A blueprint for the future monetary system

Speech by Hyun Song Shin
Economic Adviser and Head of Research, Bank for International Settlements

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Tokenisation – another major leap for the monetary system?

Developments in the monetary system and society at large have been closely interwoven. This interplay has been a story of one side pulling the other, leading to dramatic spurts of economic activity over time.

The advent of money in the form of book entries on ledgers overseen by trusted intermediaries opened the door to new financial instruments (Graph 1). For example, bills of exchange played an instrumental role in boosting economic activity a few centuries ago. There is no doubt that the rapid expansion of trade and commerce that has occurred over the past centuries would have been impossible if buyers and sellers still had to cart around heavy loads of metal coins to pay for goods and services.

Evolution in recordkeeping and asset transfer   Graph 1
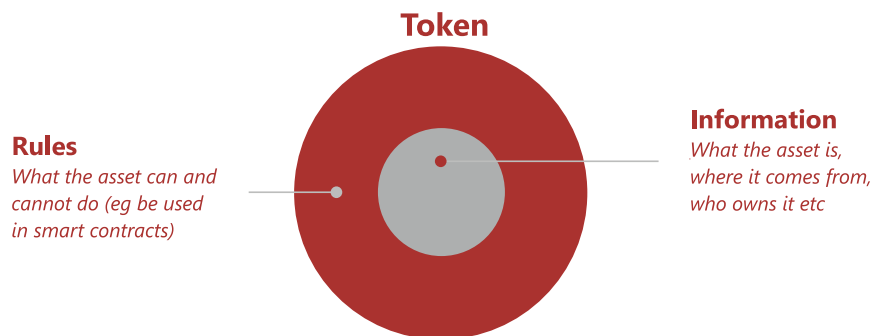

Source: BIS.

With the advent of the digital age, paper-based ledgers were replaced by their digital counterparts. Through dematerialisation and digitalisation, the interplay between money and the economy has wrought profound changes on society at large. After dematerialisation and digitalisation, what could be the next step in the evolution of the monetary system?

This year's special chapter argues that the monetary system could be on the cusp of another major technological leap in the form of tokenisation. Tokenisation is the process of representing claims digitally on a *programmable* platform. It can be seen as the next logical step in the long evolutionary arc of recordkeeping and asset transfer.

Tokens both define assets and specify what can be done with them   Graph 2

Token

Rules
What the asset can and cannot do (eg be used in smart contracts)

Information
What the asset is, where it comes from, who owns it etc

Sources: I Aldasoro, S Doerr, L Gambacorta, R Garratt and P Koo Wilkens, "The tokenisation continuum", *BIS Bulletin*, no 72, April 2023; BIS.

Tokens integrate the records of the underlying asset normally found in a traditional database with the rules and logic governing the transfer process for that asset (Graph 2). Hence, whereas in traditional systems the rules that govern the updating of asset ownership are common to all assets, tokens can be customised to meet specific user or regulatory requirements that apply to individual assets. Tokenisation introduces two important capabilities. First, it enables the contingent performance of actions through smart contracts. And second, it provides greater scope for composability, whereby several actions are bundled into one executable package. In this way, tokenisation could overcome pinch points in the current monetary system and unleash latent demands.

Improving the old, enabling the new

To see how, think of the way digital money currently operates and how payments are made. Money sits at the edges of communication networks, where it resides in siloed proprietary databases operated by banks and non-banks. Account managers are entrusted with maintaining and updating an accurate record of ownership. External messaging systems that send messages back and forth are required to link these databases (Graph 3.A). This separation between messaging, reconciliation and settlement can lead to delays in payments and implies that participants often have an incomplete view of completed actions. Consequently, errors may go undetected for extended periods of time, leading to higher error resolution costs and increased operational risk. For these reasons, payment processes can be costly, cumbersome, slow and opaque.
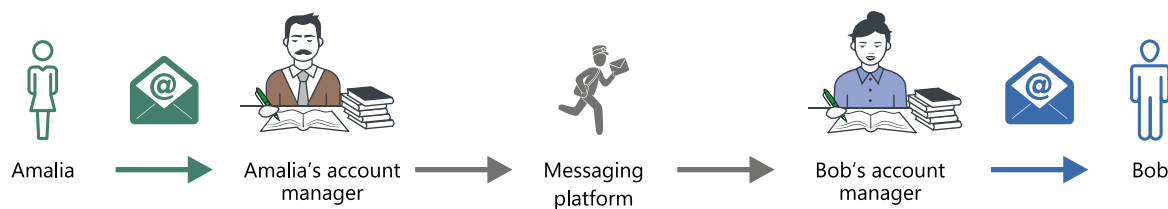
Tokenisation combines messaging, reconciliation and settlement in one step (Graph 3.B). Smart contracts and composability enable so-called atomic settlement, the instant exchange of two

