



Strategic and Technological Aspects of the Digital Euro: Between Regulatory Challenges and Academic Reflection

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Abstract.

Relevance. The global digitalization of finance and the advancement of technologies are driving central banks to implement central bank digital currencies (CBDCs), which in turn create new challenges for monetary and payment systems. The European Central Bank's digital euro project serves not only as an innovative response but also as a strategic tool to safeguard monetary sovereignty, ensure payment inclusion, and strengthen monetary security amid digital transformation. It has become critically important to analyze the legal, architectural, and social dimensions of this process within the context of public administration and the institutional framework of the EU. The purpose of this study is to provide a comprehensive analysis of the strategy for implementing a central bank digital currency as an integral part of the digital transformation of the European Union's financial system, under the current challenges of public governance, economic security, and institutional development. The study also aims to identify the role of cash within this new financial paradigm.

Results. The paper examines the major stages of the digital euro project, from conceptual research to the preparation phase for implementation (November 2023 - end of 2025). The analysis reveals that: the digital euro complements rather than replaces cash, preserving attributes such as privacy and offline availability; the project's architecture takes into account user interests, technological security, and the EU's technological autonomy; the regulatory framework, involving working groups and stakeholders, contributes to overall transparency and legitimacy of implementation.

Conclusions. The digital euro is a strategic initiative that combines technological innovation with the strengthening of financial sovereignty. Its success depends on a clear regulatory and legal framework, changes in the banking system structure aligned with institutional interests, adherence to high standards of cybersecurity and privacy, effective engagement with the public and business entities, and an inclusive approach to populations with limited access to digital services.

Keywords: strategic planning, digital currencies, CBDC, digital euro, European Central Bank, public administration, financial inclusion, monetary sovereignty, digital transformation

Стратегічні та технологічні аспекти цифрового євро: між регуляторними викликами та науковим осмисленням

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Анотація.

Актуальність. Глобальна цифровізація фінансів та розвиток технологій підштовхують центральні банки до впровадження цифрових валют (CBDC), що у свою чергу формує нові виклики для монетарної та платіжної систем. Проєкт цифрового євро від ЄЦБ виступає не лише інноваційною відповіддю, але й стратегічним інструментом захисту монетарного суверенітету, забезпечення платіжної інклюзії і грошової безпеки в умовах цифрової трансформації. Стало критично важливим аналізувати правові, архітектурні та соціальні аспекти цього процесу в контексті публічного управління, інституційної структури ЄС. Метою дослідження є всебічне осмислення стратегії впровадження цифрової валюти центрального банку як складової цифрової трансформації фінансової системи Європейського Союзу в умовах сучасних викликів публічного управління, економічної безпеки та інституційного розвитку, а також виявлення місця готівки в цій новій фінансовій парадигмі.

Результати. Проведено аналіз значних етапів проєкту цифрового євро: від концептуальних досліджень до етапу підготовки впровадження (листопад 2023 - кінець 2025). Виявлено, що: цифровий євро доповнює, а не замінює готівку, зберігаючи властивості приватності й офлайн-доступності; архітектура проєкту враховує інтереси користувачів, технологічну безпеку та технологічну автономність ЄС; регуляторна структура за участі робочих груп та стейкхолдерів сприяє загальній прозорості і легітимності впровадження.

Висновки. Цифровий євро – це стратегічна ініціатива, що поєднує технологічні інновації з посиленням фінансового суверенітету. Його успіх залежить від чіткої регуляторної бази та юридичних норм, змін у структурі банківської системи з урахуванням інституційних інтересів, забезпечення вищих стандартів кібербезпеки та приватності, ефективного залучення громадськості й бізнес-структур, інклюзивного підходу до населення з обмеженим доступом до цифрових сервісів.

Ключові слова: стратегічне планування, цифрові валюти, CBDC, цифровий євро, Європейський центральний банк, публічне управління, фінансова інклюзія, монетарний суверенітет, цифрова трансформація



Introduction.

