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Case Study

The Role of Financial Technologies in the Development of New Financial Instruments and Markets

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ABSTRACT

Financial technologies have significantly influenced the structure of financial markets and instruments used in the modern high-tech environment. The article aimed to outline the impact and significance of financial technologies in shaping new financial instruments and markets. The research methodology included general scientific methods of analysis (statistical and structural), synthesis, induction, and deduction, as well as case study techniques to assess the role of financial technologies in the development of the financial technology sector and digital banking. The results demonstrate a substantial contribution of financial technologies to digitizing financial markets and instruments. Financial innovations and technologies serve as new structural elements of the financial sector. They are implemented in the following forms: new products (such as new types of securities); new technologies (such as credit scoring, ATMs); new institutions (such as venture capitalists, mutual investment funds, fintech startups/unicorns, and financial service providers). Digitization has led to the development of new forms of the following services: banking activities (neo-banking, virtual banking, and digital banking); products and financial instruments (digital currencies, electronic money, digital payments); tools for providing financial services (marketplaces, digital platforms, mobile applications, Internet banking based on websites). On the one hand, financial innovations create regulatory issues and systemic risks. However, their potential ensures cost reduction in the financial sector, scalability, expansion of activities beyond national markets, increased profitability, as well as more convenient and user-friendly services.

HIGLIGHTS

- The dynamic growth of financial technology (FinTech) companies and their innovative financial instruments, such as digital payments, electronic money, and digital currencies, has significantly transformed traditional banking activities, leading to increased accessibility, efficiency, and competition in the financial sector.
- The adoption of financial technologies, including artificial intelligence, blockchain, and machine learning, has not only spurred the development of digital banks and FinTech startups but also reshaped the landscape of financial markets globally, with emerging trends like open banking and central bank digital currencies influencing the digital transformation of banking services and international payments.

Keywords: Financial technologies, financial innovations, digital financial instruments, digitalization of the financial sector, digital financial market

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The dynamic development of the technological sector has contributed to the emergence of financial technology companies and the corresponding field of financial services ("FinTech" - short for "financial technology"). This innovative economic sector brings together private companies, financial institutions, providers of financial services, and national regulators. They all implement cutting-edge developments and innovations to improve the quality of financial services. The key principles of FinTech activity include transparency, adaptability to market needs, systematicity, instant access to client accounts, and the digitization of financial instruments.

Financial innovations have become a factor in the competitiveness of companies in the financial sector. They lead to an increase in investments in new technological developments and solutions. From 2010 to 2019, the total volume of global investments in FinTech companies significantly increased from USD 9 billion in 2010 to USD 216.8 billion in 2019. In 2020, total investments slightly decreased to USD 138.8 billion. However, by 2021-2022, there is a recovery in the indicator, reaching USD 209.3 billion in 2022 (Statista, 2023a).

North American countries lead in financing volumes for FinTech unicorns and the number of startups in the new financial technology sector. In total, 11,651 companies in this industry are registered in America. At the same time, in the EMEA (Europe, the Middle East, and Africa) region, there are 9,681 companies, and in the Asia-Pacific region - 5,061 companies as of May 2023 (Statista, 2023b).

The development of the financial technology sector has influenced the digital transformation of financial markets. The sector is growing new segments and introducing innovative financial instruments:

- electronic money and payments;
- digital currencies;
- digital insurance;
- digital loans and deposits.

Financial technologies are entirely changing the activities of traditional banking institutions. They also affect the development of Internet banking, mobile banking, and online banks (neo-banks and virtual banks).

The aforementioned trends in the development of financial technologies and the relevant industry require a comprehensive study of their role in the formation of new financial instruments and markets.

The article aims to outline the impact and importance of financial technologies in forming new financial instruments and markets. The authors focus on such financial technologies as open banking and digital banking, artificial intelligence, blockchain, and machine learning.