assets, such that the transfer of each one occurs only upon transfer of the other one. Such functionalities can increase efficiency and reduce risks.
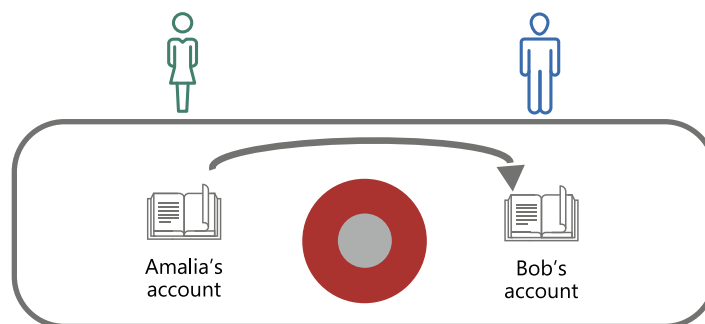

Tokenisation can improve efficiency and mitigate risks in payments
Graph 3

A. Current payment processes can be costly, cumbersome, slow and opaque

| Amalia | Amalia's account manager | Messaging platform | Bob's account manager | Bob |

B. Tokenisation enables the combination of messaging, reconciliation and settlement

Amalia's account   Bob's account

Source: BIS.

Securities settlement could benefit greatly from tokenisation. Securities settlement currently involves multiple parties, so there is a need for various messaging instructions, money flows and reconciliation procedures. These lengthen the process, increase the costs and expose parties to additional risks. In a tokenised environment, some of these risks could be mitigated by shortening settlement lags and obviating the need for messaging across systems and reconciliation. Moreover, the simultaneous execution of the delivery and payment legs could expand the scope of securities covered in delivery-versus-payment (DvP) arrangements.
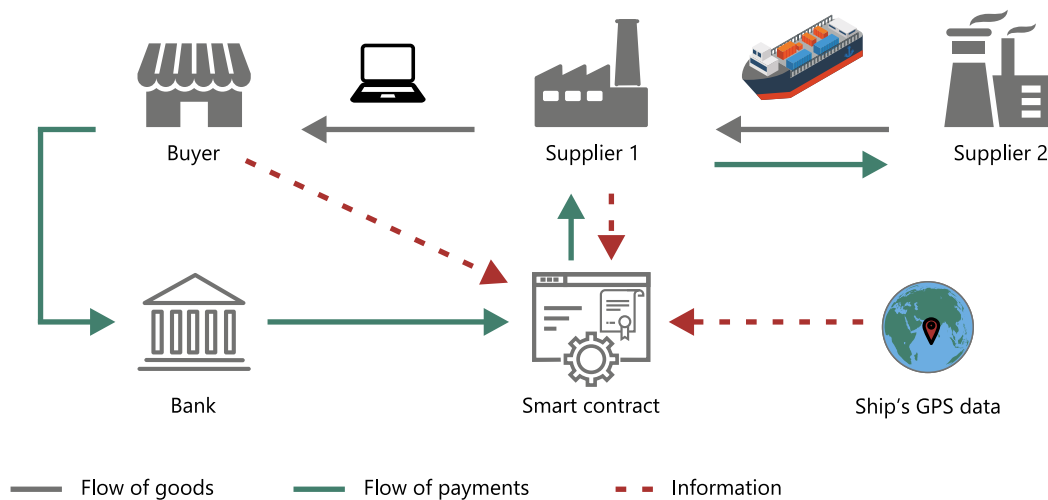
These benefits could be especially large in the cross-border context and for transactions involving different currencies (Graph 4). Cross-border transfers require international messaging systems on top of domestic ones. Differences in operating hours and/or holidays as well as inconsistencies across operating systems, for example in the form of different messaging standards, can lead to further delays, increasing settlement risk. When multiple currencies are involved, there is also foreign exchange (FX) settlement risk. Transfers in a tokenised environment could lead to significant improvements, as it allows contingent performance of actions, even in complex settings.
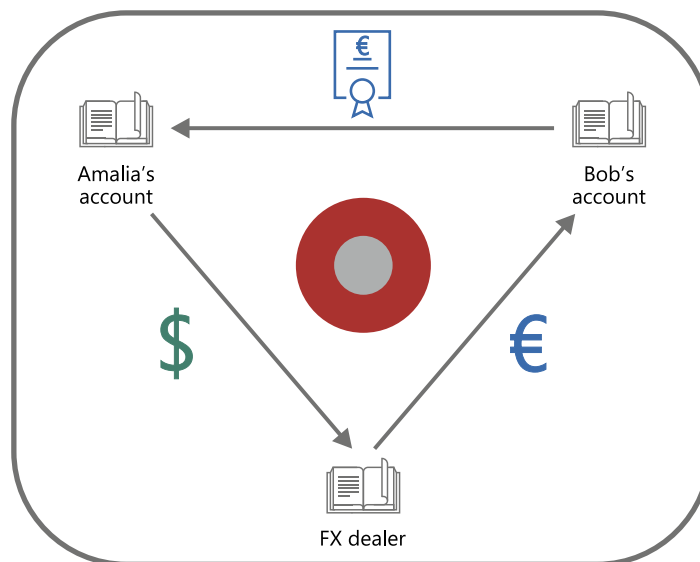
Source: BIS.

A concrete example is supply chain financing, where suppliers need upfront financing to pay their workers and purchase materials to produce intermediate goods (Graph 5). Improving supply chain finance has been a notoriously difficult problem to solve, for two main reasons.

First, incentive problems loom large. For example, a buyer might refuse to pay the full amount to the supplier after receiving the goods. Or a supplier might engage in fraudulent behaviour and try to pledge collateral to different parties simultaneously, a recurring problem in trade finance. Second, there is a lack of transparency and information. For example, banks might face prohibitively high costs to verify the quality and creditworthiness of smaller suppliers, or to track the progress of intermediate goods.

Trade finance on a programmable platform
Graph 5

Buyer   Supplier 1   Supplier 2

Bank   Smart contract   Ship's GPS data

—— Flow of goods   —— Flow of payments   - - - Information

Source: BIS.

Tokenisation could help in multiple ways. Smart contracts could specify an automatic payment from the buyer to its suppliers upon delivery of goods, or partial early payment when intermediate steps are reached. This could eliminate incentive problems. Banks could further extend loans that feature smart contracts that act upon real-time information on shipments through GPS data. Through this advantageous use of tokenisation and of the Internet of Things, suppliers could finance part of their working capital needs as early as the production phase. Finally, because all trade finance contracts would be written on a common ledger, it would be impossible to write duplicate loan contracts tied to the same collateral, which would further encourage lenders to extend credit to firms.

Tokenisation efforts are already happening. Crypto and decentralised finance offered a glimpse of tokenisation's promise. But recent scandals have made it clear that crypto is a flawed system that cannot take on the mantle of the future monetary system.

Away from crypto, efforts by commercial banks and other private sector groups have explored the capabilities of tokenisation for real-world use cases. But these efforts have been hampered by the silos erected by each project and the resulting disconnect from other parts of the financial system. In particular, they lack the ability to settle with finality, which depends on central bank money.

What these projects lack is integration with a tokenised version of the settlement asset in the form of a wholesale central bank digital currency (CBDC). The foundation of trust provided by CBDC and its capacity to knit together the various elements of the financial system derive from the central bank's role at the core of the monetary system (Graph 6). Among its many functions, the central bank issues the economy's unit of account and ensures the finality of payments through settlement on its balance sheet. Having central bank money as the settlement asset in the same venue as other tokenised claims provides a firm foundation for the functionalities of tokenisation. Wholesale CBDCs would serve a similar role as reserves in the current system, but with the added

functionalities enabled by tokenisation, such as the composability and contingent performance of the actions.