At the turn of the third decade of the 21st century, the global economy is undergoing a profound structural transformation driven by a technological revolution, the digitalization of finance, and the re-configuration of the international monetary order. In this context, central bank digital currency (CBDC) is emerging not only as a technically innovative tool but also as a strategic means of safeguarding monetary sovereignty, ensuring the circulation of money in the digital age, and guaranteeing financial inclusion.

The digital euro project, initiated by the European Central Bank (ECB), represents an attempt to combine the stability of central banking with the flexibility of digital instruments. The rollout of this project is taking place in stages—from conceptual research to technical implementation, from academic discourse to political decision-making. The digital euro experience constitutes a valuable subject for analysis in the realm of economic theory, public governance, law, and strategic planning.

This analytical work aims to examine the stages of the digital euro's development, based on primary ECB sources—working papers, statistical publications, legal analytical notes, and project evaluations—as well as the positions of key stakeholders.

Relevance. In the current context of rapid digitalization of the global economy and the transformation of financial systems, central bank digital currencies (CBDCs) are emerging as a response to new technological, social, and geopolitical challenges. The European Central Bank's initiative to introduce the digital euro is a reaction to the growing competition from private digital currencies and technological giants, as well as a crucial strategy for preserving monetary sovereignty, enhancing financial inclusion, and maintaining the stability of the euro area's payment infrastructure.

Against the backdrop of the increasing role of non-bank intermediaries in payment processes, the proliferation of cryptocurrencies, and the risk of public institutions losing control over monetary circulation, the digital euro is designed to become a public financial instrument that meets high standards of security, privacy, and accessibility. At the same time, its implementation is accompanied by a range of technical, regulatory, and institutional challenges that require systematic research.

The relevance of this topic is further reinforced by the need to integrate the digital euro into the already established banking and legal ecosystem of the EU, to ensure a balance between innovation and traditional forms of money (particularly cash), and to find inclusive solutions for socially vulnerable groups. Moreover, considering the role of the Eu-

ropean Central Bank as one of the leaders of global financial stability, the analysis of the strategic and technological aspects of the digital euro holds significant importance for international scientific and policy discourse.

Research Objective. The objective of the research is to comprehend the strategy for implementing a central bank digital currency (CBDC) as an integral component of the digital transformation of the financial system under the current challenges of public governance, economic security, and institutional development. It also aims to determine the role of cash in this new financial paradigm. The study focuses on analyzing the stages of development, architectural solutions, legal regulation, and challenges for public administration in the context of the digital transformation of the European Union's financial system.

Analysis of Previous Research and Publications. Recent studies demonstrate a growing scholarly interest in the impact of digital finance and digital transformation on the functioning of banking institutions, particularly in terms of efficiency, risks, and strategic transformations.

The article "An Empirical Analysis of the Impact of Digital Finance on the Efficiency of Commercial Banks" (Zhang et al., 2023) presents an empirical study of Chinese commercial banks aimed at identifying the impact of digital finance on total factor productivity (TFP). The authors use a modified Malmquist productivity index within the framework of Data Envelopment Analysis (DEA), which allows for a quantitative measurement of efficiency dynamics in conjunction with the level of digitalization of banks. The results show a positive correlation between the level of digital finance and efficiency, especially in privately-owned and medium-sized institutions. At the same time, institutional heterogeneity is identified: large state-owned banks exhibit lower adaptability to digital innovations, which is explained by organizational inertia and more complex bureaucratic structures. Thus, digital finance is considered not only a technological tool but also a driver of institutional transformation in the banking sector (Zhang et al., 2023).

Another significant study, "How Digital Transformation Affects Bank Risk: Evidence from Listed Chinese Banks" (Li et al., 2023), focuses on the relationship between digital transformation and bank risk. The panel data analysis of 36 Chinese banks over the period 2011–2021 reveals that digitalization generally contributes to the reduction of banking risks, particularly through enhanced operational efficiency and profitability. However, the effect is not uniform: small and medium-sized banks, as well as regional institutions, benefit more from di-



gitalization compared to larger banks, where institutional complexity hampers adaptability. The study emphasizes the importance of strategic integration of digital tools for effective risk management (Li et al., 2023).

