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## **DIGITAL YUAN ON THE FOREGROUND: INITIAL CONCLUSIONS FROM THE CHINESE EXPERIMENT**

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Digital currencies issued by the central banks are a new phenomenon that the global financial system will face in the near future. They differ from electronic money, cryptocurrencies based on blockchain, and private digital currencies, which will be issued by fintech corporations. The disadvantages of these types of future currency are uncontrolled issuance, limited liquidity, insufficient divisibility, dependence on the motives of issuers and energy consumption. The launch of digital currencies by central banks must overcome the described limitations, be centralized and guaranteed by the authorities.

The digital currency created by the People's Bank of China will have its own characteristics: programmability, traceability, alternative registration technology. It is based on innovative software developments of the Chinese central bank, borrowed experience of Chinese fintech corporations. Special centers for registration, recording and big-data analysis will help ensure the stability of the digital renminbi. Its launch aims to substitute the US dollar in world transactions, for which China is developing a special financial infrastructure around the world.

The digital yuan distribution algorithm among users still maintains a conservative approach that includes both the central bank and commercial institutions. For users, the digital yuan offers such benefits as inclusiveness, offline service, transaction customization. The latter will be carried out by private companies by preserving some of the elements built in blockchain technology. Among the shortcomings of the China's model for launching of its digital currency are artificially limited privacy and cross-border operability. After overcoming its own limitations, the digital yuan will be able to restructure the system of global financial relations through the introduction of national Chinese standards in the world practice of monetary settlements.

**Key words:** digital yuan, digital renminbi, Central Bank Digital Currency, Digital Currency Electronic Payment, CBDC, DCEP, People's Bank of China.

## **ЦИФРОВИЙ ЮАНЬ НА АВАНСЦЕНІ: ПОЧАТКОВІ ВИСНОВКИ З КИТАЙСЬКОГО ЕКСПЕРИМЕНТУ**

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Цифрові валюти, емітовані центральним банком, – новий феномен, з яким стикнеться світова фінансова система найближчим часом. Вони різняться від електро-

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них грошей, криптовалют, побудованих на блокчейні, та приватних цифрових валют, емісію яких буду здійснювати фінтех корпорації. Недоліками перелічених різновидів майбутньої валюти є неконтрольованість емісії, обмежена ліквідність, недостатня подільність, залежність від корисних мотивів емітентів та енергозатратність. Запуск цифрових валют центральних банків має подолати описані обмеження, відбуватиметься централізовано та гарантуватиметься органами влади.

Цифрова валюта, створена Народним банком Китаю, відзначатиметься власними характеристиками: програмованістю, відслідковуваністю, альтернативною технологією реєстрації. В її основі – інноваційні програмні розробки китайського центрбанку, запозичений досвід китайських фінтехкорпорацій. Спеціальні центри реєстрації, запису та big-data аналізу допоможуть забезпечити стабільність обігу цифрового женьміньбі. Його запуск має за мету потіснити долар США в світових розрахунках, для чого Китай розвиває в світі спеціальну фінансову інфраструктуру.

Алгоритм розподілу цифрового юаню серед користувачів поки що зберігає консервативний підхід, який включає як центральний банк, так і комерційні установи. Користувачам цифровий юань пропонує такі вигоди, як інклюзивність, офлайн сервіс, кастомізація транзакцій. Остання здійснюватиметься приватними компаніями за рахунок збереження частини елементів, побудованих на технології блокчейн. З-поміж недоліків китайської моделі запуску цифрової валюти можна виокремити штучно обмежену приватність та транскордонну операбельність. Подолавши власні обмеження, цифровий юань зможе викликати перебудову системи глобальних фінансових відносин за рахунок запровадження національних китайських стандартів у світову практику грошових розрахунків.

**Ключові слова:** цифровий юань, цифровий женьміньбі, цифрова валюта центрального банку, електронні платежі цифровою валютою, CBDC, DCEP, Народний банк Китаю.

The world monetary system is on the verge of decisive change. Banknotes and coins that mankind has used for hundreds of years are disappearing from circulation. They are replaced by tokens that exist in electronic form. Users have long been accustomed to online shopping, online banking, e-wallets, debit and credit cards. Next to them is a new type of payment method – digital money, which differs in the way of making electronic records of cash flows. They are based on the use of distributed ledger technology and a specific payment system, which provides that information on accounts and transactions with digital money is decentralized and distributed among participants, rather than concentrated in one place.

Digital means of payment, the possibilities of which are now widely studied by world science, have the potential to change the mechanism of functioning of the country's monetary system as well as the global world. They are expected to transform the calculation algorithm, the banking system, and the role of interest rates in the economy.

