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A Digital Euro for the EU
A Comment on Potential Impacts

A DIGITAL EURO FOR THE EU (A COMMENT ON POTENTIAL IMPACTS DATE)

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Preliminary note

As members of the Weizenbaum research group Trust in Distributed Environments, we greatly appreciate the opportunity to comment on the European Commission's initiative to launch a digital euro for the EU.

Our research group investigates a broad spectrum of topics in the context of cryptocurrencies, legal automation and peer-to-peer networks in an interdisciplinary manner. We have previously accompanied the debate on centrally-banked digital currencies (CBDCs) and the digital euro through our research, talks, workshops with political officials, and written statements such as our response to a recent consultation initiated by the European Central Bank (ECB).

In the following, we comment on seven significant impacts that the introduction of a digital euro could have on EU citizens and European society as a whole, based on our interdisciplinary expertise.

About the Weizenbaum Institute

The Weizenbaum Institute conducts interdisciplinary and basic research into societal transformation through digitalisation developing design options for policymakers, business, and civil society. The goal is to better understand the dynamics, mechanisms, and implications of digitalization. To this end, the Weizenbaum Institute investigates the ethical, legal, economic, and political aspects of the ongoing digital transformation. The Weizenbaum Institute is a research association funded by the German Federal Ministry of Education and Research (BMBF) comprising five universities - Freie Universität Berlin (FU Berlin), Humboldt-Universität zu Berlin (HU Berlin), Technische Universität Berlin (TU Berlin), Universität der Künste Berlin (UdK Berlin), Universität Potsdam - as well as the Fraunhofer Institute for Open Communication Systems (FOKUS) and the Berlin Social Science Center (WZB). The central administration and legal representation are carried out by the Weizenbaum-Institut e.V., which, as the coordinator of the association, is responsible for the overarching areas of public relations, knowledge transfer with policymakers, business and civil society, networking and internationalization, as well as academic career development.

I. Creation of a digital payments solution that puts citizens first

The EU Commission and European Central Bank are uniquely positioned to launch a digital currency that prioritizes the interests of European citizens and European society above all else. This is in contrast to private endeavors that are ultimately motivated by the interests of private individuals and organizations, financial or otherwise. The features of today's cash are difficult to replicate by the private sector.

A well-designed and EU-backed centrally banked digital currency (CBDC) might be the only realistic option for arriving at a digital payments solution that protects EU citizens' rights (for example, by ensuring privacy and financial inclusion) while being under their own democratic control. This is in contrast to cryptocurrencies and foreign CBDCs. While some cryptocurrencies offer exceptional levels of financial privacy and financial freedom, control over their functioning and monetary policy is either entrusted to a static algorithm or claimed by intransparent groups of investors and technologists.

A well-designed digital euro that protects citizens' rights "by-design" can become a viable alternative to cryptocurrencies and foreign CBDCs, reducing their relative attractiveness and thereby also any risks associated with their excessive popularity among EU citizens.

II. Reduced financial privacy and wide-ranging surveillance

Extreme care must be taken to ensure that the digital euro cannot be repurposed as surveillance infrastructure: Neither under current nor under future political leadership. The existence of a central digital euro ledger maintained by the European Central Bank (ECB) implies a significant centralization of citizens' financial data. Additionally, the success of the digital euro will likely lead to strong economic pressure on citizens to actively use it. Technical possibilities for privacy intrusions on digital euro users can

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therefore enable wide-ranging surveillance activities, which is a significant risk to European democracy and individual freedom in the EU.

To sustainably preserve core liberties and promote trust in the privacy offered by the digital euro, it is insufficient to rely only on organizational protection measures and safeguards. Data protection standards can be reduced on changes in the political climate, as can the rigour in enforcing them. Deployed technical infrastructures, on the other hand, will persist, along with the full surveillance potential they afford. Therefore, the digital euro should offer strong privacy guarantees "by-design": Citizens' privacy should be protected through technological means that are effective independently of any actions that the ECB or other involved stakeholders might take. Notably, due to the potential for automation and the vast amount of financial data that will likely be amassed at the ECB in the context of a digital euro, even the smallest privacy backdoors can have devastating effects.

A variety of technological solutions exist that enable strong privacy guarantees in digital currency settings. For example, for realizing a back-end ledger structure with cash-like privacy guarantees, cryptographic solutions from the cryptocurrency world can be reused, such as ring signatures and non-interactive zero-knowledge proofs. These approaches maintain privacy guarantees even in the face of strong adversaries with full access to the ledger data structure.

It is true that strong privacy guarantees can impede criminal investigations and the regulation of financial flows, for example, in the context of anti-money laundering (AML) and combating the financing of terrorism (CFT). Solutions towards resolving the tension between privacy and regulation are in active development. An especially promising approach is to enable cash-like privacy while also enforcing cash-typical usage rules. In [1], for example, a design is presented that allows fully anonymous usage of a digital currency up to a fixed balance, transfer, or turnover limit. Once the preconfigured limit is exceeded, financial details become observable by authorities - in analogy to current AML/CFT rules for cash. Other notable approaches for combining financial privacy with regulation options include the GNU Taler scheme [2], which enables merchant auditability despite consumer anonymity, and our own ideas involving the self-regulation of digital currency communities [3].

The introduction of the digital euro should be seen as an opportunity to reevaluate the effectiveness and costs of current AML/CFT regulation. Existing rules should be adapted to better accommodate a sound technical design for the digital euro, not the other way around. Better integration between regulatory framework and technical architecture can likely improve effectiveness while reducing harmful impacts on privacy, financial inclusion, and innovation.

III. New transmission channels for monetary policy

The central bank cannot influence the supply of money directly but via the creation and repayment of credit. After all, the major part of the money supply is credit money (instead of digital central bank money or cash). Banks and other financial intermediaries, however, follow their own business decisions. With interest rates close to zero, the most important tool of the European central bank has become void. Monetary policy action via alternative transmission channels (especially stock market prices, real estate prices, and exchange rates) might be suboptimal economically and erode the support for the central bank's independence from the governments [4].

CBDCs might provide novel opportunities for effective monetary policy (for a literature review, see [5] and for disentanglement of economic design principles, see [6]). The digital currency might be designed so that the central bank could increase or decrease the money supply directly. By steering the purchasing power of the cash holdings of consumers directly, the central bank might be in a much better position to incentivize or disincentivize consumption. Studies like [7] show that steering the CBDC supply to counter business cycles might positively affect the overall economic performance.

It might be noted that phasing out cash would open up a further tool for monetary policy: Without the possibility to hoard non-digital cash, negative interest rates would become a possibility. However, it should be noted that this step would incur political and social risks.

IV. Risks for financial stability

A digital euro might increase risks to financial stability in times of banking crises [9]. Limiting the risk of high-powered central bank money flowing out of the system into digital euro wallets might be the first priority to avoid destabilization of the financial system. Quantity limits of CBDC-holdings, in this context, might be a robust and thus preferable way to mitigate the above risk. While monetary punishment for holding large amounts of digital euros might also be a potential solution, this might be politically more difficult. Nowadays, holding large balances of cash naturally holds increased cost-of-storage. The latter is hard to replicate for digital money.

Furthermore, depending on the exact implementation, citizens perceive tiered remuneration as "helicopter money" and threaten their trust in the currency's value. A remedy

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might be to credibly communicate the ECB's primary goal of providing stable currency in this new context.

V. Potential for financial innovation

Undeniably, a digital euro might initiate a wave of financial innovation. Despite numerous controversies and technical and ecological shortcomings, cryptocurrencies have undoubtedly contributed to increased financial innovation (simple payment processes, open-source wallets, non-custodial ways to store tokens, multi-party transactions, decentralized exchanges, etc.). A central reason for this innovation lies in their focus on open source technology, their well-documented protocols, standards, and interfaces, and the low barrier for entry (no banking license or permission to connect to a banking network is needed). A digital euro can be designed to support and foster innovative use cases and improve the access of average EU citizens to innovative financial services by aiming at low barriers of entry and (re-)usable interfaces. The introduction of a CBDC might offer competitive advantages to banking infrastructure innovations that go beyond updating outdated and fragmented legacy systems.

Of course, the innovation potential of a digital euro is highly dependent on its practical realization. Barriers to entry such as the introduction of gatekeepers will be just as detrimental to its innovation as an intransparent technical design and a lack of widely accessible and (re-)usable programming interfaces. For innovative features to be relevant, however, a digital euro must first address challenges related to privacy risks, usability, resilience, and transparency.