In the context of global digital innovation trends, it is also worth mentioning the systematic review "Central Bank Digital Currencies: A Comprehensive Systematic Literature Review on Worldwide Research Emergence and Methods Used" (Fahad & Bulut, 2024), which analyzes 169 academic studies dedicated to central bank digital currencies (CBDCs). The authors identify the main areas of scholarly discourse, methodological approaches (R, Biblioshiny, Excel), and regional features. This allows for the mapping of the current state of academic research on CBDCs and the identification of gaps for further investigation (Fahad & Bulut, 2024).

Overall, the review highlights the growing integration of digital innovations in the banking sector and confirms the need for flexible adaptation strategies tailored to the size of the institution, type of ownership, and institutional conditions.

Results.

In the current era of rapid digital transformation in financial services, central banks are increasingly focusing on the need for a thoughtful evolution of monetary circulation. In this context, the European Central Bank (ECB) has launched the digital euro project - an electronic form of central bank money that will be available to all citizens and businesses in the euro area. This initiative is not intended to replace the existing cash form of the euro but to complement it. The digital instrument is expected to retain the functions of traditional cash while expanding the possibilities of modern transactions, both in physical and digital environments. Its introduction aims to ensure the security, accessibility, and speed of payments while safeguarding citizens' fundamental right to privacy.

The motivation for introducing the digital euro encompasses several deeply strategic dimensions. First and foremost, it reflects the ambition to preserve and strengthen the financial sovereignty of the Eurozone. Given that a significant portion of Europe's payment infrastructure relies on technological solutions controlled by non-European entities, the digital euro emerges as a tool to enhance strategic autonomy. It is intended to become a component of a stable, reliable, and independent European payment infrastructure, reducing vulnerabilities to external influences. Furthermore, the ECB sees the digital euro as a means of promoting innovation in the financial sector. The new platform is expected to enable the development of competitive digital

payment solutions, creating added value within the EU. A particularly important aspect in this context is ensuring inclusiveness - the digital euro must be accessible even to those citizens who are currently outside the banking system or have limited access to digital services. This opens up the potential to strengthen financial integration at both individual and macro levels (European Central Bank, 2024a).

The functional architecture of the digital euro provides for the use of digital wallets, which citizens will be able to open through banks or other authorized intermediaries. These wallets will enable instant payments at physical points of sale, in online environments, and even within P2P transactions. It is anticipated that these transactions will function both online and offline. One of the central requirements is the preservation of user privacy. The ECB emphasizes that it will not have access to users' personal data, which is intended to alleviate concerns about potential government control over citizens' financial activities (European Central Bank, 2024).

In December 2024, the European Central Bank published its second official report, reflecting the progress of the preparatory phase of the digital euro project, covering the period from May to October of the same year. The report not only documents the progress achieved but also highlights the complex institutional dynamics accompanying the deployment of a next-generation currency intended to serve as a digital public good in the Eurozone (European Central Bank, 2024b).

One of the defining steps in this process was the work of the Rules Drafting Group (RDG), which completed the review of the initial draft of the regulatory document (version 0.8). Significantly, during this phase, the group received over 2,500 substantive comments from stakeholders, indicating a high degree of market and public interest in shaping the framework conditions for the digital euro's operation. In May 2024, to deepen specialized elaboration, seven thematic working groups were established, focusing on such critical dimensions as user experience standards, risk management, and technical implementation specifications. These areas of activity demonstrate a commitment to achieving regulatory flexibility and full compliance with the anticipated legal environment of the European Union. In parallel, to build the technical infrastructure for the digital euro, the ECB announced a tender for the development of the external components of the Digital Euro Platform (DESP) and invited national central banks to submit proposals for its internal components. At the time of the report's publication, the evaluation of submitted applications was ongoing.



Another important component is the study of end-user needs. In September 2024, empirical research began in the form of field testing aimed at gathering qualitative feedback on functionality, usability, and expectations for the future product. The publication of the analytical results from this phase is planned for mid-2025. Simultaneously, under innovative partnerships, testing of new use-case scenarios for the digital euro - including conditional payments - was initiated, with results expected in July of the same year.

The European Central Bank (ECB) pays particular attention to the issues of architectural design and technical implementation. Among the key questions are the methodology for setting the maximum amount of digital euro that can be held by a user, as well as the prospects for applying offline solutions, particularly through secure elements on mobile devices. In October 2024, consultations were held with device manufacturers and service providers, confirming the ECB's commitment to ensuring the technological resilience and security of the platform.

At the same time, the ECB continues its active communication with the public, market participants, and legislative institutions. This triangle of interaction aims to ensure transparency, legitimacy, and broad social acceptance of the digital euro.

According to the approved timeline, the preparatory phase will continue until the end of 2025. Only upon its completion will the ECB Governing Council decide whether to move to the next phase. However, the final implementation of the digital euro will only be possible if an appropriate legal framework is adopted by the European legislator.

As of June 2025, the European Central Bank remains in the preparatory phase of the project. This phase began in November 2023 and includes establishing the legal and regulatory basis, analyzing technological solutions, identifying potential platform providers, and conducting a series of consultations with stakeholders-both in the public and private sectors. It is expected that by the end of 2025, a decision will be made on transitioning to the next implementation phase, which will involve testing, infrastructure deployment, and potential launch of pilot projects (European Central Bank, 2024a, 2024b).

Among the anticipated advantages of the digital euro are universal access, free basic functions, a high level of privacy, and the stimulation of innovative services. However, the project also faces several challenges. Chief among them is the risk of deposit outflows from commercial banks to the central bank, which could negatively impact the liquidity of the banking system. In addition, serious attention must be paid to the technical implementation

of solutions that must meet the highest standards of cybersecurity, scalability, and user-friendliness. Another layer involves legal and regulatory issues requiring the adaptation of European legislation to the realities of digital currency.

Thus, the digital euro is not merely a technological innovation but, above all, a geo-economic and political project with the potential to transform the very nature of money in the 21st century. Its successful implementation will require both technical excellence and strategic foresight, broad stakeholder engagement, and well-balanced regulatory support.

The Cash Side. The Response of «Players»: From Rejection to Acceptance and Proposals for a Digital Currency Concept.

In the context of rapid digitalization of payment systems, the concept of a central bank digital currency (CBDC) has sparked active discussions among experts and practitioners. The phased response of Germany's federal printing enterprise (Bundesdruckerei) reflects the evolving attitudes of key players-from a conservative emphasis on cash preservation to the active adoption of innovative solutions that combine traditional and digital forms of payment.

1. Creating the Digital Euro as a Complement to Cash.

In the article "Wie Bares, bloß digital: Was der digitale Euro leisten muss" (2021), the digital currency is considered a logical stage in the evolution of payment systems. Emphasis is placed on preserving the key properties of cash-anonymity and offline functionality-that should be integrated into the digital euro. This approach seeks to combine the advantages of digital payments (convenience, speed, automation of device-to-device operations) with traditional values (Bundesdruckerei, April 26, 2021). Special attention is devoted to the security and privacy of user data, which are critically important for building trust in new financial instruments.

2. Preserving Cash as a Basis for Financial Inclusion and Reliability.

The article "Harte Währung in digitalen Zeiten" (2023) emphasizes the fundamental role of cash in the modern economy, especially regarding financial inclusion. Dr. Dieter Sauter stresses that a significant portion of the population, particularly vulnerable social groups, still lacks access to banking services or digital payment instruments. Unlike digital means, cash is not dependent on electricity or internet connectivity, making it indispensable in emergency situations. Moreover, the anonymity of cash transactions is a key factor in protecting user privacy, which enhances its social acceptability (Bundesdruckerei, 2023).

3. Banknotes Beyond Transactions: The Cultu-



ral, Emotional, and Cognitive Value of Cash.

The article “Banknoten: mehr als ein reines Zahlungsmittel” on the Bundesdruckerei website provides an in-depth analysis of the benefits of cash that go beyond its traditional role as a means of payment. In a conversation with economic psychologist Prof. Dr. Julia Pitters, numerous psychological, cultural, and social aspects are explored, which give cash its unique value in today's world. For example, contact with physical cash activates brain areas responsible for the sense of reward, triggering dopamine release—a neurotransmitter associated with feelings of pleasure and achievement. This effect is absent in cashless payments, giving cash a special status in the field of behavioral economics (Bundesdruckerei, 2023).

Furthermore, cash holds significant cultural and social importance as an integral part of traditional rituals and festive customs such as gift-giving. These practices preserve and transmit social and emotional values that digital payment methods cannot fully replicate. The tactile experience of interacting with banknotes fosters a sense of stability and reliability—especially relevant in times of economic uncertainty, such as during the COVID-19 pandemic. Lastly, the design of banknotes is not merely aesthetic but also a functional element that shapes trust in the currency; involving the public in this process enhances the sense of identification and strengthens the perception of cash as a stable means of payment.

Thus, cash is not limited solely to the role of a transaction tool, but functions as a multidimensional phenomenon combining psychological stimulation, cultural heritage, and social trust. These aspects emphasize its importance and make cash an indispensable element of the financial system, harmoniously complementing digital payment methods.

4. In the publication “Bundesdruckerei gewinnt Branchenpreis für Konzept zur Banknote der Zukunft” (2024), an innovative concept for the banknote of the future—ExNihilo—is presented, merging the physical characteristics of traditional cash with the capabilities of digital technologies. It is equipped with an embedded chip that enables offline payments and preserves user anonymity, facilitating a secure and convenient transition to digital forms of payment (Bundesdruckerei, May 21, 2024). The project was recognized as the best in its category at the IACA Excellence in Currency Award 2024, underscoring the concept's high innovative value and practical significance.

Summary of the Stepwise Development of the Digital Currency Concept.

In contemporary financial discourse, there is a growing trend toward integrating digital payment

instruments into everyday economic activity. However, despite the rapid advancement of digital technologies, cash not only remains relevant but also acquires new meanings that require comprehensive interdisciplinary analysis. The digital euro, whose concept was outlined in studies as early as 2021, is seen as the logical continuation of the payment system's evolution. At the same time, it is not intended to replace traditional cash but rather to complement it, preserving key properties such as anonymity, offline functionality, and a high level of security. These characteristics are essential for building user trust, especially amid increasing concerns about data privacy in the digital environment.

Of particular significance is the social dimension of preserving cash. As Dr. Dieter Sauter aptly noted in a 2023 interview, cash serves as the foundation of financial inclusion, especially for demographic groups that, for various reasons, remain outside the digital economy. Vulnerable social groups—such as the elderly, migrants, or those without permanent residence—often lack stable access to banking services or reliable internet connectivity. Therefore, cash becomes their only available means of participating in economic life. Its reliability in crisis situations—such as power outages or natural disasters—further confirms its vital role as an element of financial-system resilience.

That said, the role of cash is not limited to its utilitarian value as a medium of exchange. Research into the psychological and cultural dimensions of cash convincingly demonstrates that banknotes are a multidimensional phenomenon. In her work at the intersection of economic psychology and neuroscience, Prof. Julia Pitters highlights that the tactile contact with cash activates brain areas associated with reward systems, triggering dopamine release. This creates feelings of control, achievement, and stability, which digital payment methods do not evoke. Furthermore, cash holds powerful cultural and social significance—it is present in gift-giving rituals, festive traditions, and daily practices that shape our notions of material value, mutual trust, and economic fairness.

The synthesis of these approaches is embodied in the innovative hybrid banknote concept ExNihilo, developed in 2024. It represents an attempt to combine, within a single payment instrument, both traditional and digital properties: physical tangibility, tactile engagement, and cultural resonance on one hand, and capabilities for digital data processing, anonymity preservation, and offline transactions on the other. This banknote not only reflects technological progress but also serves as a symbol of institutional adaptation to the new challenges fa-



cing public institutions and central banks in the 21st century.

