraine is stronger in its agile approach, practical digitalization (Diia, high crypto adoption), and financial inclusion, but lags behind in specialized technological modules.

The main driver of financial education development is integration with the EU. Therefore, Ukraine is actively implementing European standards, expanding dual-degree programs and joint programs. In the near future, more fintech tracks are expected in KNEU/SET and the integration of e-hryvnia/CBDC topics into curricula. Ukraine can provide strong IT and practical talent for EU programs.

The Kharkiv region has traditionally been a strong educational center, but due to the war it has faced significant challenges, including destruction of infrastructure and the outflow of staff and students. The leading institutions providing financial education in the region are V. N. Karazin Kharkiv National University, Simon Kuznets Kharkiv National University of Economics, and the National Technical University «Kharkiv Polytechnic Institute» (KhPI), which offer strong classical training with elements of digitalization.

Traditional financial education predominates in Kharkiv. Digital components, such as AI and FinTech, are present only to a limited extent, often through individual courses or master's-level modules. The region actively uses distance learning and international programmes, such as Erasmus+.

It should be noted that the general trends in the region include growing interest in digital finance among prospective students, limited partnerships with businesses due to the ongoing war, and stronger positions in traditional skills, such as financial analysis, risk management, and banking.

At the same time, informal education is developing actively. Online courses offered by platforms such as Prometheus, Coursera, EdEra, and others are becoming increasingly popular, as are educational programmes involving banks, fintech companies, and other employers as stakeholders. For example, at S. Kuznets Kharkiv National University of Economics, the Career Laboratory operates and organizes training sessions, workshops, and meetings with business representatives.

Traditional financial skills, including accounting, financial planning, budgeting, and financial statement analysis, remain the foundation of professional training. A positive aspect is the availability of comprehensive fundamental educational programmes and the development of dual education, which enables students to combine theoretical training with practical experience at enterprises.

The main gaps in financial education at both the national and regional levels include an insufficient number of instructors with practical experience in FinTech and AI, weak integration of practical projects and hackathons, a low level of implementation of micro-credentials and certifications (CFA, FRM, FinTech), and a shortage of interdisciplinary programs combining finance, IT, and regulation (MiCA, DORA, PSD2).

However, in 2025 – 2026 positive trends can be observed, including growth in the number of digital finance educational programs, active use of AI in education (for example, personalized platforms and simulations), government support for digital skills, and the development of the Skills Alliance for Ukraine and international projects.

Demand for digital skills is growing in Ukraine. According to the IT Ukraine Association, the IT sector, including fintech, remains one of the key and most resilient industries of the Ukrainian economy, accounting for a substantial share of service exports with strong growth potential. This surge creates demand for specialists possessing digital financial skills such as payment system management, data analytics, and cybersecurity.

The prolonged armed conflict has accelerated the transition to distance learning. Platforms such as Prometheus offer courses on digital finance, including «Fundamentals of FinTech» and «Cybersecurity in Finance».

Grant projects within Erasmus+ contribute to the integration of European practices into financial education in Ukraine. For example, Simon Kuznets Kharkiv National University of Economics may develop and implement programs focused on digital financial skills in blockchain and artificial intelligence analytics and may create digital tools such as mobile applications and VR simulations.

Ukrainian banks, including PrivatBank and Monobank, are actively implementing digital solutions, contributing to the development of the fintech sector and creating demand for appropriately trained specialists. As of 2023, Monobank had more than 6 million clients, stimulating demand for professionals capable of working with digital financial instruments.

However, many instructors in educational institutions do not possess sufficient digital competencies. Research in other countries indicates that teachers often have only basic ICT skills, and a similar situation is observed in Ukraine. Most vocational education institutions do not have access to

modern digital platforms, which also hinders the teaching of digital financial skills.

Furthermore, the war in Ukraine has destroyed numerous educational institutions. Access to high-speed internet and modern equipment (for example, computers for simulations) remains a problem, especially in rural areas.

The ongoing war and economic instability have complicated employment opportunities for graduates. For example, during 2022 – 2023 many small and medium-sized enterprises (SMEs) reduced their workforce, limiting opportunities for vocational education graduates.

Thus, financial education in Ukraine and the Kharkiv region is transitioning from a traditional model to a digital one, but this process is uneven. Traditional skills remain strong, while digital skills are developing rapidly but still lag behind market needs. To overcome these gaps, deeper implementation of practice-oriented programs, stronger cooperation between universities and businesses, and active use of European instruments (micro-credentials, Erasmus+) are required.