VI. Decreased resilience

The digital euro could become a dominant method of payment in the EU, reducing the availability of cash and alternative digital forms of payment. An economic system dependent on a single digital form of payment is exposed to a different quality of availability risks than a system with an effective fallback option to cash or alternative payment infrastructures. On a small scale, connection problems might hinder individual users from sending and receiving funds. On a larger scale, a centralization of responsibilities can lead to long-lasting outages if central infrastructure elements fail.

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Addressing the first of these issues, the ECB has repeatedly affirmed its commitment to supporting offline usage for the digital euro. Such a goal, however, comes with significant challenges (s.a. the discussion in [8]). "Double spend" frauds involving a malicious payer using a compromised payment device are generally undetectable by an offline payment recipient. Therefore, secure offline payments can plausibly be realized only using dedicated tamper-resistant hardware devices, such as smart cards or devices resembling cryptocurrency hardware wallets. The necessity of investing in dedicated hardware might reduce the availability of offline payment capabilities.

Current consumer electronic devices with secure enclaves or similar features can theoretically act as offline digital euro wallets as well. However, multi-purpose consumer devices such as smartphones are highly complex, which leads to a significantly larger potential for bugs and vulnerabilities. This concern is exaggerated because security is rarely a top requirement in current consumer electronics. Also, the globe-spanning manufacturing chains of modern consumer devices imply extensive possibilities for supply chain attacks. Supply chain attacks on digital euro hardware can enable the insertion of backdoors that enable privacy breaches, theft, and the creation of counterfeit digital euros.

Concerning the risk of large-scale failures, it is important to realize that the digital euro can just as much fall victim to cyber-incidents, natural disasters, or other extreme events as digital payments solutions from the private sector. The threat from catastrophic failures of the digital euro infrastructure can be reduced by prioritizing the design of the digital euro towards simplicity and robustness. Richness in features might lead to complexity which in turn increases the probability of undetected weaknesses. The main feature of a medium-of-exchange offered by the ECB is to be trustworthy, which requires safety, robustness, and predictability in operation.

VII. Reduction of trust in the euro system

The digital euro can only become truly successful if it manages to secure the trust of a large majority of EU citizens. On the other hand, public distrust in the digital euro can quickly translate to distrust in the euro-based financial system as a whole, especially if the digital euro is being promoted as a dominant method of euro usage. The effects of such a lack of trust can include an increased flight to cryptocurrencies or even other (foreign) CBDCs.

The impacts we discuss in this paper can directly contribute to a reduction of citizen's trust. For example:

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- Citizens could mistrust the privacy guarantees offered by a digital euro, cultivating the mental model that the ECB monitors each of their transactions.
- Citizens could mistrust that novel monetary policy instruments enabled by the digital euro will be used in their best interest.
- Citizens could mistrust the reliability of the technical system and its resilience in the face of crises or catastrophic events.

Each of these fears should be unjustified in the final digital euro system, for example, due to an appropriate technical architecture and strong oversight and auditing processes. As a general measure for increasing the trust in the digital euro, mechanisms and practices for increasing transparency should be adopted. Users should be enabled to determine by themselves whether the digital euro functions in the way they expect and whether any relevant overrides to the standard functioning have taken place.

Transparency can be fostered through technological means. For example, cryptographically secured ledgers, as popularized in the context of blockchain systems, enable the implementation of a global transaction log that can be easily audited. Privacy requirements, as well as the ECB's stated desire to retain control of the digital euro system, suggest that the full transaction log (and resulting account system) should be visible and extendable only through the ECB itself. To promote the transparency of the digital euro system, mechanisms for end-users to (cryptographically) verify the correct maintenance of the ledger and their accounts could nevertheless be implemented.

Even with the most transparent and secure technical design, negative mental models might still prevail or be encouraged by media campaigns. To promote long-lasting trust, the design of the digital euro should be transparent, avoid complexity, and be reviewed and approved by renowned independent institutions, such as academic institutions. To ensure that education campaigns about the qualities and benefits of the digital euro strike fertile ground, the general technical literacy of EU citizens should be furthered. To increase the trust in the software that citizens will use to interact with the digital euro, open-source versions of such software should be made available.

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