To define the digital money created by central banks, the term *Central Bank Digital Currency* or *CBDC* was formed in scientific discourse [Bank of England 2020; Bank for International Settlements 2020]. Central banks around the world are persistently studying the organization and circulation of digital money, and some are moving to experiments on its implementation.

In the spring of 2020, the People's Bank of China (*PBoC*) was one of the first to initiate the creation of the digital yuan, officially called the *Digital Currency Electronic Payment* or *DCEP*. Its appearance will hypothetically have macroeconomic consequences of the new quality, which will affect the stability of money circulation within the country and improve the position of the Chinese currency in international

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settlements. The study of the conditions and effects of the pioneering introduction of *DCEP* in China is of scientific utility. In 2022, China's full transition to a new financial ecosystem based on the digital yuan is planned. Later, the monetary systems of other countries, including Ukraine, will face similar challenges.

Based on an analysis of leading research on digital money, the author intends to identify theoretical approaches to building the *CBDC* architecture, identify the main macroeconomic implications expected from its implementation, and compare them with China's experience in working with *DCEP*. The obtained results will create opportunities for forecasting the development of the world financial system and ways of adaptation of Ukraine to them.

### **Basic concepts and classification of digital currencies**

To avoid confusion, we distinguish the categorical apparatus used for the analysis of digital currencies. We will rely on the methodology proposed by the IMF [International Monetary Fund 2020], as well as the characteristics of non-cash currencies, summarized by the Bank for International Settlements [Bank for International Settlements 2020]. Digital currencies should be distinguished from electronic money, which is widely used by households for current transactions. Electronic money (e-money) is a digital representation of fiat currencies and is based on digital payments. Instead, digital currencies use cryptographic methods to validate transactions. They are divided into cryptocurrencies based on a decentralized issuance mechanism and digital currencies of central banks, which will have a centralized issue center - the country's central bank.

Distributed ledger or *blockchain* technology, which underlies the issuance of digital currencies, involves the storage, transmission and validation of information about transactions through *nodes* in the network, by encryption. Nodes check information, but do not have the ability to change it. The blockchain provides 1) avoidance of the problem of dual use of money, 2) security and transparency of the use of funds, 3) irreversibility of transactions [Daskalakis 2020].

To support the operation of the blockchain, *mining* activity is necessary – the implementation of permanent calculations that encode and add information to the ledger. Computers that provide access to their own computing capacity are rewarded. As the number of transactions registered by the system expands, so does the need for computing power and, consequently, electricity for their implementation. Sweeping electricity along with the cost of supporting calculations is the cost of issuing digital currencies.

Cryptocurrencies, the most famous of which are *Bitcoin*, *Ethereum*, are issued by a large number of private players who are not banks, but are engaged in currencies distribution; their circulation is not supported by any government, they are not the obligations of any organization and are not tied to ordinary fiat currency. However, cryptocurrencies are able to partially perform monetary functions – to serve as a means of payment.

Despite a long period of circulation, cryptocurrencies do not demonstrate the ability of a full-fledged alternative to fiat money. Their main disadvantage is considered to be inelastic supply and poor fragmentation. The number of their users remains limited: Bitcoin is used by approximately 1 million people. Cryptocurrencies also cannot be a full-fledged intermediary in the exchange of goods, demonstrating a low rate of transaction confirmation. Being sensitive to the psychological expectations and moods of users, they work as a speculative asset, not a means of accumulation. The *Proof of Work* protocol that underlies the issuance and accounting of Bitcoin is extremely energy-intensive. The advantages of cryptocurrencies – anonymity and

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decentralization – marginalize their circulation at the junction between the formal and shadow economies.

There are private and state digital currencies among the set of digital currencies. Reliability and confidence in private digital currencies will be ensured by the reputation of fintech corporations that issue it, or by the stabilization of their value to existing fiat currencies or by financial reserves formed from highly liquid assets of private enterprises. In some cases, such as Facebook's *Libra* (alternative name – *Diem*), having a network of users (2.5 billion people) will guarantee their scale of use, operability and hyperliquidity. Following the example of *Libra*, private digital currency issues will be overseen by private associations with monetary expertise, established by representatives of financial corporations interested in the stable circulation of electronic money. For each unit of digital currency issued, they will form a reserve basket of ordinary currencies or assets of other companies – securities of mostly short-term circulation, capable of generating interest income. Regular users will not receive *Libra* directly from the issuer, but through authorized distributors who will buy it from the association in exchange for assets. The benefits of launching a private digital currency for issuing companies are obvious – they will receive seigniorage from the conversion of electronic money into profitable assets. For end users, there is a risk of excessive issuance of such digital currency in the pursuit of profit, which will lead to a decline in its purchasing power [Claeys, 2019]. Therefore, the stable circulation of the private digital currency will require a strict supervisory and regulatory system built into the financial mechanism of its circulation.

The idea of introducing digital currency is to eliminate the shortcomings inherent in cryptocurrencies, to increase the influence of monetary instruments on the economy, to simplify and reduce the cost of managing monetary circulation, to smooth the negative effects of instability observed in the use of cryptocurrencies.

#### **The objectives for the introduction of digital currencies of central banks**

General incentives for the introduction of state digital currencies as alternatives to private digital and cryptocurrencies are increased monetary inclusion, the ability to make payments offline, higher speed and monetary targeting, the creation of a channel for flexible financing of government programs, the ability to provide social distance during the pandemic and avoid money laundering.

In the case of the digital yuan, the People's Bank of China also aims to make money circulation more trackable and programmable [Yao 2019] and to achieve maximum inclusiveness in non-cash payments. Some observers [Fanusie 2021] point to the desire of the public institution to seize the initiative in the private financial sector, whose influence and innovation capacity could threaten the stability of the country's financial system and undermine the role of the central bank. It is expected that the developments of large Chinese digital companies will be integrated into the DCEP architecture created by the PBoC. It is possible that the tightening of e-payment regulations provided on the platforms of private Chinese corporations Alibaba Group (*Alipay* payment system) and Tencent Holding (*WeChat Pay*) was caused by the need to consolidate government policy in the run-up to the digital renminbi, reducing transaction fees as well as the desire to borrow their experience and technological developments.

The financial circles of China do not hide that the important purpose of the introduction of the digital currency is to reduce the dependence from the US dollar in international transactions and from the system of interbank settlements based on SWIFT. The right to issue and control one's own digital currency is seen as a field of

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new technological battle in the competitive confrontation between countries [Reuters 2020]. The drive to build an alternative financial payment system intensified with the Trump administration's pressure on US-China bilateral trade in 2018 [Yeung 2020].

The internationalization of the yuan has been declared one of the official goals of the People's Bank of China for 2021. By comprehensively accelerating this process, China is reaping the benefits of the pioneer: more accurate knowledge of technology, the benefits of studying the economic effects of operations, image and influence in setting global standards for the use of CBDC.

#### **The architecture of the financial system after the introduction of DCEP**

Initially (until about 2018), the introduction of DCEP was planned to be based on distributed ledger technology, where nodes for data processing and mining will be controlled by the central bank. Approaches have subsequently been revised, given that blockchain does not demonstrate compliance "for highly competitive scenarios, such as traditional retail payments", which manifests itself in lower-than-required transaction processing speeds per second. It is appropriate to maintain a distributed ledger basis for financial applications with fewer transactions, such as trade finance, supply chain management and invoice trading.

China's current approach to the model of organizing its own DCEP can be traced in the declared principle of "One coin, two addresses, three centers" [Kong 2020]. The term "coin" refers to the digital yuan itself, issued and guaranteed by the PBoC. Digital wallets, installed as software applications for personal devices and smartphones, will become a tool for calculations and transactions with "coins" of end users. This approach will allow their integration with devices operating in the field of the Internet of Things, including the infrastructure for monitoring after a private apartment, car, other property and personal electronics. The "two addresses" link the "coins" to data centers run by the People's Bank of China and a client-authorized commercial bank. "Three Centers" – institutions created for the processing of digital information – an identification center for user registration, a record center for transaction registration and a center for big data analysis to monitor the overall situation and combat money laundering. The last point seems relevant given the CCP's party leadership's task of combating corruption within the state apparatus.

It follows that the Chinese central bank plans to organize the circulation of DCEP so as to retain the issuance and management of the internal properties of digital currency, and commercial banks and financial firms to use for its public distribution. There is reason to believe that in the Chinese model, the division of responsibilities will be as follows: the central bank will be responsible for verifying the final ownership of the digital currency, managing the flexibility of its supply, money laundering, auditing and big data analysis of the entire system. Commercial banks will analyze the solvency of their customers and their personal data, process payments and manage users' wallets, and facilitate the transfer of funds and deposits.

The Chinese government's commitment to such a two-tier model is due to the concern to "concentrate the risks of failure in one place", which will be observed if the central bank, excluding intermediaries, will transfer DCEP directly to users. It is also believed that the relationship between business and private financial institutions will be open, resulting in chaos in the provision of credit [Fanusie 2021].

