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Theoretical and Methodological Perspective on the Prerequisites of Emergence and Peculiarities of the Functioning of Decentralized Finance

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ABSTRACT

Existing studies of the problem of the emergence and development of decentralized finance (DeFi) are largely limited to non-principled clarification of certain positions and formulations, with emphasis on technical and technological innovations, far from the level of fundamental research. The authors set the task of theoretical understanding of the ongoing transformation processes in the financial sphere. The **purpose** of the study was to identify the conditions, driving forces and nature of the process of development of decentralized finance; to define DeFi and identify its sustainable features; and to substantiate the possibilities of considering DeFi as a separate economic category and institution. Setting the goal determined the sequence of its solution in two stages. The first stage implied a higher level of abstraction, an appeal to the theory of money and its modern achievements. The second stage – “movement to the surface”, inclusion in the analysis of specifications accompanying the development of DeFi. The authors used systematic and logical **methods**, induction and deduction as the main methods, which allowed them to generalize and systematize the ideas about the essence of decentralized finance, identify problems in the modern scientific discourse. As a result, the causes are revealed, and the nature of the process of emergence and development of the sphere of decentralized finance is substantiated, the definition of DeFi is given, the principles of their functioning are highlighted and recommendations on structuring the conceptual apparatus of DeFi are developed. It is concluded that the process of formation and development of decentralized finance is objective and driven by changes in the monetary sphere, technological advances, and problems of traditional finance. At the same time, the stable features of DeFi determine the potential of reproduction of financial relations on a decentralized basis, but at the same time do not allow us to qualify DeFi as an independent category and institution. The results of the study can be used both in elaborating the concept of DeFi development and taken into account as part of the regulatory response to DeFi.

Keywords: decentralized finance; traditional finance; denationalization of money; private money; cryptocurrencies; DeFi architecture

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INTRODUCTION

The fragmentation of the financial sphere occurring before our eyes, manifested in the formation of its decentralized segment, requires a theoretical understanding of this process both in terms of its prerequisites and the mechanism driving it. The overwhelming majority of studies on the phenomenon of decentralized finance (DeFi) focus on its utilitarian aspect, the implementation of which is aimed at understandable economic benefits for the progressively expanding set of financial market segments encompassed by this phenomenon. An important aspect, considering

the speed and scale of the expansion of this sphere, is the regulatory response to the challenges it poses. Without denying the significance of these aspects of the functioning and development of DeFi, it should be noted that the direction of their research aligns with the positivist trend in economic studies that emerged several decades ago.

Giving due credit to the results obtained to date, which are abundant with formalized assessments of various parameters of decentralized financial instruments, recommendations for national regulators and supranational financial institutions, it is necessary to acknowledge that a

qualitative — theoretically saturated — procedure for analyzing the DeFi phenomenon has not yet been implemented. By this procedure, we mean the understanding of the emerging phenomenon at the theoretical and methodological level, especially regarding its prerequisites, the nature of the latter, driving forces, and the relationship with so-called traditional (centralized) finance (TradFi). It is evident that understanding this important fundamental aspect is the key to addressing issues of a more applied nature, including those related to regulatory responses to the opportunities and threats associated with this phenomenon.

GAPS IN THE SCIENTIFIC DISCOURSE ON DECENTRALIZED FINANCE AND THE CHOICE OF METHODOLOGICAL TOOLS

The logic of studying such a new phenomenon as decentralized finance involves building it from the general to the specific, from considering theoretical issues related to identifying the prerequisites for the emergence of DeFi, their nature, and principles in explicit or implicit form, which reflect on the content and contours of this phenomenon, to specific questions that have a pronounced practical, instrumental character, including those addressed within regulatory and supervisory practices. Not claiming to implement such a comprehensive approach, which consists, on the one hand, in understanding the essence of the phenomenon itself, and, on the other, in formalizing the mechanics of its functioning, the present study is limited to the first part of it, based on the obvious assumption that our understanding of the nature and essential characteristics of the phenomenon determines the prospects for its development and the possibilities for regulatory response. This conditioning emphasizes the relevance of the present study, as well as its consistency, expressed in the sequence of using different approaches at various stages — reproductive and heterodox, which opened up opportunities for an adequate reflection of the unique features of DeFi and their similarities with traditional finance.

DeFi today is most often considered as decentralized financial services or decentralized financial protocols managing smart contracts on a specific platform.¹ It should be acknowledged that such definitions obscure rather than illuminate the meaning and potential of this new, purpose-built financial system. DeFi is more like the internet of money [1]. The beginning of this research stems from this important and simple definition. The main reasons for the emergence of DeFi are concentrated in the monetary sphere. The objective nature of the evolution of the latter, driven by equally objective factors of scientific and technological progress, has the most significant impact on the fragmentation of the financial sphere. Moreover, it predetermines the irreversibility of this process, which is already manifesting on the surface of phenomena in the expanding array of private digital currencies, financial instruments, and products. The features of the production of the latter and the operation with them formed the basis of numerous definitions of the phenomenon under analysis (*Table 1*), determining their focus primarily on the functional, instrumental, and technological aspects of the latter, as well as attempts to present it from a systemic perspective.