While the form of the settlement asset – CBDCs – in a tokenised environment is clear, there is greater room for debate concerning the appropriate form of private tokenised money that complements CBDCs. There are currently two main candidates: asset-backed stablecoins and tokenised deposits. Both represent liabilities of the issuer, but they differ in how they are transferred and in their role in the financial system.

Central banks are uniquely positioned to knit together the system as a whole   Graph 6
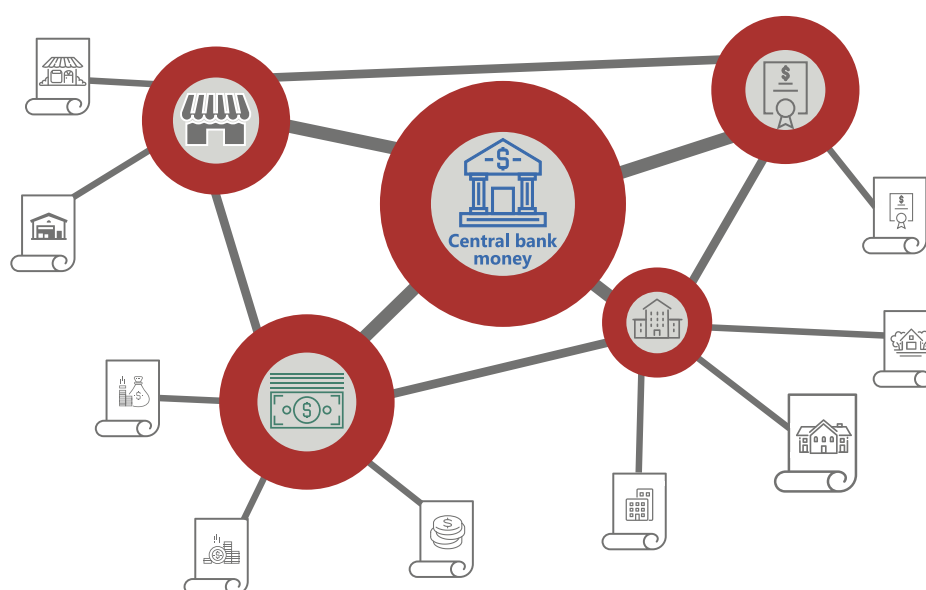

Source: BIS.

Stablecoins represent a transferrable claim on the issuer, akin to a digital bearer instrument. As they are tradable, it is almost certain that their prices will deviate from par. They are similar in spirit to the private banknotes that circulated during the free banking era, where private money circulated with the issuer's name printed on the note. When users open their electronic money wallets on their phones, they would have a list of their money balances with the name of each stablecoin issuer next to the amount. But these are all different versions of money. And because there is no single money, there is no singleness of money, which is the property that all payments using money go through exactly at par value. (Graph 7).