An analysis of technological developments for the introduction of the digital yuan patented by the PBoC (more than 130 patents [Reuters 2020]) shows that experiments with alternatives are ongoing and aimed at improving the interaction of the digital yuan with external payment systems. The updated DCEP architecture will be based

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on four components: a centralized management system, a digital currency issuance system, a quota control system and a currency terminal. Under this organizational model, the central bank will provide commercial banks with quotas for the distribution of digital currency, taking into account certain technical characteristics of banks.

#### **Adapting DCEP to user needs**

Big-data analysis and deep PBoC's control over the circulation of the digital yuan will allow the Chinese government not just to monitor its citizens more closely (which is already possible by means electronic money) but to manage the economy more effectively using non-market approach as well as flow and price planning mechanisms. By building a system based on the "One Coin, Two Addresses, Three Centers" scheme, the PBoC will have consolidated information on money users, which has not been the case before, and will be able to target money demand, which in economic theory remains rather vague.

At the user level, funds will be transferred in a different way from usual clearing. When agents make payments in one bank, they are recorded in the register (balance sheet) of this institution. Registration of payments between clients of different banks is done by changing the entries in the own accounts of these banks in a joint clearing bank. Agent transactions between different clearing banks involve clearing from the central bank in which their accounts are placed. The central bank also ensures the credibility of the system and its stability by regulating the capital, leverage and liquidity requirements of commercial banks [Barrdear 2016].

Once DCEP is implemented, the system will transfer funds by deleting the amount in the sender's account and making the same amount available on the recipient's account. This technique is seen as a compromise between the traceability of the transaction and the requirements of sufficient storage space for information about them, which will support large volumes of daily transactions.

The PBoC approach also abandons the possibilities of smart contracts with complex software code used by blockchain-based cryptocurrencies such as Ethereum. DCEP will have its own cryptographic framework on which commercial banks and fintech companies will build a self-developed payment interface. Thus, the digital yuan will demonstrate useful properties that allow programming and customization. Another attractive advantage of the digital yuan is the possibility of offline payments.

The anonymity of digital renminbi users is expected to be "controlled": they will be able to choose whether to tell their real names to counterparties, but their online accounts must be registered with real names. It is not yet clear whether private customer information will be available to commercial intermediaries. There are fears that DCEP tracking will be incorporated into the social credit system being developed by the Chinese government among the country's population. Of course, it will be a challenge for citizens, partially restricting their freedom, in response to which a shadow settlement market can be expected to arise. They could provide the exchange for some barter services via digital technologies or quasi-money substitutes, which has usually happened in history when the financial system failed to meet the expectations of citizens.

Another important question for users – how should the access to their digital wealth be organized? The choice is between two models, one of which provides access based on the results of identity verification, as in bank accounts (sometimes called "account-based access"), the other does not verify identity, but rather the validity of the object being exchanged, as with physical availability of cash to participants ("access based on tokens"), but now - by cryptography. The form of identification is crucial for the

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security of the payment system, the prevention of fraud, the fight against money laundering and the fight against terrorist financing. In the case of the digital yuan, as can be seen from the previous analysis, traceability (first model) will be preferred to availability. For a country with a large population, this option, based on more customer information, offers the benefits of preventing money laundering and tax evasion. A well-established user identification mechanism will provide law enforcement and financial authorities with new tools to exercise their powers [Carstens 2021].

The spread of the digital yuan in settlements with foreign users is an important component of the process of internationalization of the digital yuan. China is actively building its infrastructure for the yuan extension by concluding currency swaps with central banks. The platform of the initiative “One Belt, One Road” also strengthens financial coordination with participants, in particular, through the creation of clearing banks for settlements in Chinese currency (Singapore, Thailand, Malaysia, UAE, Russia, Hungary, etc.), the formation of export promotion zones and the harmonization of free trade agreements.

There are reports that the software of new smartphone models from Huawei has already been equipped with the wallet for payments using the digital yuan [Iwamoto, 2021]. In developing countries, such as African or Central Asian, where there are many Chinese companies, there are good prospects for its distribution among ordinary users.

However, the expansion of the Chinese currency is hampered by China’s control over cross-border capital movements, restrictions on foreign currency conversion and exchange rate fixation.

As a result, the introduction of the digital yuan in the early stages will create several parallel tracks of circulation and settlement in Chinese currency. Its introduction will not only strengthen the directiveness of monetary policy or the targeted use of money. In the face of the threats posed by the Covid-19 pandemic, this measure will accelerate the movement towards a cashless society. By gaining the lead in the introduction of digital currency, China solves its own strategic goals: exit from the US-controlled space of dollar transactions, the formation and dissemination of its own standards for digital currency settlements, raising national image and strengthening influence in the global financial system. Success in solving these issues may lead to a reconfiguration of the system of international relations and the emergence of new global institutions, at the center of which will be China.

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