Therefore, we are dealing with a paradigm in which cash and digital currencies do not conflict but coexist in a complementary dynamic. This model envisions maintaining the fundamental characteristics of cash as a public good while integrating the advantages of digital technologies. For public administration, this means the need to develop strategies that account for the multidimensional nature of money - as an economic instrument, a cultural artifact, and a bearer of social trust. Only through such an integrative approach can we ensure sustainable, inclusive, and technologically adaptive development of the financial system.

In summary, the digital euro is not merely a response to technological shifts in finance, but a well-considered strategic initiative by the ECB aimed at modernizing the Eurozone's financial infrastructure in light of 21st-century challenges. Its conceptualization reflects a desire to preserve monetary sovereignty in a world increasingly influenced by private digital currencies and transnational payment ecosystems beyond the control of public institutions.

At the same time, the digital euro is intended to address a range of important social and economic objectives: from expanding access to financial services and reducing inequality to stimulating technological renewal in the payments sector. It is positioned as a complement to existing payment instruments, not a replacement-indicating an evolutionary, not revolutionary, approach to monetary transformation. The focus on high standards of privacy, including the possibility of anonymous offline transactions, underscores the ECB's intention to provide a digital alternative to cash that preserves its social function as a tool of trust and privacy protection. Meanwhile, the digital euro may serve as a catalyst for forming a more competitive and secure payments services market, an important factor in enhancing the efficiency of economic processes. Thus, the digital euro may emerge as a multifaceted instrument combining macroeconomic stability, technological innovation, social inclusion, and strategic independence. Its successful implementation will demand not only technical excellence but also political coherence, regulatory clarity, and a profound understanding that money in the digital age represents not merely a medium of exchange but also an element of democratic infrastructure.

Conclusions.

To date, a certain consensus has been established between the European Central Bank (ECB), key financial players, and political structures, although its nature is more procedural and strategically con-

ditioned than fully substantive. In other words, the parties agree on the necessity of the digital euro as a tool for adapting to digital transformation and preserving monetary sovereignty; however, deeper issues of implementation, role distribution, technological architecture, and interaction models remain subjects of debate. Among the key aspects currently forming the foundation of the strategic vision for the digital euro, there is a notable convergence of positions among major stakeholders-namely, the European Central Bank, EU political institutions, and representatives of the financial sector. One of the most important elements of this evolving consensus is the determination of the digital euro's functional role not as a replacement, but as a complement to cash. This approach allows for the continuity of the monetary circulation while expanding citizens' access to digital forms of central bank money without compromising familiar forms of financial interaction.

Equally fundamental is the general recognition of the need to safeguard monetary sovereignty, especially amid the rapid rise of transnational technology corporations and the proliferation of private digital currencies, which could potentially threaten the integrity of monetary policy. In this context, the digital euro is perceived as both a tool of technological renewal and a means of strategic self-defense in the emerging landscape of global financial competition.

Professional discussions place particular emphasis on upholding privacy principles and ensuring an adequate level of personal data protection-recognized as foundational pillars of trust in the digital financial architecture. The idea of a digital currency capable of coexisting with high standards of privacy is seen as a precondition for public trust and legitimacy, which holds fundamental importance within the European legal framework. The emphasis on anonymity, particularly in offline transactions, reflects the developers' intent to strike a balance between technological innovation and the preservation of citizens' fundamental rights.

As for the distribution architecture of the digital euro, a preliminary consensus has emerged that commercial banks will serve as the interface between the central bank and end users. This approach preserves institutional continuity within the financial system and minimizes potential destabilizing effects that could arise from direct competition between the digital euro and bank deposits. The commercial sector, although showing cautious restraint, currently acknowledges the rationality of such a functional division and views participation in the project as an inevitable adaptation to new regulatory and technological realities.



Areas remaining at the intersection of technological design, economic equilibrium, and societal legitimacy require regulatory resolution and systematic academic reflection. The business model for commercial banks, in particular, demands quantitative modeling of the digital euro's impact on the financial stability of the banking system and the search for instruments to balance private interest with public good. Similarly, storage limits for the digital currency cannot be established arbitrarily—empirically grounded parameterization is needed, taking into account users' everyday payment practices, macrofinancial dynamics, and associated systemic risks.