Without denying the significance of these aspects, it is necessary to note that such a focus brings the external side of the phenomenon to the forefront of research, leaving a whole range of fundamental, theoretical questions on the periphery of scholarly attention. At the same time, following the reproductive approach to the analysis of DeFi implies uncovering the prerequisites for their emergence, sources of development, as well as characteristics that distinguish or bring them closer to the conventional conceptual and categorical apparatus of financial science. Such a

¹ Decentralized Finance: information frictions and public policies. Approaching the regulation and supervision of decentralized finance. European Commission. June, 2022. URL: https://finance.ec.europa.eu/system/files/2022-10/finance-events-221021-report_en.pdf (accessed on 22.03.2024).

theoretical and methodological reliance on the reproductive approach appears necessary and important. At the same time, not only the mentioned gaps in the modern analysis of the DeFi phenomenon are taken into account, but also its viability.

The initial, fundamental stage of DeFi research involves selecting the basic methodological toolkit. Our research is based on a reproducible approach combined with systemic and functional analysis and a heterodox approach [13]. This allows:

- on the one hand, to investigate the nature of the formation and development of DeFi processes, relationships, and institutions shaped by dynamics, uncertainty, multifactoriality, and irreversibility;

- on the other hand, consider the social aspects of the processes occurring in the DeFi sphere, the peculiarities of organizing economic relations and the activities of institutions, and the level of public trust.

The representation of observed phenomena and processes depends on the questions we pose in our research. The first question from a fundamental approach: is the concept of DeFi an independent economic category, analogous to the categories of money, finance, credit?

In our daily practical dealings with finances, we rarely think about theoretical, fundamental questions. Understanding finance as a scientific category does not happen immediately, as externally, finance appears as an economic phenomenon, as “an object of sensory contemplation, in contrast to its essential basis — the noumenon as an object of intellectual contemplation”.² It is achieved based on an intellectual perception of finance as an economic category, related to the category of finance in its highest degree of abstraction, i.e., when abstracting from all specific forms and types in which they (finance) function (i.e., as opposed to perceiving finance as a market phenomenon). At the same time, the concept of

finance is often identified with its public form. To a greater extent, this is characteristic of the domestic tradition in relevant studies, whereas foreign interpretations are not prone to such “looping” and, paradoxically, a greater degree of abstraction of the essence of the phenomenon from its numerous species composition. That is why the phenomenon received the corresponding name. But be that as it may, without opposing the various positions in the interpretation of the term “finance”, we note that most of them recognize the monetary basis of financial relations. Thus, the category “finance” can be considered the foundation of the DeFi sphere, while the latter merely constitutes its specification — a form, type, implemented under specific conditions, the novelty of which does not serve as a basis for shifts in the essence of the phenomenon itself.

The second question from the perspective of institutional studies: does the concept of DeFi relate to the so-called basic institutions, which are understood as “deep, historically stable, and constantly reproduced social relations that ensure the integration of different types of societies, historical invariants that allow society to survive, maintain its integrity, and develop in its given material environment”? [13, p. 57].

The answers to the first and second questions will be negative. The emergence and functioning of finance in their decentralized form of organization do not change the essential foundations of finance, which have been thoroughly and meticulously studied by various branches of financial science, including the Russian one, traditionally relying on the reproductive approach and linking finance with the movement of monetary funds. Similarly, the form of organization of credit relations, insurance, etc., on a decentralized basis does not change the essence of credit, insurance, or bank as a theoretical concept.

Considering the conditionality of financial relationships on the movement of funds regarding the implementation of distribution and other processes in the decentralized sphere,

² Website of the National Encyclopedic Service. URL: <http://terme.ru/termin/noumen.html> (accessed on 22.03.2024).

Table

Definitions of Decentralized Finance

No.	Determination	Author
1	"Financial infrastructure built on public smart contract platforms, ... based on open protocols and decentralized applications"	F. Schär [2]
2	"An open financial system based on blockchain technology without centralized financial intermediaries"	Y. Chen, C. Bellavitis [3]
3	"An alternative form of financial planning that allows bypassing inefficient government institutions and insolvent banks, based on decentralized applications operating using blockchain protocols"	R. Leonhard [4]
4	"An emerging field at the intersection of blockchain, digital assets, and financial services, which, using blockchain protocols, eliminates financial intermediaries through specialized financial services [decentralized applications (dapps)], used without a single centralized mechanism"	DeFi Beyond the Hype. The Emerging World of Decentralized Finance*
5	"Decentralized database stored on a certain number of nodes"	I.A. Dokukina, A.V. Polyanin [5]
6	"Decentralized monetary system"	M.G. Zhigas, S.N. Kuzmina [6]
7	"One-tier (decentralized) credit system model based on blockchain technology with the identification of individual participants and levels of their interaction"	S.A. Andryushin [7]
8	"Financial services based on distributed ledger technology"	T.A. Kudryashova, T.V. Fedosova, E.A. Shulgina [8]
9	"Financial instruments that are services and applications built on blockchain platforms"	A.V. Aleshina, A.L. Bulgakov [9]
10	"A new direction for the development of the financial system and the creation of analogs of traditional financial management tools in a decentralized architecture"	H.S. Umarov, H.S. Umarov, T.S. Umarov [10]
11	"An alternative financial system aimed at replicating existing financial services in a more open and transparent manner"	I.V. Pashkovskaya [11]
12	"The principle of operation of decentralized services, applications (Dapps), and protocols"	A.V. Pomogalova, E.A. Donskov, I.V. Kotenko [12]
13	"A model of financial organization in which there are no intermediaries, transactions are carried out automatically using smart contracts executed on the basis of distributed ledger technology, and users have direct control over their assets"	Decentralized Finance. Report by the Bank of Russia**

Source: Compiled by the authors.

Note: * DeFi Beyond the Hype. The Emerging World of Decentralized Finance. Research produced by the Wharton Blockchain and Digital Asset Project, in collaboration with the World Economic Forum. May, 2021. URL: <https://wifpr.wharton.upenn.edu/wp-content/uploads/2021/05/DeFi-Beyond-the-Hype.pdf> (accessed on 22.03.2024). ** Decentralized Finance. Report by the Bank of Russia. M: Bank of Russia; 2022. URL: https://www.cbr.ru/Content/Document/File/141992/report_07112022.pdf (accessed on 22.03.2024).

clarity is required regarding the presence of a basic set of characteristics in the funds servicing it, confirming the mentioned status. Overall, sharing the position on such existence, since otherwise monetary theory would ignore an important object of analysis, losing its adequacy in reflecting modern economic reality, we will further focus on confirming this thesis and then on the objectivity of the processes occurring in the monetary sphere that have led to the fragmentation of finance. Essentially, these processes, among other things, are expressed in the movement of money towards their denationalization and dematerialization. But the next question is: is this process objective, and to what extent are its driving forces inevitable? Answering this requires addressing the essence of decentralized payment means, justifying their place and role in the species composition of money.

The current opinions on the status of decentralized payment instruments underlying DeFi are extremely polarized. Moreover, such discussions, which are significantly less heated in contemporary foreign analysis compared to domestic analysis, resemble the difficulties that accompanied all stages of the evolution of economic thought regarding the definition of money as such. British economists Jevons and Andrews pointed this out as early as the 19th century. Thus, the former drew a parallel between the non-triviality of the tasks of defining money — an economic science — and the squaring of the circle — mathematics [14]. The second one spoke more extensively and less allegorically: “Although money was among the first economic phenomena to attract human attention and has since remained at the center of economic research, there is not even relative agreement on what this word should denote” [15, p. 3].

The relative coherence of Marx’s theoretical construct, often unconditionally transferred by domestic tradition to the modern context, richly fertilized by an expanded species composition of money and tools for its regulation, is opposed by a diversity of foreign

interpretations, not without reason focusing on the functionality of money (their functions) and their social underpinnings. These differences are already today superimposed on the notions of the nature and essence of decentralized payment instruments. Namely, they evidently constitute the economic basis of the corresponding sphere of modern financial reality, having reached the pinnacle of the evolutionary movement of money, realizing the possibility of competition in the monetary sphere, as well as between decentralized and traditional finance.

Thus, the object of DeFi (not only as part of the mentioned reality but also of finance as such in all its theoretical content) includes new forms of payment instruments and other financial assets, such as cryptocurrencies, stablecoins, and digital financial assets, identified by some researchers as new forms of money [16]. This position is opposed by another one, which denies the monetary status of these instruments and appeals only to new ways of conducting transactions with their help [7, 17, 18]. In the modern world, “monetary funds” can take various forms over time and space, moreover, they may not have a tangible form and, most importantly, can still be liquid, trusted, and therefore in demand to the extent that is determined by the trust in them, and reflect a certain value. The value of these “monetary funds” is based more on economic expectations and behavioral preferences. Besides the absence of real assets backing them, there is also no institution endowed with the right to unilaterally influence their key characteristics, such as issuance volumes and exchange rate dynamics. Although this defect of decentralized issued currencies can transform into an advantage by minimizing arbitrary decisions and policy bias.

These features testify to the monetary filling of these means not only in terms of functionality but also in their basic characteristics. These means should be considered as a result of the dematerialization and denationalization of money, a process

that is objective in its essence and driving forces. The latter, as is known, bring productive forces to a new stage of development, or level, which is today commonly referred to as a new technological order, shifting the frontier of production relations that are becoming inconsistent with this level. In our case, we are talking about changes in the traditional financial architecture, and these changes are of a radical nature, but at the same time, they do not affect the essence of the categories with which we describe the ongoing changes and the emerging reality.

CHANGES IN THE MONETARY SPHERE, TECHNOLOGICAL SHIFTS, AND PROBLEMS OF TRADITIONAL FINANCE AS PRECONDITIONS FOR THE EMERGENCE AND DEVELOPMENT OF DEFI

The dynamism of the monetary sphere today is characterized not only by revolutionary changes in the payment industry, although underestimating them is at least reckless, considering the speed of digital technology implementation in the creation of fiat payment instruments, the infrastructure supporting their movement, and so on. This dynamism is more prominently expressed in the formation of an increasingly tangible alternative to fiat money. It is about the denationalization of money, essentially a reversal in their evolutionary movement, the emergence and expansion of the composition of decentralized currencies — private money. The concept of private money, updated by the aforementioned changes, was thoroughly and originally studied in its time by F. Hayek [19]. Moreover, the corresponding phenomenon as a result of the evolutionary development of money was not considered by this outstanding economist. At the same time, he discovered numerous historical confirmations of this phenomenon, proved the possibility of productive competition between concurrently circulating currencies, and refuted the thesis, first put forward by W. Jevons, that there is nothing less suitable for competition than money [14, p. 64]. By doing so, he opposed

his position to the “dogmas” of the quantitative theory — universals whose immutability is still not questioned by many today. F. Hayek’s concept does not exclude the possibility of the emergence and spread of “parasitic currencies”, which we can see today in the world of DeFi. At the same time, F. Hayek believed that *banks* would control “their currency” or resort to “reliable private currency” from other issuers. Today, this role can be performed by DeFi *institutions*. Both in F. Hayek’s concept and in the concept of decentralized finance, the factor of trust is of great importance, not least determining the scale and stability of one of the fundamental characteristics of money. Just as in both concepts, the possibility of productive circulation of several currencies and simultaneously the rejection of the inferior from their totality is allowed. In this context, it is appropriate to recall the Gresham-Copernicus law, according to which “bad money drives out good”.

In economic history, we find numerous confirmations of the issuance and circulation of non-state payment instruments, which were subsequently centralized and codified by corresponding legislative establishments. The subsequent development of financial reality gives rise to many instruments that take on the attributes of payment means, often interpreted as “near money”. Private issuance at this stage is a settled reality, expressed in the issuance and active operation of these highly liquid instruments (for example, government debt instruments, highly liquid corporate securities of private companies, whose market authority is undisputed). The competition between these means of payment, which evidently possess distinct monetary qualities, is “the only market-efficient way for multiple such issuers to coexist” [20, p. 27]. That is, financial resources can also include so-called “financial money” [21] (in the context of DeFi — issued on a decentralized basis, serving as a store of value, but with predetermined yield and default probability). The successful implementation of both new forms of money and new payment

instruments largely depends on the ease with which the issuer or intermediary can become part of a reliable and efficient financial system, while part of the “money” itself may be a “no one’s” obligation.

Thus, the culminating phase of the temporally fragmented process of developing the phenomenon of private money is the denationalization of money, caused by technological and social factors, which, in their action, impart a distinctly objective character to the entire process. The role of the technological factor in this process is also explained by the action of objective forces and fits into well-known theoretical constructs about the development of productive forces. The social underpinning of this process is the focus of economic sociology, which has developed its own vision of both the essence of money as a social concept and the peculiarities of its development. According to this approach, money cannot be neutral with respect to social processes and culture; moreover, they are deeply infused with the social conditions of their production and use. It is this connection that clearly defines the motivation of DeFi participants, provoking the proliferation of the multiplicity of money, which, apart from their number, manifests itself in different financial behavior strategies, as noted by V. Zelizer [22].

N. Dodd points out that money, being more of a social process than a universal measure, is created by users [23]. Its main properties are not objective; they are socially constructed, which does not negate the objective nature of its movement and changes. Thus, money, according to this approach, is social and pluralistic; it requires the recognition of the pluralism of ideas about various forms of money. A clear reflection and, accordingly, a convincing practical confirmation of this thesis are demonstrated by the history of the establishment and development of DeFi. And at this modern stage of financial development, just as in the times of the emergence of F. Hayek’s innovative monetary concept, when

even the boldest forecasts could not reflect the faint outlines of modern financial reality, the question of private-origin payment means is often reduced to denying their monetary status.

One should not forget that the institution of “money” can also be informal in nature, while still performing certain functions of money, if this is the choice of the participants in economic relations and is permissible from a legal standpoint. The very fact of this reality, expressed in the emergence of the digital money phenomenon, its active dissemination, recognition, and trust by financial market participants, determines the possibility of expanding the circulation area of decentralized issued digital monetary funds, capable of performing certain functions of money, but lacking the property of universality in its legal aspect. It is important that universality is initially recorded at the level of the perception of participants in exchange transactions as an informal institution, which should be qualified as a result of an objective process. Only then does formal recording occur at the level of regulations that have the status of law. “The very fact of the development of a decentralized financial reality actively signals the presence of this characteristic in the payment instruments circulating within it, providing grounds for recognizing their monetary essence. Thus, we can hardly speak of a transformation in the essence of money, but rather that the emerging new types have shifts in the ratio of various factors that shape their essential positions” [24, p. 21]. Thus, we can recognize the existence of monetary relationships within the functioning of the decentralized finance sector.

Based on the reproductive approach, decentralized finance can be defined as a distinct part of finance, the development of which is a consequence of the objective process of the denationalization of money, an expanding set of private digital currencies, functioning without intermediaries, encompassing a range of opportunities for adaptation to the complexity and increasing number of needs of the participants involved,

and at the same time — threats inherent to decentralization as such.

The presented definition is generally neutral regarding the technological aspect of DeFi, which produces a complex of opportunities and risks that influence the motivation to participate in its projects. The same can be said about the functional side of this phenomenon.

An attempt to justify the most important condition for its emergence, in our opinion, was made above. This “dilution” of the monopoly on the issuance of payment means due to the influence of the technological factor, the transformation of economic and social institutions predetermined by shifts in the motivational mechanism of market participants, and the influence of the cultural factor in its broad interpretation [25]. That is, everything that constitutes the objective nature of transformational processes, in our case — the denationalization of money. At the core of this movement, we identify:

- scientific and technological progress;
- social and cultural attitudes, manifesting in different directions depending on specific national conditions — from inertia, which reinforces ineffective institutions, to dynamism, ensured by the improvement of regulatory practices;
- the state of national economies, reflected in the global economy and manifested in well-known phenomena of macroeconomic instability, dynamism, and indicators of the functioning of traditional markets;
- regulatory and supervisory practices, combined with the macroeconomic situation and the growing awareness of traditional market participants about the vulnerabilities of these markets, are provoking a shift of activity into unregulated and poorly regulated areas of finance.

These factors are interconnected, and it is often difficult to identify the location of the primary impulses that affect the fragmentation of the financial sphere. At this stage, it can only be asserted with a high degree of certainty that changes in the monetary sphere and

the technological breakthrough that has occurred have constituted the most important conditions for the emergence and spread of private digital currencies. And these conditions and factors themselves extend their influence to the sphere of decentralized finance, fueling it and increasing its potential for expansion.

Transitioning from the fundamental level to the empirical level according to our idea of the “multilayeredness” of research in the field of decentralized finance, we note that the further elucidation of the concept of decentralized finance is characterized by a certain dualism: the combination of objective factors in the development of the DeFi sphere with the high significance of social context, which precisely underscores the importance of a heterodox approach to studying this sphere of financial relations. The effectiveness of this combination in influencing the processes of decentralization in the financial sphere is reinforced by the shortcomings of the traditional model of financial organization. The most obvious of these are: centralized control, limited access, inefficiency or insufficient efficiency, opacity, and lack of functional compatibility.

So, centralization means hierarchy. Most consumers and businesses interact with a single local bank that controls rates and payment amounts. The core of a centralized banking system is a consolidated organization — the central bank, which sets short-term interest rates and influences the level of inflation, often doing so in a manner that is insufficiently transparent and detrimental to numerous interests. This phenomenon extends beyond the financial sector and spreads to technology players.

Decentralized finance potentially reduces barriers to access traditional finance. Currently, more than 1.5 billion people do not have access to banking services, which makes it difficult to obtain loans and participate in online commerce. Many consumers are forced to take short-term loans from microfinance organizations to cover liquidity shortages. And

even having access to banking services does not guarantee their availability.

The most demonstrative example of the inefficiency of traditional finance is transaction fees. The payment systems market exhibits a pronounced oligopoly. Additionally, there are often excessive bureaucratic costs. Other less obvious examples of inefficiency include expensive and often slow money transfers, direct and indirect brokerage fees, lack of security, and frequent inability to conduct microtransactions. Often, bank customers are unaware of their financial institution's condition and are forced to rely on government deposit insurance agencies. This is seen as the essence of the problem of TradFi's lack of transparency. Consumers often find it difficult to understand, for example, whether the interest rates being offered to them are advantageous. Despite the fact that there has been some progress in the financial industry, thanks to fintech services that help find the lowest price, the market remains fragmented. At the same time, all players suffer from the inefficiency of the system. As a result, the lowest price for a financial service may still reflect inflated operating expenses and costs.

The lack of functional interoperability in TradFi manifests in the fact that consumers and businesses interact with financial institutions in an environment that does not allow for interconnectedness. Traditional systems are fragmented and designed to maintain a high switching cost. Mitigating the problem prompts traditional players to seek solutions that allow any company to connect to the information stack of the same banks or payment systems. But such measures do not solve the fundamental problems of centralized financial infrastructure.

The influence of these factors, "burdened" by the advantages of DeFi, amplifies the growing attention to the crypto industry and catalyzes the shift of activity towards DeFi, which the

Russian regulator unequivocally highlights in its documents.³

Thus, the formation and development of decentralized financial relations is a product of human activity, but one that is shaped by a whole range of objective factors, including technological ones, in this case, digitalization, the development of fintech, internet technologies against the backdrop of gamification, changes in the nature of online communities, and the increase in online experience of conducting various operations, including operations in the financial market and payment space. These factors enhance the response of participants in financial relationships to the vulnerabilities of traditional (centralized) finance. From this perspective, decentralized finance, in the concept of, for example, D. North's neo-institutional theory, is the rules of the game in society that organize relationships between people and structure exchange incentives in all its spheres — politics, social sphere, or economy [26]. In this case, attention is primarily focused on the possibility of purposefully forming a specific system of financial relations, built on a centralized or decentralized basis. In relation to the organization of financial relations, the formation of its innovative model in the new format of the information and communication environment is taking place.

Thus, the factors determining the organization of financial relations on a decentralized basis are objective in nature, and the sphere of DeFi development is characterized by dynamism and irreversibility, just as scientific and technological progress is dynamic and irreversible. Today, this is a stage of large-scale digitalization of all aspects of social, including economic, life, forming an information-type society. This process is based

³ Website of the Central Bank of the Russian Federation. URL: https://www.cbr.ru/Content/Document/File/132241/Consultation_Paper_20012022.pdf; https://cbr.ru/Content/Document/File/141992/report_07112022.pdf (accessed on 22.03.2024).

on the industrial exploitation of high-tech solutions of a new generation, becoming the “new normal” or “new economic normal” of socio-economic reality [27].

The dynamism of the emergence and development of the decentralized finance sector is due to the dynamism of the digitalization process itself. For example, the report by DataReportal provides statistical data that allows for an understanding of the “digital state” in Russia. Thus, at the beginning of 2024, Russia had 130.4 million Internet users with a population of 144.2 million people (in 2023, there were 127.6 million Internet users with a population of 144.7 million people); the internet penetration rate was 90.4% (in 2023 it was 88.2%); 106 million social media users, which is 73.5% of the total population; 227 million mobile cellular connections, which corresponds to 156.9% of the entire population,⁴ the development of the digital profile infrastructure, which ensures simple and quick data exchange when receiving financial services in a remote format, continues. The process of remote identification and/or authentication using the Unified Biometric System (UBS) is evolving. Nine Financial Service Providers (FSPs) have been registered, allowing consumers of financial services to remotely purchase products from various financial organizations without geographical restrictions in a 24/7 mode. Open APIs and artificial intelligence (AI) are being implemented in the Russian financial market.⁵

FEATURES OF DEFI, PRINCIPLES OF FUNCTIONING, AND BASIC CONCEPTUAL FRAMEWORK

Despite the dynamism of the objective process for the development of the decentralized finance sector, as well as for the economy as a whole, uncertainty (“measurable” and “unmeasurable”) is characteristic, which

F. Knight wrote about back in 1928 [28]. For the decentralized finance sector, this uncertainty is greater than the uncertainty of the economy as a whole. This is not only because periods of uncertainty include unforeseen events to which probabilities cannot be assigned, as they are outside the list of expected events, and the periods of uncertainty themselves cannot be accurately predicted based on available data [29], but primarily because the theory of decentralized finance is still in its infancy. The report for public discussion “Decentralized Finance”, published in 2022, is, according to the Bank of Russia itself, merely informational and analytical in nature.⁶

The high uncertainty in the decentralized finance sector is also due to the significant role of social context, public and business trust in the development of decentralized finance objects (cryptocurrencies, tokens, etc.), institutions, instruments, products, and services.

The significant role of the social context is due to the fact that decentralized finance serves as an external environment for the actors involved, but the stakeholders in the processes occurring in the field of financial relations, regardless of whether they are organized in a centralized or decentralized manner, are people. It is precisely their inclusion in the process of financial digitalization (or digital financialization) that determines the reality and future development of any given operation in the financial market. Even if we encounter M2M (Machine-to-Machine) operations within the data exchange process between devices, where a person acts as a “regular observer of the process”, we understand that these operations are backed by both their creators and possibly “data and result falsifiers”, i.e., fraudsters (any program created, including for conducting operations in the financial market, can be hacked). Financial digitalization in a decentralized form (or digital financialization),

⁴ DataReportal. URL: <https://datareportal.com/reports/digital-2023-russian-federation> (accessed on 22.03.2024).

⁵ Website of the Bank of Russia. URL: https://cbr.ru/collection/collection/file/49041/ar_2023.pdf (accessed on 22.03.2024).

⁶ Website of the Central Bank of Russia. URL: https://cbr.ru/Content/Document/File/141992/report_07112022.pdf (accessed on 22.03.2024).

combined with the increased accessibility of financial services (financial inclusion), is a prerequisite for creating “new frontiers of possibility” in the financial market, including in a decentralized form based on the emergence of an increasing number of “fintech insiders” in the Russian market. They shape the behavior of large groups of people and organizations under the increasing influence of virtualization on both financial culture and the activities of economic entities themselves, even if these activities have not received proper legal regulation. To a large extent, the growth in the number of DeFi users is closely linked to the trust of society members in this innovative form of organizing financial relationships and the rejection of the “overregulation” of the traditional financial sector. Trust in the DeFi sector is an integral part of the progress of decentralized finance development. In our country, it relies, among other things, on clearly formulated and transparent rules and objectives of the National Program “Digital Economy”.

At the same time, the decentralized sphere of financial relations traditionally involves the transfer of responsibility and, accordingly, risks for participation in these relations, for the use of resources, tools, and technologies to the users. This is precisely the “reverse side” of decentralization, which, on the one hand, attracts users as an alternative to moving away from the “overregulation” of the centralized (traditional, CeFi) financial sector, while ensuring a high level of financial inclusion, and on the other hand, assumes that participants in the decentralized financial sector understand and adequately assess the level of risks involved, including new risks of hacking attacks, technical errors, and fraud. As interest in decentralized finance services grows, which allow for independent financial services and, consequently, as the level of financial inclusion of the population increases, the attention and demands of financial regulators, primarily the monetary regulator and the state, towards decentralized

finance services and institutions begin to rise. Understanding the risks of deepening financial inclusion in the context of DeFi development, which is related not only to the expansion of access points to innovative digital financial services but also to the adequate modern levels of financial, investment, legal, and cyber literacy, raises the question: how deep should financial inclusion be, conditioned by the development of the decentralized finance sector? Will it not become, at a certain point in time or within certain spatial boundaries, a factor hindering the achievement of the goals of financial market development, which is intended to create the necessary prerequisites for sustainable economic dynamics?

Limited access to financial services, as already noted, constitutes one of the key problems of traditional finance. At the same time, financial inclusion as a concept has a deep semantic context and corresponding significance. It is considered not only as a factor of financial development [30], but also as one of the most important conditions for achieving economic development goals, according to the World Bank⁷ and a number of contemporary researchers [31].

Research, including in the context of the development of decentralized finance, has shown that it is necessary to distinguish between financial accessibility and financial inclusivity [32]. Thus, financial accessibility, which is enhanced by the development of decentralized finance, emphasizes the possibility of obtaining and acquiring financial products and services by economic entities [33]. Inclusivity, on the other hand, indicates not only the possibility but also the involvement in the process of acquiring them [34]. That is, the process of inclusion in the financial market, including in the context of the development of decentralized finance, is considered by us in the following way: a transaction or service may be available,

⁷ Website of World Bank. URL: <https://www.worldbank.org/en/topic/financialinclusion/overview#1> (accessed on 22.03.2024).

but the consumer cannot take advantage of it due to low financial or digital literacy, and therefore does not participate in the process of acquiring and consuming it. In this case, neither the expansion and deepening of access points to financial services, nor advertising, nor the expected profitability of a particular financial transaction will help. Therefore, understanding “involvement” is important in discussions about financial inclusivity in the field of decentralized finance.

The significance of this aspect, which has not yet received proper development within the framework of a centralized form of financial organization and constitutes one of its key problems, was mentioned above. And it is precisely this aspect that forms one of the principles of decentralized finance. Among other principles, we highlight:

- decentralization and self-governance;
- financial autonomy;
- openness and transparency;
- demandingness and sensitivity to innovations;
- variety of products;
- interoperability;
- transboundary;
- flexibility of user experience;
- safety.

Decentralization and the self-governance that it obviously entails constitute the most important principle of DeFi. Here, there are no centralized governance structures, and the rules of business conduct are reflected in the smart contract. When a smart contract is launched, the DeFi application operates independently with minimal or no human intervention: there is no need for approval from banks or other intermediaries to carry out transactions or access financial instruments.

Financial autonomy is one of the manifestations of decentralization; however, we distinguish it as an independent principle that complements the latter, considering that the degree of decentralization within DeFi can vary depending on the project, and self-governance

is not identical to financial autonomy, which implies full control by users over their own funds and financial operations.

Openness and transparency are manifested in the fact that all transactions and operations in DeFi are recorded on a public blockchain, which forms the technological basis of DeFi and, accordingly, serves as the foundation of their entire structure. This makes the operations completely transparent and accessible for verification by any network participant. The source code of DeFi applications is open for auditing, allowing any user to understand the functionality of the contract or identify bugs. All transactional activity is public, which fosters trust and potentially reduces opportunities for fraud.

Demandingness and sensitivity to innovation are expressed in the fact that DeFi must stimulate innovation. This is the key to the viability of this sector, which it generally manages to achieve by demonstrating flexibility towards new solutions and producing new products and services based on smart contracts. The implementation of this principle contributes to the expansion of the product range produced by DeFi, which, in turn, stimulates the involvement of various types of investors, including traditional players.

The principle of interoperability suggests that new DeFi applications can be created by combining other DeFi products (stablecoins, decentralized exchanges, prediction markets, etc.). DeFi represents a unique model in which a certain structure can be assembled in various compatible combinations (the LEGO principle).

Most DeFi applications are accessible to any internet user. This demonstrates their cross-border nature, creating the possibility of implementing the principle of broad financial inclusivity.

The DeFi ecosystem provides the possibility of flexible user reconfiguration: if a user does not like the application's interface, they have the option to use a third-party interface or create their own. “Smart” contracts are similar to an open API, within which anyone can create applications to their own specifications.

The principle of security is predetermined by the characteristics of the technological basis of DeFi — a public blockchain — which closely corresponds with the principle of openness. Moreover, smart contracts and cryptography in the DeFi platform ensure a high level of security. Transactions in DeFi are executed automatically, and they cannot be canceled once they are placed on the blockchain, which protects users from hacking attacks and third-party interference..

The listed principles highlight the advantages of the analyzed sphere and the associated opportunities. However, one must not overlook the fact that any decentralization accompanying the movement of value in one form or another is fraught with threats. In our case, this is a whole set of risks related both to the characteristics of decentralized payment instruments and the technologies that ensure their movement, as well as to unconventional methods of organizing business in a decentralized digital environment. These threats are already in the spotlight of regulators, whose possible responses to them constitute a separate, extremely important issue.

The formation of the conceptual apparatus of decentralized finance necessitates addressing their architecture. A brief overview of its levels is contained in the aforementioned report by the Bank of Russia on DeFi.⁸ The construction presented here is reproduced from a more detailed analysis of its components [2], but it also does not contain attempts to classify the conceptual apparatus and focuses on the technological and institutional foundations of the analyzed sphere. Moreover, the institutions in the overwhelming majority are not institutions in essence and are confined within the technological frameworks of platforms that produce various tokens, each serving different purposes, providing a traditional set of composable financial products. In DeFi, unlike traditional finance, the familiar, established institutions are absent. The decentralized digital financial space is saturated

with corresponding platforms — decentralized exchanges (DEX), and solutions for information exchange with the external environment and so on are implemented here as well. Given this, it seems quite logical that the focus of modern analysis is on very specific technical terminology, which imposes equally specific qualification requirements for its mastery to successfully realize the opportunities provided by decentralized finance. That is, the conceptual framework appears to have the same narrowness as the definition of the entire phenomenon of decentralized finance. At the same time, solving research tasks related to justifying the development prospects of the phenomenon and regulatory responses to it requires at least the extraction of its fundamental block and the structuring of the conceptual apparatus. To this block, we refer to components of a monetary nature, expressed in financial assets — those that have broken away from centralized finance and their part (in participants, resources, etc.), which have formed as a result of the action of the aforementioned objective factors into an independent area of modern financial reality. A separate section of it consists of functioning principles, which generate a set of opportunities, and on the other hand — provoke the emergence and growth of vulnerabilities. The “tuning” part of the conceptual apparatus contains components that we attribute to the technological, operational, managerial, and infrastructural blocks. All these components or elements drive the mechanism of decentralized finance. They are represented at various levels of the DeFi stack. Given their multitude and diversity, we do not aim to fully list and describe their functionalities, but merely state their subordinate position in relation to the fundamental components. Thus, the standard toolkit of the systems approach is quite applicable to the analysis of the conceptual apparatus of DeFi, which implies the necessity of isolating a fundamental block within the established decentralized financial sphere. The latter ensures both the viability of the elements derived from it in all their varietal diversity and, accordingly, the possibilities of extended reproduction of

⁸ Decentralized finance. Report of the Bank of Russia for public discussion.. URL: https://cbr.ru/content/document/file/141992/report_07112022.pdf (accessed on 22.03.2024).

relationships implemented on a decentralized economic basis.

CONCLUSION

The emergence of DeFi should be qualified as a result of the action of objective forces. The improving visibility of the contours of this sphere against the backdrop of the power of TradFi, its unstable expansion, draws the attention of national and supranational regulators, especially regarding the opportunities and risks it produces. The research community does not remain aloof from the analysis of this reality, trying to assess the sustainability of these trends and their impact on the potential shift of conventional financial concepts. At the same time, we are still forced to confirm the stated theses that it is premature to qualify DeFi as an independent economic category, just as it cannot be classified as a basic institution. Its development does not exhibit stable and permanently reproducing relationships, despite the fact that its emergence is the result of an objective process driven by socio-economic and technological perturbations.

At this stage, with a high degree of certainty, it can be said that there are quite significant opportunities for positive dynamics here, as well as threats, the prevention of which, due to the lack of regulation, is also a problem of social responsibility for the participants involved in DeFi projects today.

Our research allows us to suggest that significant effects on the national economy from the development of decentralized finance will be achieved through the formation and implementation of a trusted digital space concept, within which the prevention of information falsification, its non-repudiation and integrity, and the reliability of the information placed in the digital financial environment are ensured, along with personal access to it in real-time and an understanding of the operations performed with personal data when providing financial services. At the same time, the so-called boundaries of financial inclusion must be observed, and the protection of the rights of financial services consumers must be ensured, including through sufficient legal regulation of economic processes and platforms in the DeFi sector.

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O.V. Lunyakov — study of the features and principles of DeFi, generalization of the basic conceptual apparatus.

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