



# FINTECH

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## NOTES

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## The Rise of Payment and Contracting Platforms

Tobias Adrian and Tommaso Mancini-Griffoli

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Prepared by Tobias Adrian and Tommaso Mancini-Griffoli

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**The Rise of Payment and Contracting Platforms**

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## Glossary

AML/CFT ... anti–money laundering/combating the financing of terrorism

CBDC ..... central bank digital currency

CFMs..... capital flow management measures

PvP..... payment versus payments

XC ..... exchange and contracting

## Introduction

Money lies at the foundation of the financial system. Contracts are denominated in money, exchange is conducted in monetary units, and central banks, regulators, and finance ministries play a major role in the management and backstop of money via monetary policy, payment oversight, infrastructure, and banking supervision.

The history of money has been written by the combined evolution of technological innovation, governance mechanisms, economic forces, and policy action. Money evolved from metal coins to fiat currencies, from paper letters of credit to account-based systems. And while cash use is decreasing in many countries, digital innovation is rampant.

Today, technology presents another opportunity for money to evolve. Cryptography, tokenization, and programmability are being explored around the world as a basis for innovation. Banks are exploring deposit tokenization, central banks experiment with their own digital currencies, and fintech companies innovate around all dimensions of money and payments.

This Note explores the design and governance of platforms to enhance cross-border payments in line with public policy goals. While much innovation in recent years has more narrowly targeted end-user frictions, the vision in this paper is based on the mandate of the IMF, governed by the central banks and finance ministries of 190 member countries. Cross-border payments present the foundation for the global financial system, and its functioning is overseen by the IMF.

Cross-border payments continue to face challenges. Infrastructure is scarce, mostly limited to messaging. Governance is sporadic, giving rise to substantial legal and operational costs. Recourse is expensive, and settlement assets are risky. While some cross-border payments are well governed, operationally efficient, and cheap, a large fraction of the global financial system faces expensive, slow, and opaque options. The international community has come together to change that, with the October 2020 “G20 Roadmap to Enhance Cross-Border Payments.”

This Note is part of that thrust to investigate avenues for improvement—to move the evolution of money in a direction aligned with domestic and international policy goals. This Note draws partly from existing experiments, such as project Ubin 3 of the Monetary Authority of Singapore, and projects mCBDC Bridge and Dunbar, shepherded by the Bank for International Settlements (BIS) