

Efforts to Improve Payments Using DLT
- Focusing on Wholesale CBDC Experiments in Various Countries -

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In recent years, central banks of various countries have conducted experiments to distribute wholesale CBDC using DLT. Underlying these developments are the growing momentum for upgrading existing payment systems and efforts by the private sector to provide new payment services. A closer look at the experiments confirms a broadening of the focus areas covered by the experiments, from payments to securities settlement and cross-border settlement. While the findings of these experiments suggest that the introduction of wholesale CBDC has the potential to bring about improvements including the shortening of long transaction chains and the reduction of costs, they also point to further needs, such as adjusting the rules for establishing a distribution platform that spans multiple countries and examining the macroeconomic impact of the introduction of such a platform. Meanwhile, as an approach that does not involve the establishment of a DLT platform or the introduction of wholesale CBDC, there are moves to improve payments by enhancing and utilizing existing payment and settlement systems. It is important to continue to carefully monitor these developments and work closely with relevant parties both at home and abroad.

Introduction

Central Bank Digital Currency (CBDC) is a new form of central bank electronic money, which differs from existing central bank deposits. It can be classified into "general purpose CBDC," which is available for individuals and firms, and "wholesale CBDC," which is intended for use by a limited number of users such as financial institutions, mainly for large-value transactions (Chart 1).¹

In recent years, central banks of various countries have been engaged in research and experiments not only for general purpose CBDC but also for wholesale CBDC (wCBDC). According to a survey² conducted by the Bank for International Settlements (BIS), 93 percent of the 86 responding central banks have been engaged in some kind of CBDC work. More than 60 percent of these central banks are also engaged in wCBDC. 10 percent of central banks in advanced economies (AEs) and 16 percent of central banks in emerging market and developing economies (EMDEs) are in the process of conducting pilot experiments. In addition, when asked about the likelihood of issuing a CBDC in the medium term, more than 50 percent of the responding central banks answered either "likely" or "possible." Taking these trends into account, this paper will take a look at the wCBDC experiments that have been conducted in various countries, provide an overview of them, and summarize their implications.

Although the term "wholesale" in payments assumes financial institutions as users, some wCBDCs do not limit themselves to this, and the classifications of general purpose CBDC and wholesale CBDC are not always clear cut.

[Chart 1] Different Forms of Money

		Form	Issuer
Wholesale (Available for financial institutions etc.)	Central bank deposits	Digital	Central bank
	Wholesale CBDC (The scope of this review)	Digital	Central bank
General purpose (Available for individuals and firms)	Bank deposits	Digital	Financial institutions
	Cash	Physical	Central bank
	General purpose CBDC	Digital	Central bank

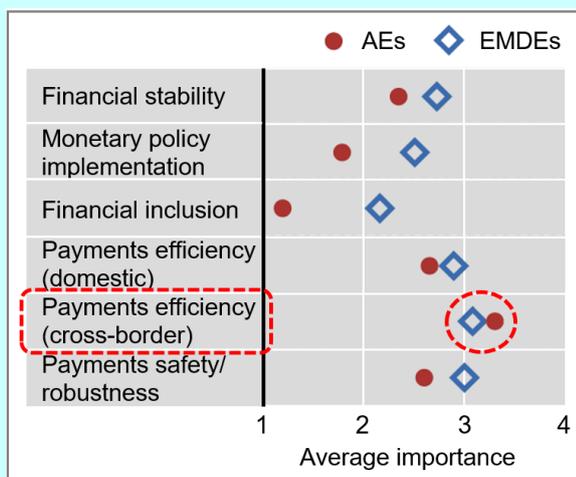
Source: "Liaison and Coordination Committee on Central Bank Digital Currency 'Interim Report'," Bank of Japan.

Background to Increase in Wholesale CBDC Experiments

The following three developments can be attributed to the increasing number of central banks engaged in wCBDC experiments.

First, central banks have become increasingly aware of the challenges facing existing payment infrastructures. Addressing and tackling these challenges is recognized as crucial for the international community, as seen in, for example, the endorsement of a roadmap for improving cross-border payments at the G20 meeting in October 2020. The results of the aforementioned BIS survey indicate the following: the most important motivation behind consideration of wCBDC issuance is "Payments efficiency (cross-border)," followed by "Payments efficiency (domestic)" and "Payments safety/robustness" (Chart 2). In another BIS report,³ "Limited operating hours" and "Long transaction chains" of current payment systems in advanced economies are cited as being among the key pain points that could be alleviated with a wCBDC.

[Chart 2] Motivations for Issuing a wCBDC



Note: 1 (not so important) - 4 (very important). The survey covered 86 central banks (28 respondents in AEs and 58 in EMDEs).

Source: Anneke Kosse and Ilaria Mattei, "Making headway – Results of the 2022 BIS survey on central bank digital currencies and crypto."

Second, the potential of distributed ledger technology (DLT)⁴ has gained attention in that it could facilitate the efficiency and functionality of payment systems. For example, an introductory report by the Monetary Authority of Singapore (MAS), which focuses on Phase 1 of Project Ubin,⁵ points out the potential benefits of DLT, including cost reductions and real-time settlement by eliminating the need for intermediaries and automation of complex settlement processes through the implementation of smart

contracts.⁶ Given that these points have been taken into consideration, all of the experiments mentioned in this paper use DLT, regardless of the fact that wCBDC and DLT are not synonymous.

Third, innovative payment services utilizing DLT and new concepts in this regard have been introduced by private entities. Already introduced is J.P. Morgan Chase Bank's JPM Coin, which has been issued on a DLT platform and provided as a means of payment between its customers, with the intention of utilizing it for cross-border payments and other purposes. These developments reflect efforts by private entities to provide low-cost and convenient payment services by utilizing new technologies such as DLT. Central banks have traditionally played a vital role in wholesale payments; in light of these private-sector endeavors, it can be said that central banks have in a sense become aware of the importance of taking initiative in considering making improvements to wholesale payments through their own experiments.

[Chart 3] Major wCBDC Experiments

Project name (Abbreviation)	Latest phase	Participating central banks
Jasper (JA)	4	Canada
Stella (ST)	4	Japan, Europe
Ubin (UB)	5	Singapore
Jasper-Ubin (JA-U)	1	Canada, Singapore
Inthanon-LionRock (IL)	2	Thailand, Hong Kong
Helvetia (HE)	2	Switzerland
Aber (AB)	1	Saudi Arabia, UAE
Bank of France's experiments (BdF)	1	France, Singapore, Tunisia
Atom (AT)	1	Australia
Dunbar (DU)	1	Australia, Malaysia, Singapore, South Africa
Jura (JU)	1	France, Switzerland
mBridge (mB)	1	Thailand, Hong Kong, China, UAE
Cedar (CE)	1	U.S.A. (Federal Reserve Bank of New York)
Cedar-Ubin+(CE-UB)	1	U.S.A. (Federal Reserve Bank of New York), Singapore
Regulated Liability Network (RLN)	1	U.S.A. (Federal Reserve Bank of New York)
Mariana (MA)	1	France, Singapore, Switzerland

Note: Based on material released by various central banks.

Overview of the Experiments

Against this backdrop, central banks of various countries are engaging in wCBDC experiments (Chart 3).

These experiments have expanded their scope to include the settlement of domestic funds, securities, and other assets, and further, cross-border settlements (Chart 4). The following sections describe in detail the experiments conducted for each focus area.

[Chart 4] Developments in wCBDC Experiments

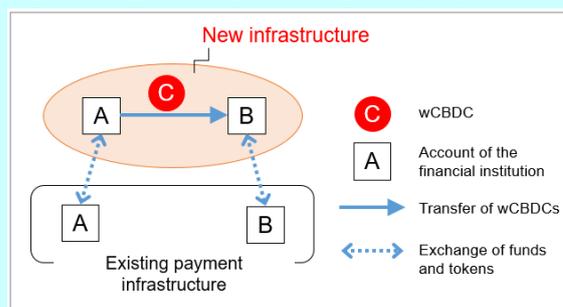
Year	Domestic			Cross-border	
	Payment	DvP settlement of securities	DvP settlement of other assets	Payment	DvP settlement of securities
2016	●JA(1)				
2017	●JA(2) ●UB(1) ●UB(2) ●ST(1)				
2018		●JA(3) ●UB(3) ●ST(2)			
2019				●JA-UB ●ST(3) ●IL(1)	
2020	●HE(1) ●AB	●HE(1) ●UB(5)	●UB(5)	●AB	
2021		●BdF	●BdF ●AT	●IL(2) ●BdF ●JU	●JU
2022		●HE(2)		●DU ●mB ●CE ●RLN	
2023	●RLN			●CE-UB ●MA	

- Notes: 1. ● represents the respective year of publication of each report as indicated in the far left-hand column, abbreviations stand for the project names (see Chart 3), and the numbers in parentheses represent the phase of each experiment.
2. Experiments that do not belong to the classifications in this table include Project Stella Phase 4 and Project Ubin Phase 5.
3. Based on material released by various central banks.

Experiments on domestic payment

In the earlier experiments, virtual infrastructures were built using DLT to identify their advantages and challenges in comparison to those of the current infrastructure, as described below (Chart 5). Financial institution A provides the token issuer (central bank) with funds on the existing payment infrastructure (central bank's current account deposits). The token issuer then issues wCBDCs to the account of financial institution A on the new infrastructure for an amount corresponding to the funds initially provided. Financial institution A transfers the wCBDCs and financial institution B receives them. Financial institution B converts tokens to funds on the existing payment infrastructure accordingly.