Literature Review

The scientific literature thoroughly examines the trends, prospects, and challenges of using technologies in the financial sector (Oliinyk, 2019; Chaikovskyi & Kovalchuk, 2020; Khudoliy & Svystun, 2021; Ivanenko, 2022). The issues of blockchain and artificial intelligence usage, as well as approaches to their integration in the financial-technological sector, are most comprehensively illuminated (Micu & Micu, 2016; Bai, Philippon & Savov, 2016; Wu & Duan, 2019; Abad-Segura *et al.* 2020). Micu & Micu (2016) emphasize the implementation of financial technologies in Romania's non-banking sector. Nguyen (2016) explores the directions of implementing blockchain technology for sustainable development. Milana & Ashta (2021) conducted a survey and literature review on artificial intelligence in financial markets. Giudici *et al.* (2019) examine the connection between artificial intelligence and financial technologies. Moșteanu (2019) studies the interplay between international financial markets and artificial intelligence in the context of digitization. Overall, it can be asserted that significant structural shifts in the development of financial markets. Besides, the implementation of financial instruments occurs due to digitization (Bazaluk *et al.* 2020; Kotenko *et al.* 2020; Kryshtanovych *et al.* 2021; Dudnik *et al.* 2020). The contemporary financial environment is becoming increasingly digitized. Thus, technologies are a new way to ensure competitiveness (Sumets *et al.* 2022; Levytska *et al.* 2022; Bazaluk *et al.* 2022).

At the same time, the research is mainly focused on the general trends and peculiarities of technology implementation, mainly in the banking sector. Meanwhile, the consequences and impact of financial technologies in shaping new instruments and markets are poorly understood.

Methodology

The article employs general scientific research methods: analysis, statistical and structural analysis, synthesis, induction and deduction, case study method, generalization, and systematization. Structural analysis was used to assess the structural components of the following instruments:

1. new financial instruments: mobile (electronic) wallets, mobile payments, contactless payments, digital currencies, central bank digital currencies;
2. new financial markets: virtual banking (digital banking, neo-banking, financial technology banks) and the financial technology industry.

The case study method was employed to describe new financial instruments introduced during the activities of financial technology companies (banks). The examples included:

- The digital mobile bank Atom.
- The mobile bank N26.
- The UK financial and technology company Revolut.

RESULTS AND DISCUSSION

The role of financial technologies in the development of new financial instruments

The development of financial technologies has contributed to the growth of fintech companies and digital banks, as well as increased competition among them. This happened due to the introduction of innovative financial instruments such as electronic money and wallets, digital loans, loans, deposits, insurance services, digital currencies, and cryptocurrencies. National regulators are developing projects and launching central bank digital currencies (CBDCs), considering the significant prospects of the digital transformation of the financial industry.

The intensification of competition in the financial sector through digitization and the emergence of cryptocurrencies has led to the need for the development and launch of CBDCs. It is noteworthy that the implementation of digital currencies affects the digital transformation of the banking sector and has consequences for financial stability, monetary policy, and the structure and functioning of the financial system. Among the key areas of impact of CBDC implementation in the context of the digital transformation of banking services are digital payments and international cross-border payments and transactions, which have seen significant growth.

Let us delve into the specified areas of impact in more detail:

1. Digital Payments. CBDCs can simplify payment processes and reduce transaction costs, simultaneously speeding up transactions through faster and seamless banking operations. Consequently, digital payments enhance the accessibility of banking services, especially in low-income countries where population access to banking sector services is significantly limited. The market for digital payments is dynamically growing due to the development of e-commerce and the increase in contactless and mobile payments, especially during the COVID-19 pandemic.

Digital wallets and mobile payment apps like Venmo, PayPal, and Cash App are becoming increasingly popular among consumers, facilitating smooth and secure transactions. Furthermore, the integration of blockchain technology and artificial intelligence into payment systems, as well as the growth of fintech startups, have contributed to the expansion of the digital payments market, shaping the market for payment innovations.

Payment innovations based on FinTech include the abovementioned elements: mobile (electronic) wallets, mobile payments, contactless payments, identity verification technologies, machine learning for security, and artificial intelligence. Mobile wallets have almost replaced physical wallets. They allow the use of loyalty cards and users' credit cards, thus expanding the user base. In 2019, there were 2.1 billion users of mobile wallets, conducting USD 154.4 billion transactions. In 2020, the transaction volume reached USD 214.7 billion. In 2021, it amounted to USD 274.4 billion (Statista, 2023c). The volume of mobile payments sharply increased in 2021. According to Statista, in 2018, about 440 million people used contactless payments (Statista, 2023c). In 2020, this number increased to 760 million (Khudoliy & Svytsun, 2021).

Since the beginning of the pandemic, in low- and middle-income countries (excluding China), over

40% of adults have made payments in stores or online using a card, phone, or the internet. In all low- and middle-income countries, more than a third of adults pay utility bills directly from their official digital accounts. After the start of the pandemic, over 100 million adults in China made their first digital payment, and in India, over 80 million adults did so (Statista, 2023c). In 2021, two-thirds of adults worldwide made or received digital payments/income. The share of digital payments in developing countries increased from 35% in 2014 to 57% in 2021. In developing countries, 71% of individuals have opened an account with a bank, mobile money provider, or other financial institution (for comparison, 42% in 2011 and 63% in 2017) (World Bank, 2022).

2. *International payments:* The launch of CBDCs can increase the speed of conducting cross-border transactions, which are slowed down by different banking systems and time differences. According to the Atlantic Council (Atlantic Council – a US-based analytical center, a non-governmental organization) (Atlantic Council, 2023), as of 2023, 119 countries are implementing digital currency projects. 11 countries have launched digital currencies, 17 are implementing pilot projects, 33 are developing projects, 39 are conducting research on digital currency, 15 are inactive in this area, and 2 have canceled projects. The potential for launching digital currency is being studied in 114 countries, representing over 95% of the world's GDP. For comparison, in May 2020, only 35 countries were considering the possibility of implementing CBDC projects. Today, 60 countries are in an advanced research stage (development, piloting, or launch). Among the 11 countries that have fully launched digital currency, China's pilot project covers 260 million people, and in 2023, the country plans to expand the use of digital currency nationwide.

The development of regional cooperation has led to the need to implement CBDC test projects for cross-border payments. Therefore, there are currently 9 wholesale CBDC cross-border projects and 7 retail CBDC cross-border projects, almost twice as many as in 2021. In 2023, more than 20 countries will take significant steps to launch CBDCs. Australia, Thailand, Brazil, India, and South Korea intend to continue or start pilot testing in 2023. The ECB will also begin pilot-testing digital currency in 2023. This is specifically noted on the official website of the European Data Protection Supervisor (EDPS): "The European Central Bank, having examined scenarios for the development of the digital euro and consulted with stakeholders, has decided to launch the CBDCs project, the research phase of which will last until October 2023" (The European Data Protection Supervisor).

The role of financial technologies in the formation of new financial markets and sectors

The use of financial technologies in banking activities has led to the development of the financial technology market and the market for digital currencies. The interaction between fintech companies and the big technological (BigTechs) sector based on cooperation and competition strategies enhances the positive dynamics of these markets.

Over the last five years, the financial technology sector has been rapidly developing and significantly influencing the creation and provision of financial services on a global scale. The financial technology industry is at the intersection of financial services and a unified digital market. It promotes the implementation of technological innovations in the field of financial services. The financial sector most fully utilizes digital technologies. It serves as the main driver of the digital transformation of the economy and society.

In 2018, approximately 70% of banking executives claimed an increase in the importance and opportunities of collaboration with financial and large technology companies to create new services. Collaboration requires significant investments, the volumes of which have significantly increased since 2017. In 2018, the global volume of investments in financial technology companies reached a record USD 112 billion. From 2017 to 2018, the annual value of global venture capital investments in financial technology companies doubled. Meanwhile, there are differences in the growth of the financial technology sector in various national markets.

As of February 2020, the largest number of financial technology startups were concentrated in North America. Differentiation in the adoption rates of financial technologies in the financial sector is also observed in countries, taking into account consumer needs (Statista, 2023d).

The narrow specialization of financial technology companies in specific financial services ensures the provision of high-quality services to consumers and the improvement of financial instruments and types of banking services. In the future, this will contribute to expanding cooperation with other market players, including banks, large technology companies, and other financial technology companies.

Big technology (BigTech) companies have started integrating financial products into their own business and offering corresponding services to consumers. Revenues from financial services account for almost 11.3% of the total revenues of companies in the big technology sector. They simultaneously compete and collaborate with traditional banking institutions, offering and developing distribution channels for financial service providers (International Monetary Fund, 2021).

For example, the Brazilian financial technology company Nubank offers credit cards and personal loans to 50 million customers. Most of them could not obtain credit from traditional banks due to the absence of a credit history. However, Nubank's use of artificial intelligence technologies, customer behavior data, and proprietary algorithms for assessing the creditworthiness of customers has contributed to solving a similar problem of the lack of credit history and thus reducing the level of potential losses for the bank from non-performing customers (European Central Bank, 2022).

Another example is large technology firms Amazon and Google. They have started offering financial services using their own networks, customer data, and available technologies, focusing on specific financial services. Traditionally, banks safeguarded customer data, including data necessary for assessing creditworthiness and solvency. In comparison, large technology companies increasingly can conduct similar assessments using their customer data. Therefore, the traditional role of banks in ensuring confidentiality and data protection is shifting to new players who possess the technological resources to fulfill these functions.

The financial technology sector and companies in the field of big technologies offer customers additional interfaces based on banking payment infrastructure. Thus, they cover market segments or clients who were not previously served or did not have bank accounts (for example, through lending platforms), including providing domestic and international money transfer services and establishing partnerships with existing credit institutions. In some cases, innovations and competition from new participants in the financial sector have pushed traditional financial institutions to use technology to expand the range of services and reach previously uncovered market segments. They use digital identification and convenient interfaces to attract consumers with lower levels of financial literacy.

Shifts have occurred in financial technologies due to the implementation of new products and services specifically designed to fulfill specific functions of the financial ecosystem, such as Reg-tech, Insurtech, and robotic consulting. In the practice of financial and credit institutions, technologies such as digital banking, artificial intelligence, open banking systems, mobile wallets, and blockchain are rapidly developing and spreading (Khudoliy & Svytsun, 2021). The most widespread types of technology-based financial innovations include:

- Smartphone technology.
- Internet network.
- Application programming interfaces (APIs).
- Big data and artificial intelligence (AI) technologies, and distributed ledger technology (DLT) (International Monetary Fund, 2021).

As a new component of the financial sector, digital banking (digital finance and virtual banking) offers new financial instruments such as contactless payments, international (global), cross-border transfers and payments, and commission-free P2P transfers. Digital banking employs these instruments to provide remote banking services, such as platforms for acquiring and exchanging digital currencies (Ethereum, bitcoins, among others) and digital banking platforms (for example, Macrobank – a platform for launching virtual banks by fintech companies). The increase in the number of digital banks has led to a 36% reduction in the number of visits to bank offices/branches from 2017 to 2022, significantly allowing for a decrease in administrative expenses. The main advantages for consumers of digital banking services include:

- instant bill payment;
- real-time account analytics;
- balance viewing speed;
- income and expense management;
- remote PIN code setting (Khudoliy & Svystun, 2021).

According to the research conducted by McKinsey (2022), a challenge in the development of virtual banks is posed by the activities of powerful financial technology companies that offer customers a wide range of financial services, speed, convenience, availability, and simplicity. The competition they create for banking systems simultaneously contributes to and helps modernize the ecosystem of the financial sector and poses risks to the functioning of traditional banks.

Virtual banks position themselves as financial technology companies. The European Central Bank (hereinafter ECB) defines the concept of a financial technology bank as one that operates based on a business model. According to this model, the production and provision of banking products and services are based on technological innovations (European Central Bank, 2018). According to the Single Supervisory Mechanism (SSM) requirements, digital banks must obtain a license to conduct financial activities within the Eurozone.

Among the examples of financial technology banks is the digital Atom Bank, founded in 2014 in the United Kingdom. It operates based on an innovative platform built on the Google Cloud platform, using a mobile application as a tool for providing digital services.

In the financial technology sector, the mobile bank N26 was founded in Germany in 2013. The online bank operates in 24 markets and remotely manages personal and business accounts. It provides real-time expense and savings control services (Official site of N26 mobile bank, 2023). In 2016, the bank obtained a banking license from the European Central Bank. Among the innovative financial services of N26 are insurance, including electronic insurance, travel insurance, and property insurance.

The financial technology company is Revolut from the United Kingdom, founded in London in 2015. It offers remote banking services, including currency exchange, payment cards, stock trading, commodities, and cryptocurrencies. In 2015, Revolut launched the ability to exchange and transfer money in the UK. In 2017, the company launched the Revolut Business project, offering business consumers payment services, electronic money, currency exchange services, acquiring, prepaid corporate cards, and international and domestic bank transfers for small and medium-sized enterprises and freelancers. In July 2020, Revolut launched consumer lending services, including unsecured loans and credit cards (Official site of Revolut, 2023).

Digital banks are considered "unicorns" or startups in the financial technology sector that attract significant venture capital, thanks partly to their innovative digital business models, digitization of service processes, and rapid scaling beyond national markets (Statista, 2023d). As of February 2018, the financial technology company Revolut had attracted 1.5 million customers. As of 2022, the company had 18 million customers (Official site of Revolut, 2023). The dynamic growth in the number of users of digital financial services is evident in mobile banks in Germany – N26, whose customer base reached 7 million clients as of January 2021 (Statista, 2023e). Alongside the increase in the volume of consumers of digital banking services, there is a growth in the funding of challenger banks. As of February 2023, the total funding for the N26 mobile bank exceeded USD 1.7 billion, securing its leadership in this sector in Europe (Statista, 2023f). For comparison, the value of the financial technology company Revolut was over EUR 1 billion as of April 2018 and reached EUR 1.7 billion as of August 2018 (Statista, 2023f). The financial technology company Revolut continues to attract significant investment, mainly through venture capital, with funding for the digital bank reaching USD 1.7 billion in February 2023 (Statista, 2023f).

The Open Banking (OB) system is employed in the online banking sector. It aims for a greater focus of products and services on the needs and demands of consumers. The essence of Open Banking involves using an Application Programming Interface (API) to provide access to the banking data of clients to third parties (developers) with their consent. The main goal of OB is to enhance the quality of banking services and create innovative financial services based on customer data analysis (Chaykovsky &

Kovalchuk, 2020). Open Banking is a technology that unites financial institutions, technology providers, and third parties to form a network for data transmission and secure exchange of customer information with their consent (income, expenses, transactions). This technology allows the control of banking and other financial data of clients through third-party applications using API and artificial intelligence. According to Allied Market Research, in 2018, API technology enabled banks to generate USD 7.29 billion in revenue. According to forecasts, by 2026, the revenue volume will reach USD 43.15 billion (Khudoliy & Svytsun, 2021).

Considering the effectiveness of APIs, the number of registered authorized Third-Party Providers (TPP) utilizing APIs for open banking services in Europe has been increasing from January 2019 to December 2022 (Statista, 2023g). The highest number of authorized providers for open banking services is registered in Sweden, with 38 registrations as of December 2022, totaling 153 registrations. Germany and Poland follow closely, while the United Kingdom leads in the overall number of authorized providers with 223 (Statista, 2023h).

Artificial Intelligence (AI) is seen as a promising technology for the development of the financial technology sector. Automation in customer service processes is a significant direction in the development of AI technologies. Through intelligent distribution, analysis, and automatic classification of banking data, financial institutions easily address issues related to a large volume of messages, reviews, and calls. Thanks to AI technology, banks can use chatbots instead of operators in call centers. Virtual bots can solve most traditional consumer problems, answer common questions, and, if necessary, direct the client to the support department (Ivanenko, 2022).

Among the most dynamically evolving financial technologies, artificial intelligence and machine learning, natural language processing (NLP), and natural language generation (NLG) stand out. These technologies are based on learning algorithms that collect and analyze large datasets for self-improvement. Table 1 provides examples of the use of artificial intelligence in banks in different countries.

The banking sector is a leader in developing and integrating artificial intelligence to address numerous tasks. According to the research organization