Failure of FTX coincided with stablecoin price volatility

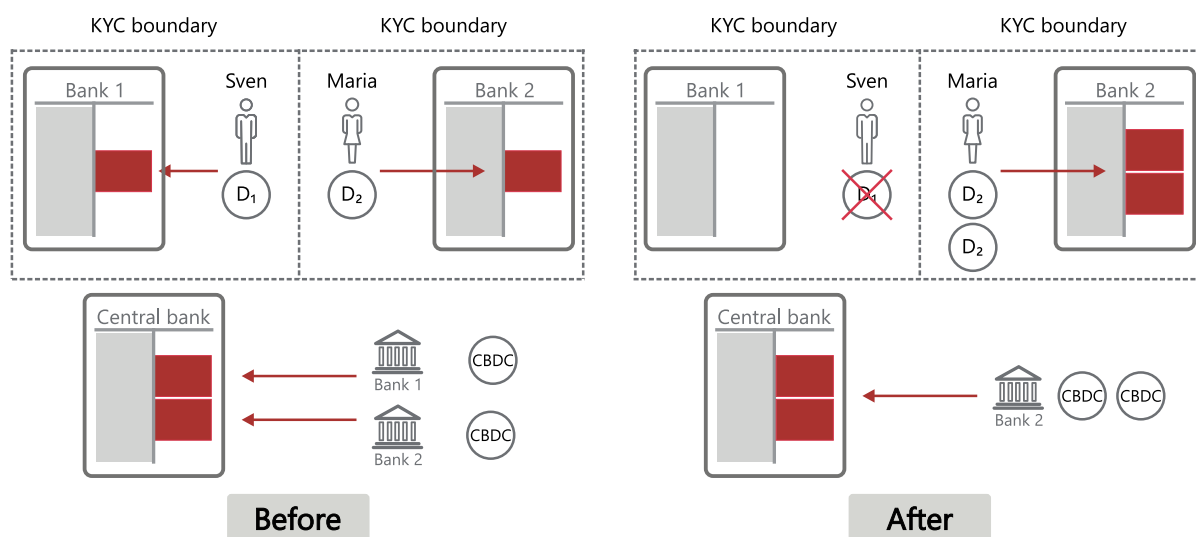In US dollars   Graph 7

Price: ─── Binance USD ─── USD Coin ─── Tether
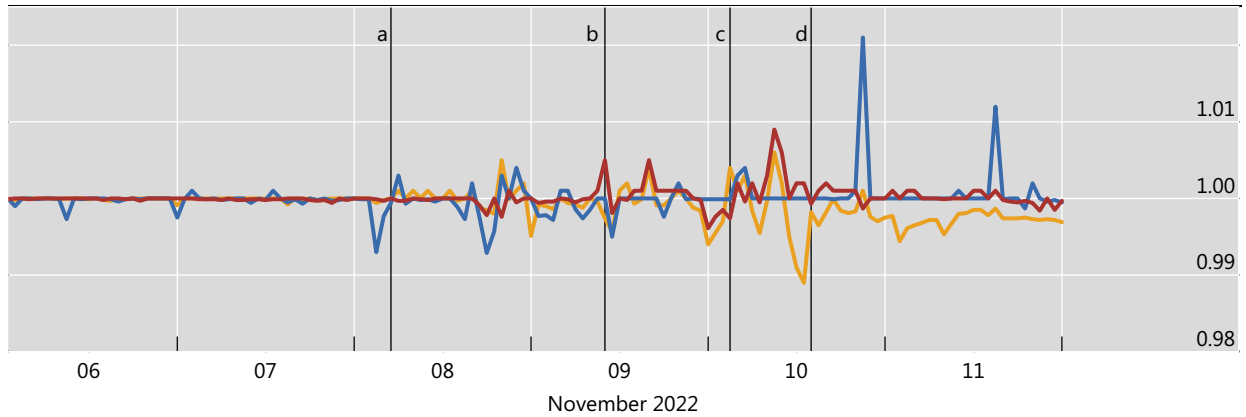
[a] FTX strikes an acquisition deal with Binance for its non-US business.   [b] Binance backs out of the deal.   [c] FTX CEO Sam Bankman-Fried apologises on Twitter.   [d] Bahamas securities regulator freezes FTX assets.

Sources: R Garratt and H S Shin, "Stablecoins versus tokenised deposits: implications for the singleness of money", *BIS Bulletin*, no 73, April 2023; CCData.

In contrast, tokenised deposits would not only preserve but at times enhance some advantages of the current two-tier monetary system (Graph 8). They would maintain singleness by using automatic settlement in wholesale CBDC. Payments in tokenised deposits settled in wholesale CBDC would ensure settlement finality. And by building upon established know-your-customer (KYC), anti-money laundering (AML) and combating the financing of terrorism (CFT) rules, they would ensure the integrity of the monetary system.

One important benefit of tokenised deposits is that they increase the scope for successful coordination. In many instances, mutually beneficial outcomes cannot be achieved when participants need to undertake costly joint efforts. The reason is that individual participants may have an incentive to free ride on the contributions of others. Contingent performance promises to overcome such coordination problems by eliminating free-riding. For example, a smart contract could specify that each participant contributes only a certain amount to a project if all other participants also contribute.

Tokenised deposits are non-bearer instruments and are conducive to singleness   Graph 8

KYC boundary   KYC boundary   KYC boundary   KYC boundary

Bank 1   Sven   Maria   Bank 2   Bank 1   Sven   Maria   Bank 2

D_1 D_2 D_2 D_2 D_2

Central bank   Central bank

Bank 1   CBDC   Bank 2   CBDC   CBDC

Bank 2   CBDC

Before   **After**

Source: BIS.