[Chart 5] Conceptual Diagram (Payments)



Note: Based on material released by various central banks.

The new infrastructure being referred to here is assumed to be a consortium-based DLT platform, which requires permission for participation, although this may not be stated explicitly for some experiments. In the rest of this paper, new infrastructures established in the experiments refer to consortium-based DLT platforms unless specified otherwise.

Phases 1 and 2 of Project Jasper by the Bank of Canada⁷ and Project Ubin by MAS, respectively, are typical examples of experiments conducted during this early stage. Also observed since this period is Project Stella, a joint project by the Bank of Japan and the European Central Bank (see BOX). The results of these experiments confirmed some advantages of the DLT platform, such as its ability to reproduce various functions of the existing payment infrastructure, potential to improve system resilience and reliability, and ability to settle payments instantly regardless of the operating hours of the existing payment system. At the same time, it was pointed out that there was a risk of liquidity becoming fragmented between the central bank's current account system and the DLT platform.

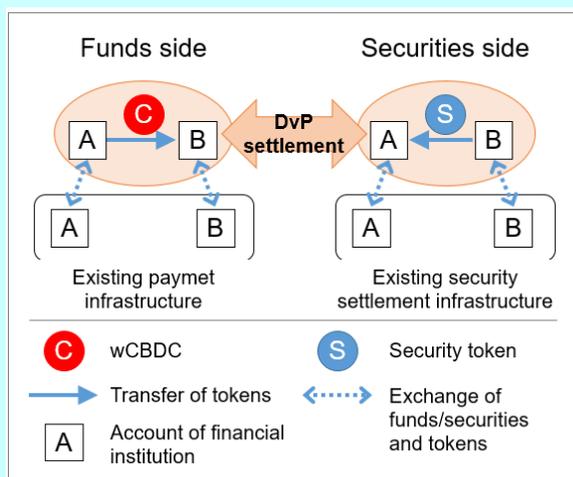
Recently, the scope of experiments has widened to include not only wCBDC but also tokenized commercial bank deposits. Specifically, the proof of concept (PoC) conducted by the Regulated Liability Network (RLN)⁸ has seen involvement by a number of participants including the Federal Reserve Bank of New York and Citi. Its report, published in July 2023, describes how tokenized commercial bank deposit transactions were settled in wCBDCs to verify whether the RLN could function as a domestic payment system.

Experiments on DvP settlement of domestic securities

From around 2018, experiments expanded their scope to include delivery versus payment (DvP), or the simultaneous delivery of securities and transfer of funds. A typical experiment involves a DvP settlement of wCBDCs and security tokens such as government bonds and other securities issued on the DLT platform.

For some experiments, wCBDCs and security tokens are issued on different DLT platforms and exchanged between these platforms in a synchronized manner (interlinked platform type, Chart 6). In this type of experiment, technologies to synchronize different platforms, such as Hashed Timelock Contracts (HTLC), are used to achieve an atomic exchange, i.e., an exchange that returns to a state where no transaction has taken place at all unless the entire set of transactions is successful. Such exchange was expected to improve the interoperability of the existing funds and securities settlement infrastructure, thereby facilitating DvP settlement. While the results of the experiment identified the advantages of the system, such as reduction of the time required for settlement and streamlining of post-trade administrative work, they also indicated the need for modifications to the workflows of securities settlement and for legal and policy considerations.

[Chart 6] Conceptual Diagram (DvP Settlement of Securities, Interlinked Platform Type)



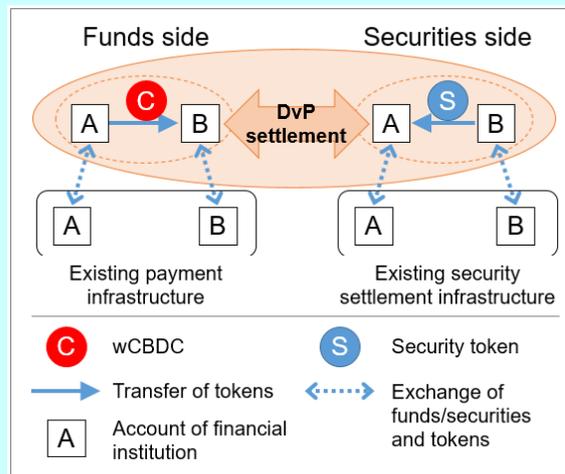
Note: Based on material released by various central banks.

Experiments of the single platform type, in which wCBDCs and security tokens are issued on the same DLT platform, have also been conducted (Chart 7). Unlike the Interlinked platform type, this type does not require a mechanism for coordination between platforms, but does require thorough research on the operation and governance of the platform in advance.