Table 1: Examples of the use of artificial intelligence in banking supervision

Bank	An example of using artificial intelligence
Bank of Italy, Banca d'Italia	The use of AI and machine learning (ML) algorithms based on data from various sources to study the prospects for predicting loan defaults
Bank of Spain, Banco de España	The use of natural language processing (NLP) technologies to process environmental, social, and management information of institutions in order to improve the understanding of the bank's internal economic situation. Controlled AI technologies can be used to detect misconduct of banking institution personnel.
Bank of Thailand	An artificial intelligence system is used to analyze the minutes of board meetings of financial institutions, which is used by supervisors to assess the board's compliance with the regulatory authorities and to provide recommendations as part of ongoing supervision.
Bank of the Netherlands, De Nederlandsche Bank	Machine learning (ML) is based on transaction data to identify a network of interconnected organizations, assess the risks of financial institutions, and detect suspicious transactions.
ECB, European Central Bank	Machine reading of the «fit and proper» questionnaire to identify potential problem customers.
	ML for early detection and prevention of stressful situations.
	NLP and ML are used to search for information in supervisory decisions to facilitate the identification of new trends and risk clusters/groups.
Monetary Authority of Singapore	Work on a project where credit risk assessment by supervisory authorities is carried out using AI algorithms instead of sampling.
Bank of Germany, Oesterreichische Nationalbank	ML algorithms are used to predict the likelihood of errors in data sets that the reporting entity should correct.

Source: *International Monetary Fund (2021).*

Autonomous Research in the Financial Sector, by 2030, the banking sector could save around USD 1 trillion through the use of artificial intelligence. It can improve operational efficiency, revenues, and service quality (Chaykovsky & Kovalchuk, 2020). By 2030, AI is expected to reduce banks' operational costs by approximately 22%. At the same time, expenditures on AI and cybersecurity will amount to USD 96 billion by the end of 2021 (Khudoliy & Svystun, 2021).

Artificial intelligence enables a shift towards more personalized service delivery, meaning the ability to formulate an individual offer to the client based on their data. One of the most in-demand directions in artificial intelligence is robo-advisory, considering its lower cost, risk management capabilities, and fraud prevention (Chaykovsky & Kovalchuk, 2020).

According to the report of the Organization for Economic Cooperation and Development (OECD), digitization trends have accelerated, particularly in the use of artificial intelligence (AI), following the COVID-19 crisis. Projections indicate that global spending on AI will increase from USD 50 billion in 2020 to over USD 110 billion in 2024. This is associated with the growth in volumes, the number of available data, and an increase in computational power. As a result, AI implementation in the financial sector accelerates in areas such as credit underwriting, asset management, algorithmic trading, and blockchain-based financial services (OECD, 2021).

Blockchain is one of the most significant technologies used in the financial technology sector. The banking sector employs blockchain for tracking transactions, obtaining accurate and reliable information about transactions, and for the quick and precise execution of payments, reducing costs. Financial institutions are focused on developing their own digitization strategies, including blockchain projects.

Blockchain technology was first applied at the Bank of Ayudhya PCL in 2017 in Thailand, where a successful real-time international transfer trial was conducted. A transfer was made between Thai and Singaporean banks using the advanced "Krungsri Blockchain Interledger" technology in collaboration with Mitsubishi, MUFG Bank, and Standard Chartered Bank. This innovation significantly improved liquidity management efficiency and reduced costs for the Mitsubishi Corporation (Bank of Ayudhya Public Company Limited, 2021).

In the financial technology sector, regulatory technologies are rapidly spreading under Regulatory Technology's (RegTech) direction. They provide companies and corporations with tools to regulate compliance with new legislative requirements. RegTech technologies specifically provide companies with tools and means to address regulatory issues, combining fiscal, trade, and financial legislative documents from national regulators. RegTech technologies adapt and integrate solutions relatively easily and quickly to ensure compliance with financial regulatory standards. Financial institutions gain various advantages through RegTech technologies, including automating reporting formation and submission processes, risk identification and mitigation, and compliance with changing legislative requirements (Oliynyk, 2019).

CONCLUSION

Financial innovations and technologies serve as a new structural element of the financial sector and are implemented in the following forms:

1. New products (for example, new types of securities).
2. New technologies (for example, credit scoring, ATMs).
3. New institutions (for example, venture capitalists, mutual investment funds, fintech startups/unicorns, and financial service providers).

Digitization has led to the development of new forms of the following services:

1. Banking activities (non-banking, virtual banking, digital banking).
2. Products and financial instruments (digital currencies, electronic money, digital payments).
3. Instruments for providing financial services (marketplaces, digital platforms, mobile applications, internet banking based on websites).

On the one hand, financial innovations create regulatory problems and systemic risks. However, their potential ensures cost reduction in the financial

sector, scaling and expanding activities beyond national markets, increased profitability, and more convenient and user-friendly services. Further research should focus on quantifying the impact of the financial technology sector on the dynamics of financial markets.

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