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BLOCKCHAIN TECHNOLOGY IN THE FINANCIAL ECOSYSTEM

The relationship between the development of financial technologies and the formation of the financial ecosystem has been investigated. It is proposed to divide the properties of the financial ecosystem into general and specific ones. The definition of the financial ecosystem has been clarified on the basis of identification of the institutional, functional and sectoral approaches to its understanding. The signs of classification of blockchains in the financial sphere are systematized.

Keywords: financial ecosystem, financial technologies, blockchain technology, smart contract.

Волосович С., Баранюк Ю. Технология блокчейн в финансовой экосистеме. *Исследована взаимосвязь между развитием финансовых технологий и формированием финансовой экосистемы. Предложено разделить свойства финансовой экосистемы на общие и специфические. Уточнена дефиниция финансовой экосистемы на основе выделения институционального, функционального и отраслевого подходов к ее пониманию. Систематизированы признаки классификации блокчейнов в финансовой сфере.*

Ключевые слова: финансовая экосистема, финансовые технологии, технология блокчейн, смарт-контракт.

Background. The development of technological innovations and the economy of consumption have led to powerful transformations of both national and global financial systems. It initiated the formation of financial ecosystems, closely linked to the various financial technology tools that unite all its participants. Financial ecosystems are transformed by the impact of financial technology development. The emergence of accessible, fast and convenient financial services, the simplification of tax administration, public

procurement, the receipt of social security based on financial technologies enhance the processes of decentralization of financial systems and create the basis for transparency of financial transactions of economic entities, households and the state. One of the financial technology tools that provide it is blockchain technology.

Analysis of recent research and publications. Financial systems are subject to transformations, which are the characteristic feature of the economic systems of many developed countries in the world [1]. Substantial transformations of the structure of the financial system are due to the liberalization of financial legislation, the invention of new financial instruments and the gradual universalization of banking activities [2].

In foreign scientific literature, the issues of the functioning of financial ecosystems are explored by I. Lee and Y. Shin [3], K. Swenson, J. Yudesen and J. Webb [4], C. Bose [5], Z. Posser [6] and others. The most of works of domestic scientists concern the analysis of only certain types of financial ecosystems, in particular, cashless payments in the agricultural sector [7], banking ecosystem [8]. All publications, without exception, emphasize that financial technologies are the basis for the existence of financial ecosystems, and blockchain is its important tool. The works of J. Chen, K. Belavitis [9], J. Mulhol [10], O. Baranov [11] and others are devoted to some problems of the use of blockchain technology in the financial sphere. However, despite the high level of existing theoretical developments, the questions on the essence of financial ecosystems and the role of blockchain technology in their transformations require further research.

The **aim** of the article is to determine the priorities for the use of blockchain technology in ensuring the functioning of financial ecosystems.

Materials and methods. The theoretical and methodological basis for writing the article were the works of domestic and foreign scientists on the functioning of financial ecosystems, the role of financial technology tools in its provision, including blockchain technology. The study was conducted using the methods of theoretical generalization, comparative analysis and synthesis, which allowed clarifying the definition of financial ecosystem, identifying its specific properties and systematizing the features of blockchain classification in the financial sphere.

Results. The term "ecosystem" was originated to describe phenomena and processes occurring in the natural environment, but nowadays it has become widely used in other spheres, in particular, in the functioning of financial systems. There are institutional, functional and sectoral approaches to understanding financial ecosystems. The institutional approach involves an emphasis on the composition of ecosystem participants. So, I. Lee and Y. Shin include technology developers, government agencies and regulators; private and corporate financial clients; traditional financial institutions to the financial ecosystem [3]. K. Swenson, J. Yudesen and J. Webb add another compo-

nent to these participants – FinTech startups [4]. This approach is also supported by the National Bank of Ukraine. In the Strategy of the National Bank of Ukraine, the financial ecosystem refers to the set of participants in the financial market and other parties that at the same time interact on terms of cooperation and competition in order to create and provide financial products and services [12].

Within the functional approach, the team of authors considers the financial ecosystem as a technology platform aimed at digitalization of the financial market, which includes four areas: financial capital, consumer preferences when receiving financial services, Internet of things, financial technologies [13, p. 126–129]. The Internet of things is a financial technology tool, and it is inappropriate to include it as a separate area of the financial ecosystem. As a result, the financial ecosystem is identified with financial technologies [13, p. 29].

The sectoral approach assumes that its supporters understand only some of its subsystems under the financial ecosystem, in particular, the cashless payments subsystem in the agricultural sector [7], the banking ecosystem [8].

The financial ecosystem is characterized by general and specific properties of the systems.

Common properties include:

emergence implies that due to the interaction of individual components, new properties, that characterize the system, emerge*;*

totality is the sum of properties of each subsystem, that is, it is about the presence of the aggregate properties;

heterogeneity is that the system cannot consist of completely identical elements.

The specific properties of the financial ecosystem include:

adaptability, that is, functioning based on the use of financial technology tools, in particular artificial intelligence, big data, the Internet, blockchain, cryptography, biometrics;

decentralization, which implies a diminishing role of financial intermediaries in the markets;

client orientation, which is conditioned by the increasing role of the consumption economy in modern society*;*

inclusivity based on increased consumer access to financial services and citizen participation in budgeting*;*

stability, which implies the security of financial transactions, on the one hand, and crisis prevention or minimization of its consequences, on the other.

The financial ecosystem is a collection of traditional financial intermediaries, FinTech companies, FinTech startups, incubators, accelerators, regulators, business entities, individuals, public financial institutions, educational institutions which interact through the use of financial technology instruments that maximize consumer inclusivity in the financial services market and transparency of public finances.

In the ecosystem, each institution seeks to diversify data by managing partnerships with competitors that can be a source of strategic and operational risks [14, p. 25]. For the financial ecosystem to function effectively, it is important to ensure the transparency of relationships between all participants. This is to some extent facilitated by blockchain technology. In 2015, the World Economic Forum in Davos stated that blockchain is a new technology that eliminates the need for third parties to ensure confidence in financial, contractual and electoral actions [15]. As Baranov notes, blockchain can establish trust by examining the identity and potential of any counterparty through a combination of past transaction history (by blockchain), reputation indices based on generalized reviews and other socio-economic indicators [11].

The volume of global investments in blockchain technology during 2015–2018 tends to grow amid an increase in its share in global investments in FinTech (*figure 1*).

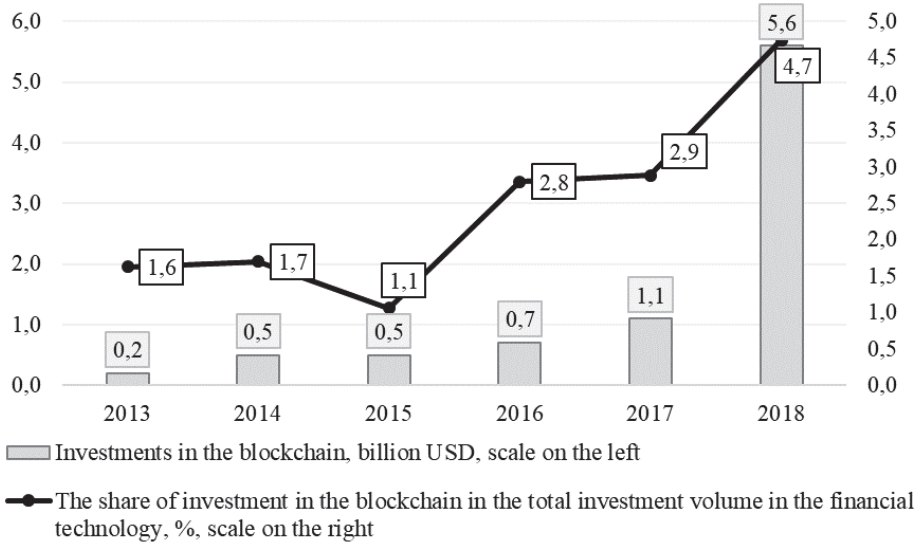

Figure 1. Global investments in blockchain for 2013-2018

Source: constructed by the authors according to the materials [16–18].

According to research company International Data Corporation, China will invest up to USD 2 billion in the development of blockchain companies by 2023 [19]. Since 2015, the US Department of Homeland Security has provided USD 800,000 to Silicon Valley tech startups to develop blockchain solutions aimed at improving the security of the country [20]. At the same time, in the world during 2013–2018, the average annual growth in the number of vacancies in the blockchain industry was 139 %, and as of the end of May 2019, 2 300 vacancies were opened [21].

There are different approaches to blockchain classification now. It is proposed to classify blockchains in the financial ecosystem by participants, level of centralization, generations and fields of application.

By participants blockchain are divided into:

public, providing wide open access for users who have equal rights and can perform basic functions: transaction validation, cryptocurrency transfer, access to database records. Examples of such blockchains are *Bitcoin, Bitcoin Cash, Litecoin*. At the same time, there are public blockchains with different levels of permissions, where there are restrictions on the transparency of transactions and the ability to perform certain functions by users, in particular transaction validation. For example, some *BitShares* users have the right to be validators or to vote, while others can only see the results of their activities. In the first case, public blockchain is decentralized and used by its participants to exchange cryptocurrency and enter into agreements based on smart contracts. In the second case, blockchain has signs of centralization and is used by corporate networks*;*

private, which has limited access for users to registry entries, within which they may have the same rights as in a public blockchain. Its example is the *Mijin* platform. The operation of private blockchains can speed up the transaction process and hide it from third parties. Private blockchain makes it easy to find the right information due to a small number of transaction records. This kind of blockchain can be both centralized and decentralized*;*

hybrid, which is a new concept that allows you to connect existing blockchain networks with additional blockchains. For example, the *Ardor* platform has a test network that is identical to the core network. It enables users to refine their skills to avoid possible mistakes and failures while working on the core network.

By the level of centralization, blockchains are divided into *decentralized*, where all users can perform the transaction validation function, and *centralized*, where this function is performed by a specific person.

There are three generations of blockchain in the genesis of blockchain technology. Blockchain 1.0 was created in 2009 on the basis of the new principle of registration of transactions with the advent of bitcoin. The second stage of blockchain development is related to the development of smart contracts by *Ethereum* company in 2013, which allow them to be executed automatically under the conditions specified therein, which prevents third parties from interfering and reduces costs. The next phase – Blockchain 3.0, started in 2017 with the development of more productive technologies, including *Cosmos*, DFINITY and EOS.

By area of application in the financial system, blockchains are divided into those used in the financial services market, in the sphere of public finance, business environment and households (*figure 2*).

It follows from *figure 2* that blockchain is most commonly used in the financial services market and in public finance. The *table* shows the possibilities of using the blockchain by individual entities of the financial ecosystem.

According to the Tax Service of the Chinese city of Shenzhen, from August 2018 to November 2019, the number of electronic invoices in this technology center in the field of finance, insurance, retail, restaurant and hotel business, written using blockchain, exceeded 10 million in the amount of 1 billion USD against the background that more than 7.6 thousand companies have accessed this system [26]. During 2018, the volume of active loans provided with the help of decentralized lending protocols increased by 1.083 % [27].

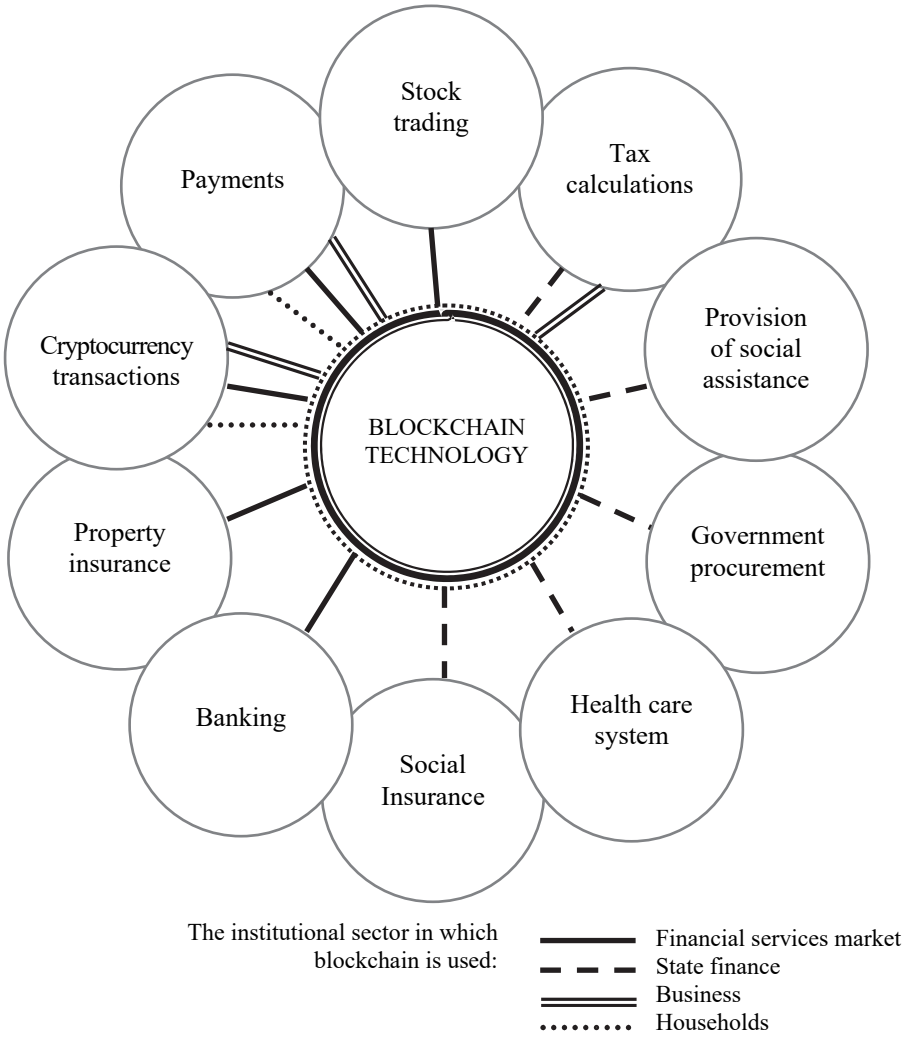

Figure 2. Application of blockchain technology in the financial sphere

Source: created by the authors.

The second largest stock exchange in the world, the New York Stock Exchange *Nasdaq*, has added the *Decentralised Finance Index (DEFX*) that monitors the effectiveness of blockchain projects after the inclusion of *Bitcoin* and *Ethereum* indices in early 2019 to exchange list [28]. This index has already been applied previously by the London brokerage company *Exante*. The *Nasdaq Global Index DataSMS (GIDS*) provides real-time

information on *Bitcoin, Ethereum and Ripple* exchange rate through *Bitcoin Liquid Index (BLX*), *Ethereum Liquid Index (ELX*) and *XRP Liquid Index (XRPLX*). With the help of blockchain technology, the Depository Trust and Clearing Corporation (*DCTT*) maintains a daily record of 90 million financial transactions with global securities amounting to 48 trillion USD [29].

Table

Opportunities for individual entities of the financial ecosystem to apply blockchain

Scope	Subjects of the financial ecosystem							
	Insurers	Banks	Payment platforms	Crowdfunding platforms	Exchanges	Business	Individuals	Regulators
Process automation	+	+	+	+	+	+		+
Creation and monitoring of insurance (payment, credit) history, ownership transfer history, delivery of goods	+	+	+	+	+	+		+
Shortening of payment terms, identifying the connection between transactions	+	+	+	+	+	+	+	+
Ensuring receipt of information from state authorities	+	+		+		+	+	
Instant fixation of insurance events	+					+	+	
Conclusion of contracts online	+	+	+	+	+	+	+	
Smart contracts conclusion	+				+	+	+	
Confirmation of identity	+	+	+	+	+	+	+	
Preliminary risk assessment	+	+	+	+	+	+	+	+
Interaction with other entities of the financial ecosystem	+	+	+	+	+	+	+	+
Transparency of settlement of clients' claims against insurers	+					+	+	
The prevention of money laundering and financing of terrorism	+	+	+	+				+

Source: constructed by authors according to the materials [10; 11; 22–25].

According to the forecasts of the World Economic Forum, 10% of the world gross product will be stored on blockchain or related technologies by 2025–2027 [15]. In 2018, the World Trade Organization stressed that international trade volumes would increase by 1 trillion USD by 2030 through the facilitation of trade financing and international shipping, logistics automation and customs clearance [30].

Consortia are now being set up in different regions of the world to explore the possibilities of using blockchain in different areas. In 2014, it was established the *R3 CEV LLC* blockchain consortium with a location in New York to develop blockchain applications in financial systems. In 2016, in Luxembourg, *BIL, BNP Paribas, CACEIS, EFA, HSBC, ING Luxembourg, Pictet, RBC Investor & Treasury Services, Société Générale Bank & Trust and PwC* companies created a *Fundchain* consortium to study the impact of blockchain on asset management. In the same year, 42 banks created a consortium in Japan to use the *Ripple* blockchain to make real-time payments.

In 2017 the Spanish bank *Cecabank* and *Grant Thornton* Company, together with other banks, established a blockchain consortium to develop money laundering counter-measures and improvement of customer identification procedures, covering 33% of the Spanish banking sector [31].

The Dutch company *Aegon*, Swiss companies *Swiss Re* and *Zurich*, as well as the German *Munich Re* and *Allianz* have joined forces to create their own blockchain consortium – the *Blockchain Insurance Industry Initiative*. The purpose of this merger is to explore new technological capabilities that will enable insurance companies to improve the quality of services they provide and access of customers to them.

In 2014, the *Blockchain Association of Ukraine* was created, according to which, in 2017, 32% of blockchain companies were founded in Ukraine. The founders of Ukrainian blockchain companies have previously worked in the fields of: finance, investment and trading (38%); programming and development (38%); cryptography and cryptocurrency (32%); marketing and advertising (12%). Most domestic blockchain companies (78%) focus on both domestic and global markets, 16% focus solely on the external market and only one company focuses exclusively on the Ukrainian market [32]. The *Bitfury* group of companies is engaged in blockchain technology and is one of the largest infrastructure providers in the cryptocurrency ecosystem. Founded in 2011, *Bitfury* delivers solutions for businesses, governments, organizations and individuals to securely move assets across the blockchain. In 2017, a Memorandum of Cooperation was signed between *Bitfury* and the State Agency for Electronic Governance of Ukraine. *Attic Lab* and *Bloqly* should also be distinguished among Ukrainian blockchain companies [33].

Conclusion. It is determined that the financial ecosystem is a collection of traditional financial intermediaries, *FinTech* companies, *FinTech* startups, incubators, accelerators, regulators, business entities, individuals, public financial institutions, educational institutions which interact through the use of financial technology tools, that ensures maximum consumer inclusivity in the financial services market and transparency of public finances. The financial ecosystem is characterized by general and specific properties of the systems. The general properties include emergence, totality and heterogeneity; specific ones include adaptability, decentralization, customer orientation, inclusivity based on increasing consumer access to financial services and citizen participation in budgeting, as well as stability.

It is established that blockchains in the financial ecosystem can be classified by participants, level of centralization, generations and fields of application. The priorities of blockchain technology in ensuring the functioning of financial ecosystems are its use to counteract money laundering and terrorist financing, improve customer identification procedures, conclude smart contracts and improve the interaction of financial ecosystem entities. Intensifying the use of blockchain technologies in the financial sector will help transform centralized financial systems into decentralized financial

ecosystems, which significantly increase the confidence of business entities and individuals in financial service providers and governments by increasing their openness, transparency and interoperability between its various participants. Further studies of blockchain technology are promising for its application in the activities of financial regulators.

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Волосович С., Баранюк Ю. Технологія блокчейн у фінансовій екосистемі.

Постановка проблеми. *Розвиток технологічних інновацій та економіки споживання започаткував формування фінансових екосистем, які тісно пов'язані з різноманітними інструментами фінансових технологій. Одним з інструментів фінансових технологій є технологія блокчейн.*

Аналіз останніх досліджень і публікацій *свідчить, що існування фінансових екосистем базується на технологіях, важливим інструментом яких є блокчейн.*

Метою *статті є визначення пріоритетів застосування технології блокчейн у забезпеченні функціонування фінансових екосистем.*

Матеріали та методи*. Теоретичним та методологічним підґрунтям для написання статті стали праці вітчизняних та зарубіжних науковців. Дослідження проведено із застосуванням методів теоретичного узагальнення, порівняльного аналізу та синтезу.*

Результати дослідження. *У розумінні фінансових екосистем існують інституційний, функціональний та галузевий підходи. Фінансовій екосистемі притаманні загальні та специфічні властивості систем. Загальними властивостями фінансової екосистеми є емерджентність, гетерогенність та сукупність. До специфічних властивостей належать: технологічність, децентралізація, клієнтоорієнтованість, інклюзивність і стабільність. Фінансова екосистема є сукупністю традиційних фінансових посередників, FinTech-компаній, FinTech-стартапів, інкубаторів, акселераторів, регуляторів, суб'єктів господарювання, фізичних осіб, державних фінансових інститутів, освітніх закладів, які взаємодіють на основі застосування інструментів фінансових технологій, що забезпечує максимальну інклюзивність споживачів на ринку фінансових послуг та прозорість державних фінансів. Блокчейни у фінансовій екосистемі можна класифікувати за учасниками, рівнем централізації, поколіннями, сферами застосування.*

Висновки. *Активізація застосування блокчейн-технологій у фінансовій сфері сприятиме трансформації централізованих фінансових систем у децентралізовані фінансові екосистеми, в яких значно підвищується рівень довіри суб'єктів господарювання та фізичних осіб до оферентів фінансових послуг та урядів завдяки зростанню їх відкритості, прозорості та сумісності між її різними учасниками.*

Ключові слова: фінансова екосистема, фінансові технології, технологія блокчейн, смарт-контракт.