Offline functionality of the digital euro presents a significant engineering challenge in the domains of distributed security systems, cryptography, and behavioral economics, as it determines the preserva-

tion of cash-like functions in the digital age. Likewise, the risks of payment infrastructure fragmentation call for interdisciplinary research, particularly in the areas of digital interoperability, adaptability of regulatory standards, and sociotechnical integration. Finally, societal acceptance of the digital euro cannot be achieved without an in-depth analysis of public awareness, trust, and attitudes toward the new currency an endeavor that necessitates the application of methods from sociology, political science, and the psychology of financial behavior.

Thus, the outlined directions must shift from the realm of assumptions and consultations into the domain of systematic scientific inquiry. Only in this way can a well-grounded, resilient, and legitimate model of the digital euro be created as a core element of a new monetary civilization.

REFERENCES

- Bundesdruckerei. (2021, 26 April). *Wie Bares, bloß digital: Was der digitale Euro leisten muss*. Retrieved from <https://www.bundesdruckerei.de/de/innovation-hub/was-der-digitale-euro-leisten-muss>
- Bundesdruckerei. (2023, 14 April). *Harte Währung in digitalen Zeiten*. Retrieved from <https://www.bundesdruckerei.de/de/innovation-hub/harte-waehrung-in-digitalen-zeiten>
- Bundesdruckerei. (2024, 21 May). *Brücke zur digitalen Welt: Bundesdruckerei gewinnt Branchenpreis für Konzept zur Banknote der Zukunft*. Retrieved from <https://www.bundesdruckerei.de/de/newsroom/pressemitteilungen/bruecke-zur-digitalen-welt-bundesdruckerei-gewinnt-branchenpreis-fuer-konzept-zur-banknote-der-zukunft>
- European Central Bank. (2023). *Digital euro*. Retrieved from https://www.ecb.europa.eu/euro/digital_euro/html/index.en.html
- European Central Bank. (2024a). *A stocktake on the digital euro: Ongoing work and way forward*. Retrieved from https://www.ecb.europa.eu/euro/digital_euro/progress/shared/pdf/ecb.dedocs231018.en.pdf?6fbce71a4be7bb3b8fab51fb5c7e2d
- European Central Bank. (2024b, December 2). *Progress on the preparation phase of a digital euro – Second progress report*. Retrieved from https://www.ecb.europa.eu/euro/digital_euro/progress/html/ecb.deprp202412.en.html
- European Central Bank. (2024c, 19 December). *Study on the payment attitudes of consumers in the euro area (SPACE)*. Retrieved from https://www.ecb.europa.eu/stats/ecb_surveys/space/html/ecb.space2024~19d46f0f17.en.html
- Fahad, A., & Bulut, C. (2024). *Central bank digital currencies: A comprehensive systematic literature review on worldwide research emergence and methods used*. Emerald Publishing. Retrieved from <https://www.emerald.com>
- Li, Y., Chen, W., & Zhao, L. (2023). How digital transformation affects bank risk: Evidence from listed Chinese banks. *Finance Research Letters*, 58(A), 104319. <https://doi.org/10.1016/j.frl.2023.104319>
- Panetta, F. (2022, June 15). *The digital euro and the evolution of the financial system* [Speech]. Insight Summit, Bocconi University. Retrieved from <https://www.ecb.europa.eu/press/key/date/2022/html/ecb.sp220615~0b859eb8bc.en.html>
- Pitters, J. (2023, 2 February). *Banknoten: mehr als ein reines Zahlungsmittel*. Bundesdruckerei. Retrieved from <https://www.bundesdruckerei.de/de/innovation-hub/banknoten-mehr-als-ein-reines-zahlungsmittel>
- Zhang, J., Liu, H., Wang, X., & Yu, M. (2023). An empirical analysis of the impact of digital finance on the efficiency of commercial banks. *Sustainability*, 15(5), 4667. <https://doi.org/10.3390/su15054667>