# A unified ledger as a new type of financial market infrastructure

As the discussion has made clear, the potential of tokenisation lies in its ability to knit together transactions and operations that encompass money and a range of other assets. But how do we bring these elements together? One solution is through incremental changes to existing systems, and then interlinking them through APIs (Graph 9). This could certainly yield benefits, but history shows that incremental fixes have their limits, especially when they accumulate on top of legacy systems. The automotive pioneer Henry Ford allegedly said: "If I had asked people what they wanted, they would have said faster horses." But making horses faster only gets you so far. At times, a more far-reaching rethink is required. Tokenisation presents one such opportunity.
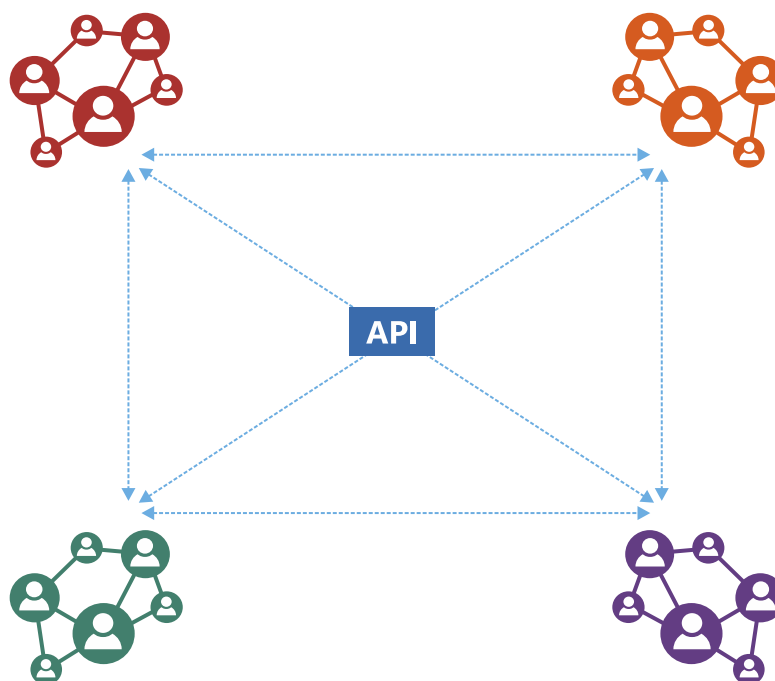
Source: BIS.

A more fundamental step would be to connect tokenised deposits and other tokenised assets with CBDC and bring all these elements together on a shared programmable platform. Bringing together CBDC, tokenised deposits and tokenised assets in such a venue could yield long-term benefits that far outweigh the short-term costs arising from investment as well as the costs and coordination efforts in shifting to new standards and procedures.

What could such a programmable platform look like? This year's Chapter III introduces the idea of a "unified ledger" as a blueprint for the future monetary system that can improve the old and enable the new (Graph 10).

Stylised representation of a unified ledger – a new financial market infrastructure   Graph 10
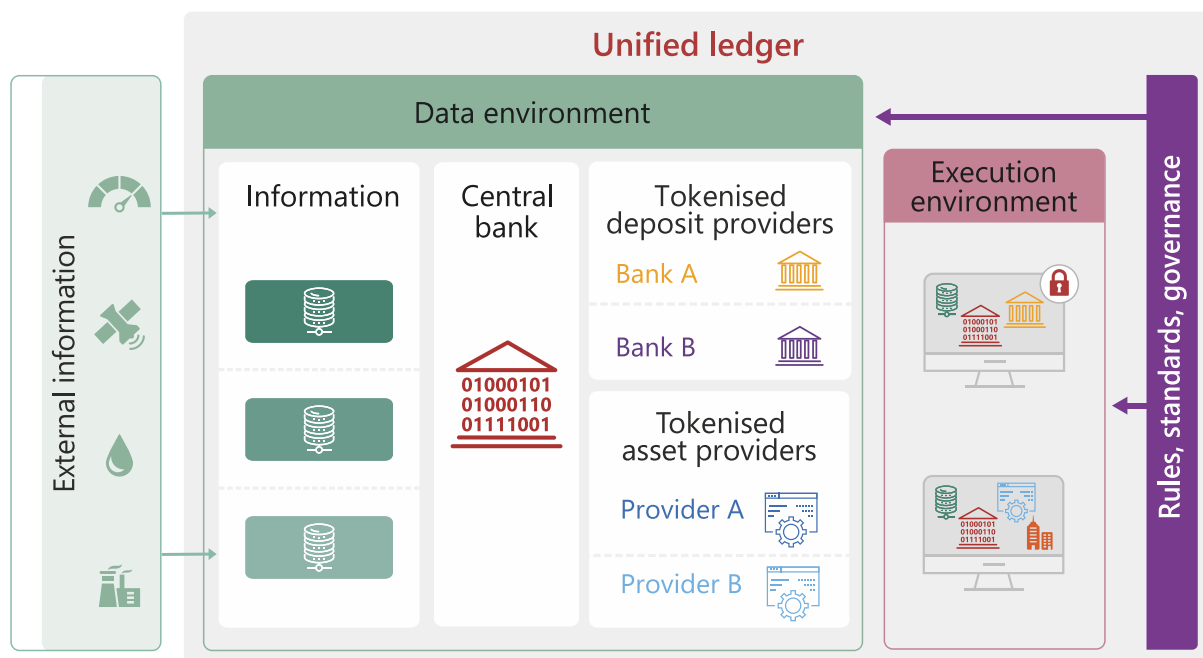
Source: BIS.

As discussed, the full potential of tokenisation needs a monetary unit of account that denominates transactions, as well as the settlement finality that can only be provided by the central bank and the trust it entails. So, in its data environment, the ledger features CBDC. Building on central bank money, private tokenised money providers, in particular commercial banks, serve firms and households, facilitating everyday transactions through tokenised deposits. And beyond money, the ledger features tokenised claims on financial and real assets. Such claims could, for example, include tokenised government securities or tokenised real estate.

The data environment that contains these elements also encompasses all the information necessary to incorporate real-world events in any contingent performance of actions. For example, it could feature GPS data on the ship's position in the supply chain example.

Any operation involving one or more of these elements is carried out in the execution environment, either directly by users or through smart contracts. For each specific application, operations in the execution environment combine only the intermediaries and assets required for each application. For example, a payment between two individuals, executed via a smart contract, would bring together the users' banks (as providers of tokenised deposits) and the central bank (as provider of CBDC). Should the payment be conditional on some real-world contingency, information would also be included.

Preserving strict confidentiality is a prerequisite if a unified ledger is to be a practical proposition. Confidentiality and data control are achieved in two mutually reinforcing ways: data partitions and data encryption. Partitions guarantee that data and information are visible and accessible to only

the respective authorised parties for each partitioned domain, ensuring strict confidentiality. At the same time, cryptographic techniques can ensure that data can be shared confidentially.

The common governance framework specifies the rules and standards on how the different components interact. Governance of a unified ledger could follow existing arrangements, whereby central banks and regulated private participants take part in governance under well-established rules. As a unified ledger would effectively be a new type of FMI or a combination of multiple FMIs, the Principles for FMIs are a natural starting point to base its standards on.

Rising costs from cyber attacks also highlight the need for strong institutional and legal safeguards for cyber resilience. The unified ledger, sustained by a public-private partnership, could overcome the underinvestment in cyber security that arises from its public good nature, thus increasing the system's overall resilience.

Conclusion

Let me conclude.

To fully realise the potential benefits of innovation in money, payments and broader financial services, it is crucial to have a vision for the future monetary system and for central banks' role in driving innovation to meet evolving needs. Chapter III of this year's *Annual Economic Report* presents a blueprint for a future monetary system that harnesses the transformative potential of tokenisation to improve existing structures and enable new possibilities.

The blueprint is best captured by the concept of a new financial market infrastructure that integrates CBDCs, tokenised deposits and other tokenised claims on financial and real assets in one place – a unified ledger. Unified ledgers could not only make existing processes more efficient, but also unlock entirely new types of economic arrangement. Given the unpredictable nature of innovation, they could become an essential feature of a monetary system that is adaptable and enables safe and sound innovation by the private sector. What exact form such innovation might take would be limited only by the imagination and ingenuity of future innovators.