Conclusions

Digital finance represents the transformation of the traditional financial system under the influence of digital technologies, ensuring the accessibility, speed, efficiency, and inclusiveness of financial services. Its essence lies in the integration of digital platforms, mobile technologies, blockchain, artificial intelligence, and data for the provision of services such as electronic payments, digital wallets, online lending, and investments.

The theoretical and methodological foundations of financial digitalization are based on the combination of classical financial theories with modern concepts of the digital economy, including digital agency theory, relational aspects of trust and value, as well as the impact of technologies on financial inclusion. The analysis of these foundations makes it possible to evaluate digitalization not only as a technical process but also as a socio-economic transformation that changes the models of interaction among market participants.

Global trends in the development of digital financial instruments include the rapid growth of FinTech, the dominance of digital payments, the integration of AI for personalization and risk management, the development of digital assets (stablecoins, tokenized deposits), and blockchain technology. These trends contribute to financial inclusion but simultaneously create challenges related to regulation, cybersecurity, and volatility.

Digital finance will occupy a central place in the financial system of the future, providing hybrid models that combine the traditional banking sector with innovative platforms, contributing to economic resilience, inclusion, and sustainable development. They will become the foundation of a data-driven economy with an emphasis on open finance and technology integration.

The EU policy on digital finance is comprehensive and proactive, including the Digital Finance Strategy, FinTech Action Plan, MiCA, DORA, FiDA regulations, and the creation of a single digital market. It is aimed at stimulating innovation, ensuring competition, protecting consumers, and strengthening cyber resilience, with a focus on the integration and scaling of FinTech.

The formation of the fintech ecosystem in EU countries is characterized by a high level of maturity, significant investments, the development of

regulatory sandboxes, open banking, and strong hubs (the United Kingdom, Germany, France, and the Netherlands). The ecosystem is supported by government initiatives, venture capital, and the integration of AI and digital assets.

The assessment of the state and dynamics of fintech ecosystem development according to key indicators (investment volume, number of companies, transactions, and penetration level) indicates the recovery of growth after periods of decline, the dominance of digital payments, the growth of the digital assets market, and a positive impact on economic resilience.

A comparative analysis of the digital maturity of the financial sector in the EU and Ukraine demonstrates a significant gap: the EU leads in regulatory maturity, investments, and infrastructure, whereas Ukraine demonstrates rapid development in payments (thanks to Diia and mobile services), but requires strengthening of regulation, investments, integration with the EU, and educational development. Ukraine has the potential for leapfrogging through digitalization, especially in the context of recovery.

Digital finance as a subject of academic training requires an interdisciplinary approach that combines finance, technology, data, regulation, and ethics. It is becoming a key competency for financial sector specialists in the conditions of digital transformation.

Educational initiatives in the EU emphasize the role of formal higher education, non-formal education, online courses (Coursera, FinTech platforms), certifications, and cooperation with industry. This contributes to the rapid adaptation of personnel, the development of digital skills, and an innovative ecosystem.

The training of specialists in the field of digital finance in Ukraine is carried out through higher education institution programs but requires modernization: strengthening the practical component, integrating AI/blockchain technologies, cooperating with business, and harmonizing with European standards (for example, DigComp). Initiatives such as Diia.Education demonstrate the potential for mass digital literacy.

The study confirms that digital finance is a driver of the modern financial system, with strong potential for economic growth, inclusion, and innovation. The EU serves as a model of a mature ecosystem, while Ukraine has opportunities for accelerated development through European integration. The

key priorities remain the improvement of regulation, investments in infrastructure, cybersecurity, and, especially, the educational training of personnel. Development prospects are associated with the further integration of AI, digital assets, and open financial data, which will make it possible to form a resilient and competitive financial system of the future.

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**ТРАНСФОРМАЦІЇ ФІНАНСОВОЇ СФЕРИ
У ЦИФРОВУ ЕРУ:
ЄВРОПЕЙСЬКИЙ ДОСВІД І УКРАЇНСЬКІ РЕАЛІЇ**

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Коректор

Представлено теоретичні та методологічні основи дослідження цифрових фінансів та аналізу сучасного стану розвитку цифрових фінансів у ЄС та Україні. Розглянуто освітній вимір цифрових фінансів. Запропоновано стратегічні підходи до розвитку цифрових фінансів та освіти.

Для студентів вищих навчальних закладів, що спеціалізуються на економіці.

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