Experiments on DvP settlement of other domestic assets

One of the recent trends in wCBDC experiments is that the types of assets exchanged for funds on the DLT platform have expanded in scope from more common securities such as government bonds to include less

[Chart 7] Conceptual Diagram (DvP Settlement of Securities, Single Platform Type)



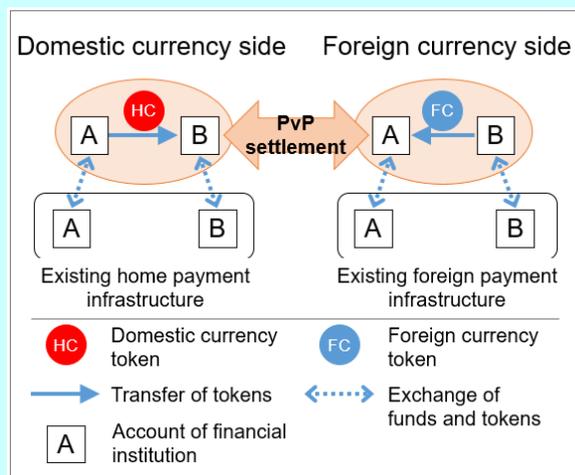
Note: Based on material released by various central banks.

common ones, and further, to assets other than securities. For example, the Bank of France is experimenting with DvP settlement not only for government bonds, corporate bonds and CP, listed and unlisted equities, MMFs, and international agency bonds, but also for investment funds. Similarly, the Reserve Bank of Australia⁹ is conducting experiments on DvP settlement for syndicated loans with wCBDCs.^{10,11} The Bank of France has pointed out that, given that tokenization of assets on DLT platforms (i.e. asset tokenization) might see progress for various assets in the future, issuance of wCBDCs that are interoperable on a wide range of DLT platforms would complement the lack of interoperability among them, possibly preempting liquidity fragmentation.

Experiments on cross-border payments

Since 2019, experiments have extended to the area of cross-border payments. An example of the experiments' schemes is to link payment systems in multiple countries¹² (interlinked platform type, Chart 8). Project Jasper-Ubin explored payment versus payment (PvP) settlement of Singapore dollar tokens and Canadian dollar tokens issued on two DLT platforms by using the HTLC. Project Cedar, led by the Federal Reserve Bank of New York, also reported that foreign exchange transactions across multiple ledgers can be completed within 10 seconds on average.

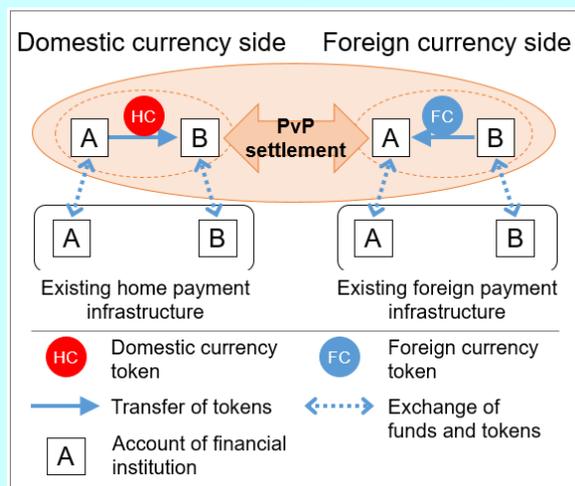
[Chart 8] Conceptual Diagram (Cross-border PvP Settlement, Interlinked Platform Type)



Note: Based on material released by various central banks.

Another example is to settle transactions on a single platform across multiple countries (single platform type, Chart 9). In this scheme, participating countries should agree to standardize technological platforms as well as rules and governance, and issue wCBDCs on a DLT platform for cross-border transactions. In Project mBridge, US\$12 million worth of wCBDCs were issued experimentally in four participating countries (Thailand, Hong Kong, China, and the UAE), resulting in cross-border payments amounting to approximately US\$22 million.¹³

[Chart 9] Conceptual Diagram (Cross-border PvP Settlement, Single Platform Type)



Note: Based on material released by various central banks.

Phase 2 of Project Inthanon-LionRock,¹⁴ which was a single platform type experiment, showed not only that (1) the time required for cross-border payments can be reduced from the current 3-5 days to 2-10 seconds, but also that (2) the administrative costs of fund transfer

can be reduced by 50 percent from the current level by improving the liquidity management of nostro and vostro accounts¹⁵ and reducing treasury administration costs at correspondent banks (Chart 10). Project Mariana¹⁶ also showed that the Automated Market Maker (AMM) algorithm, a decentralized trading system for pricing and trading tokenized assets, could pool the liquidity of the hypothetical wCBDCs denominated in Swiss francs, euros, and Singapore dollars, automatically price and carry out foreign exchange transactions, and enable immediate settlement.

[Chart 10] Findings of Project Inthanon-LionRock

- Reduction in time required for settlement



- Reduction of correspondent banking costs

Breakdown of correspondent banking costs [%]		Cost reduction methods
Nostro-vostro liquidity	35	- Algorithmic liquidity management of current method which has been based on manual operations and forecasts
Treasury operations	30	- Reduction of treasury administrative work at correspondent banks
FX costs	15	- Reduction of FX settlement risk through PvP settlement - Reduction of exchange fees at correspondent banks - Automation of transactions through smart contracts
Compliance	10	- Improvement in transparency of remittance records - Automated monitoring with smart contracts
Others	10	--
Total correspondent banking costs	100	Reduce overall correspondent banking costs by 50%

Source: BIS Innovation Hub Hong Kong Centre et al. "Inthanon-LionRock to mBridge: Building a multi CBDC platform for international payments."

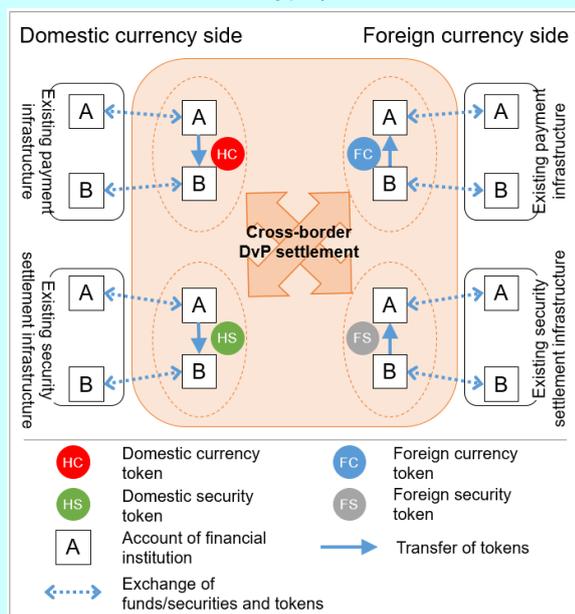
Experiments on cross-border DvP settlement of securities

Some central banks have conducted experiments on cross-border settlement of securities. Project Jura,¹⁷ whose report was published in December 2021, envisaged a single DLT platform spanning France and Switzerland, which would allow for not only cross-border payments between financial institutions in the two countries, but also cross-border DvP settlement of commercial paper tokens by using wCBDCs. The results suggested that these settlements can be made securely, inexpensively, and quickly. Future issues include developing methodologies of oversight for

multi-jurisdictional platforms, how to connect DLT platforms and existing financial market infrastructures, and legal arrangements for the issuance of wCBDCs on platforms operated by third parties.

Although there are no concrete examples of experiments at present, if many assets, for example, funds and securities of the home country and other countries are assumed to be tokenized on a single platform (Chart 11), smooth cross-border exchange of funds and securities between the home country and other countries may be realized. In addition, this platform would also streamline DvP settlement of funds and securities within the same country, as well as PvP settlement of domestic and foreign currencies. Thus, in principle, the greater the coverage of assets and currencies on the platform, the greater the efficiency of the exchange. At the same time, building such platform will also become challenging due to the governance methods of the platform, regulatory and legal adjustments, and other factors.

[Chart 11] Conceptual Diagram (Cross-border DvP Settlement of Securities, Single Platform Type)



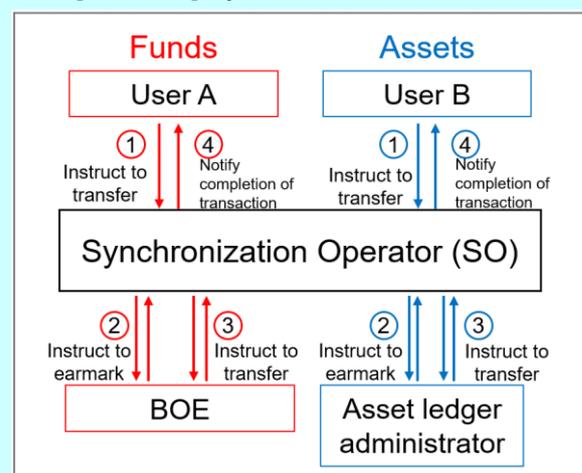
Moves to Upgrade Existing Payment Systems

So far we have focused on wCBDC experiments. It should be noted, however, that wCBDC is not the sole means of upgrading payment systems. In fact, some concrete moves to upgrade and utilize existing payment systems have been observed.

Bank of England: Synchronization

Synchronization is a feature being sought to be implemented by the Bank of England (BOE), which would allow for the atomic exchange of central bank current accounts and a variety of assets. An entity called the synchronization operator (SO) will instruct the BOE and asset ledger administrators to earmark and transfer funds and assets to and from the BOE, thereby enabling simultaneous delivery. Looking at the specific process, the SO receives instructions from each user (Chart 12 (i)); the SO instructs the BOE and asset ledger administrator to earmark the funds and assets (ii); the SO confirms that both have been earmarked and instructs the BOE and asset ledger administrator to transfer the funds and assets (iii); the SO notifies each user of the completion of the transactions (iv). This implies that, if synchronization is implemented, the improved mechanism would be equipped with the same functionality as the HTLC in experiments using the DLT platform.

[Chart 12] Synchronization Function



Source: Bank of England, "Background guide to proposed RTGS functionality: Synchronisation."

The BOE, in its releases, raises cross-border payments and housing transactions as key use cases for the aforementioned feature. It points out that the availability of the function for asset transactions that are not directly linked to the RTGS system could improve the challenges involved in said transactions (i.e., cost, complexity, and speed), fostering innovation. The BOE also notes that it has confirmed the needs for this functionality of a wide range of businesses, including over 60 domestic and international Fintech companies, banks, and non-banks. In achieving this functionality, it addresses challenges such as designing a system that allows for the earmarking of funds and assets, building an interface between the SO and the RTGS system, and responding to cases where the SO defaults or the synchronization transaction fails.

The BOE plans to launch a new core settlement engine of the RTGS system in spring 2024, and as part of this renewal project, has worked jointly with the BIS Innovation Hub (BISIH) London Center and private operators on Project Meridian, which focuses on synchronization functionality.

BIS: Project Nexus

Project Nexus,¹⁸ announced by the BISIH Singapore Center in July 2021, focuses on enhancing cross-border payments. It aims to enable cross-border payments to be completed within 60 seconds by connecting Instant Payment Systems (IPS) in each country to a single platform, Nexus. Although IPS operators need to adjust their own systems to connect to Nexus, once the connection is made, they do not have to adjust their own system even if the number of Nexus participants increases. This is considered an advantage compared with connecting IPSs bilaterally with other countries.

The project has entered a test phase, where BISIH, in collaboration with institutions such as MAS, Banca d'Italia, and the National Bank of Malaysia, will conduct technical experiments to connect payment systems in Singapore, Malaysia, and the eurozone to test the feasibility of the scheme and its scalability in case of an increase in participation.

Swiss National Bank: Project Helvetia

Project Helvetia is a joint experiment by the Swiss National Bank, SIX, and the BISIH Swiss Center. With regard to tokenized assets issued on the DLT platform, the Phase 1 report¹⁹ compares DvP settlement using wCBDCs issued on the DLT platform with DvP settlement using central bank current accounts on the existing RTGS system.

While DvP settlement using wCBDCs has the advantage of simplifying the overall settlement of each transaction by placing tokenized funds and assets on a single DLT platform, it has also been pointed out that significant changes would need to be made to central banks' business processes. On the contrary, DvP settlement that utilizes the existing RTGS system may not be accompanied by the benefits of the DLT platform; nevertheless, this type of DvP settlement does in fact have its own benefits, in that it is less likely to give rise to new legal issues given the ease of implementation in terms of central bank business processes and policies.

Wholesale CBDC Circulating on DLT Platforms: Benefits and Issues for Discussion

While the potential benefits of wCBDC circulating on the DLT platform have been noted in experiments' findings, various issues still need to be discussed further before realization.

Potential benefits

(1) Improving the efficiency and safety of settlement

Central banks have reported that reduced settlement times and lower costs per transaction could be achieved when wCBDCs are circulated on a new DLT platform (Chart 10). The potential impact on liquidity management by investors and financial institutions has also been noted. For example, correspondent banking in cross-border remittances requires a reasonable amount of liquidity to be distributed and maintained in each country. If wCBDCs become available across many DLT platforms and settlement times are reduced, the amount of liquidity needed by investors and financial institutions for asset transactions may be reduced on the condition that wCBDCs are exchanged for central bank current accounts without friction.²⁰ In addition to these efficiency gains, it has been suggested that an increase in the number of assets eligible for DvP settlement, as in the experimental environment of central banks, would lead to an increase in the safety of asset transactions.

(2) Enhancing functional scalability as a payment system

The use of smart contracts and the potential improvement in programmability among payment systems have been raised. Experiments on wCBDCs in various countries have noted that the use of smart contracts could provide a wide range of benefits, such as reducing settlement risk, streamlining and automating existing workflows, and enabling effective AML/CFT. In addition, it has been noted that if a new platform is jointly operated using DLTs, the load is distributed among parties and the time available for settlement could be extended compared with a platform operated by a single institution.

(3) Enhancing flexibility of the operating structure of the fund distribution platform

In the context of central bank current accounts, for example, the issuing entity and the operating entity of

the platform are generally central banks. Experiments on wCBDCs suggest that while the central bank is the issuing entity of a wCBDC, the DLT platform on which the wCBDC circulates may be operated by entities involving those other than the central bank or even those without central banks. Thus, the flexibility of the operating structure for the distributed platform will allow them to circulate on multiple DLT platforms, enabling DvP settlement with a variety of assets.

Issues for consideration

(1) Coordination and standardization on a multi-jurisdictional platform

Operating a new platform requires regulatory and legal coordination. Coordination becomes particularly challenging if the new platform covers multiple countries. Another point to consider is who will be responsible for AML/CFT. How to proceed with standardization of technology should also be considered.

(2) Governance of the platform and confidentiality and management of transaction information

If the potential implementation of a wCBDC may be accompanied by a possible separation of the issuing entity of the currency from the operator(s) of the platform, or a possible diversification of the operating entities of the platform, the governance of the platform will be an important issue for consideration. It must be stable and secure as a foundational means of settlement comparable to being directly managed by the issuing entity. Similarly, it is important to ensure the confidentiality of transaction information and information security at the level achieved by the existing operational entity.

(3) Impact on the macroeconomy

The impact on the macroeconomy is another focal point. For example, even if the implementation of a new platform reduces the level of liquidity required for asset transactions at individual financial institutions, it is important to carefully consider whether it is appropriate to reduce liquidity holdings in the same way, taking into account the macroeconomic stability of the financial system. In addition, policies regarding access to central bank money and impact on monetary policy also need to be carefully considered.

(4) Performance issues that cannot be resolved by DLT alone

While there have been reports that the use of DLT brings benefits including enhanced efficiency, it goes without saying that DLT is not an all-encompassing remedy. For example, Project Aurum, implemented by the BISIH Hong Kong Center and the Hong Kong Monetary Authority (HKMA), utilizes DLT; at the same time, it addresses a challenge, namely, that the processing speed becomes slower when transactions are concentrated in certain accounts.

Measures to address the issues

Some central banks' reports on their experiments describe measures to address these issues mentioned above. Regarding the governance of the platform, the findings gained from Phase 2 of Project Helvetia indicate that it is possible under Swiss law to issue wCBDCs on a platform operated by an entity other than the central bank, as long as the central bank retains the function to supervise and control the issuance, transfer, and withdrawal of wCBDCs. One of the Bank of France's experiments assumes a "public" DLT platform (Ethereum) as the platform for wCBDCs. A public network means that there are no specific criteria for participating in a DLT platform (anyone who can connect to the platform is eligible for participating in it), but the findings show that, even under these circumstances, the central bank will be able to control the distribution of wCBDCs through smart contracts, for example, by discontinuing their distribution.

In addition, with regard to regulatory and legal coordination, there have been proposals that banks within their country handle AML/CFT for remittances on behalf of banks outside of their country (Project Dunbar). On the potential macroeconomic impact, suggestions have been made, for example, to limit wCBDC holdings during the daytime, thereby reducing the impact on monetary policy (Project Inthanon-LionRock, Project Jura). Regarding the concentration of transactions in certain accounts, parallel processing by dividing accounts into sub-accounts has been presented as a possible solution (Project Aurum). In terms of privacy protection, a protocol based on the concept of zero-knowledge proof²¹ has been used to verify whether payment with encrypted transaction information is possible (Project Atom).

Points to note

Although many central bank experiments assume that wCBDCs are circulated on DLT platforms, issuing wCBDCs is not the only solution to improving payment systems. In particular, it is necessary to consider from various perspectives the cost and functionality of

wCBDC together with the means of improving the existing systems. The division of roles between wCBDC and private sector-led initiatives should also be borne in mind.

Looking ahead, it is also important to see whether there will be a greater tendency for assets to be traded on the DLT platform, causing so-called asset tokenization to progress. The further this trend develops, the more likely it would be for the fund transfers to be expected to improve their interoperability with the DLT platform to achieve greater efficiency. Even in such case, it is necessary to consider whether to respond to the situation by issuing wCBDCs or by improving interoperability between the existing central bank system and the DLT platform.²²

If progress is made in asset tokenization and a large amount of assets are transferred on the DLT platform, this will give rise to the need for policy responses to maintain the stability of the settlement system and provide liquidity in case the system is overloaded. The

issuance of wCBDCs circulating on a DLT platform may consequently be considered as a countermeasure. With studies on security tokens making headway in Japan, it is important to continue to closely follow developments in the circulation of assets on the DLT platform.

Conclusion

This paper introduces various efforts being made to enhance wholesale settlements, focusing on wCBDC experiments by central banks. As wCBDCs are merely one element that may constitute the future of wholesale payments and settlements, it is important to bear in mind the overall landscape of payments and settlements, including retail payments. It is crucial that we look into these movements, working closely with domestic and foreign stakeholders while leveraging on the findings gained from Project Stella.

BOX: Overview of Project Stella

	Phase 1: Payments	Phase 2: Securities settlement	Phase 3: Cross-border payments	Phase 4: Balancing confidentiality and auditability
Year of report publication	2017	2018	2019	2020
Main findings	(i) DLT-based solutions could meet the performance needs of RTGS systems. (ii) DLT performance is affected by network size (the number of validating nodes) and distance between nodes. (iii) DLT has the potential to strengthen the resilience and reliability of the overall payment system.	(i) DvP can run in a DLT environment subject to the specificities of the different DLT platforms. (ii) DLT offers a new approach for achieving DvP between ledgers, which does not require any connection between ledgers. (iii) Cross-ledger DvP arrangements on DLT may entail certain complexities, and could give rise to additional challenges, which would need to be addressed.	From a technical perspective, the safety of today's cross-border payments could potentially be improved by using payment methods that synchronize payments and lock funds along the payment chain.	(i) The level of auditability would vary depending on how privacy-enhancing technologies are implemented. (ii) If there is a central trusted source on the network that stores all transaction information, it would better enable effective auditing. (iii) Such entity, however, carries the risk of becoming a single point of failure for the network.

Note: Based on material released by the Bank of Japan and the European Central Bank.

¹ Bank of Japan (2022), "Liaison and Coordination Committee on Central Bank Digital Currency 'Interim Report'."

² Anneke Kosse and Ilaria Mattei (2023), "Making headway- Results of the 2022 BIS survey on central bank digital currencies and crypto."

³ Committee on Payments and Market Infrastructures et al. (2021), "Central bank digital currencies for cross-border payments."

⁴ DLT is a technology that allows network participants to

update the ledger through some consensus mechanism.

⁵ Monetary Authority of Singapore (2017), "Project Ubin: SGD on Distributed Ledger."

⁶ A smart contract is a mechanism in which a program that operates under certain conditions is registered in advance and automatically activated when the conditions are met.

⁷ Payments Canada, Bank of Canada and R3 (2017), "Project Jasper: A Canadian Experiment with Distributed Ledger Technology for Domestic Interbank Payments Settlement."

⁸ The Bank of New York Mellon et al. (2023), "Regulated Liability Network Proof of Concept Business Applicability Report."

⁹ Reserve Bank of Australia (2021), "Project Atom: Exploring a Wholesale CBDC for Syndicated Lending."

¹⁰ Syndicated loan transactions generally involve a wide variety of entities (borrowers, syndicates, agents, arrangers) and are often manual and paper-based processes that impose a heavy administrative burden.

¹¹ The repayment process for syndicated loans requires the arranger to receive repayment funds from the borrower and then transfer the funds to the loan holder individually. The experiment confirmed that funds and credit tokens exist on the same infrastructure and can be exchanged seamlessly, allowing direct and automatic repayment from the borrower to the loan holder.

¹² The BIS classifies cross-border payments by wCBDC (mCBDC arrangement) into three categories: compatible CBDC systems (model 1), interlinked CBDC systems (model 2), and single system for mCBDC (model 3). See Committee on Payments and Market Infrastructures et al (2021), "Central bank digital currencies for cross-border payments."

¹³ BIS Innovation Hub, the Hong Kong Monetary Authority, the Bank of Thailand, the Digital Currency Institute of the People's Bank of China and the Central Bank of the United Arab Emirates (2022), "Project mBridge: Connecting economies through CBDC."

¹⁴ BIS Innovation Hub, Hong Kong Monetary Authority, the Bank of Thailand, the Digital Currency Institute of the People's Bank of China and the Central Bank of the United Arab Emirates (2021), "Inthanon-LionRock to mBridge: building a multi CBDC platform for international payments."

¹⁵ A nostro account is an account in a foreign currency held in the bank's own name at a foreign bank with a correspondent agreement, while a vostro account is an account in the bank's own currency opened at a foreign bank with a correspondent agreement.

¹⁶ Monetary Authority of Singapore, Bank of France and Swiss National Bank (2023), "Project Mariana: Cross-border

exchange of wholesale CBDCs using automated market-makers."

¹⁷ BIS Innovation Hub, Bank of France and Swiss National Bank (2021), "Project Jura: Cross-border settlement using wholesale CBDC."

¹⁸ BIS Innovation Hub (2021), "Nexus: A blueprint for instant cross-border payments."

¹⁹ BIS Innovation Hub and Swiss National Bank (2020), "Project Helvetia: settling tokenised assets in central bank money."

²⁰ In the process of transitioning asset transactions from the existing clearing system to the DLT infrastructure, overall liquidity, including liquidity in the existing system, may increase more than in the situation where assets are traded only in the existing system.

²¹ Zero-knowledge proof is a method by which a person proves (convinces the verifier) that his or her claim is true without revealing any other knowledge. For more information on zero-knowledge proofs, see the following references. Bank of Japan (2020), "Privacy Enhancing Technologies: Payments and Financial Services in a Digital Society."

²² In a speech given in September 2022, former European Central Bank Executive Board Member Panetta expressed views similar to those expressed in this paper.

<https://www.ecb.europa.eu/press/key/date/2022/html/ecb.sp220926~5f9b85685a.en.html>

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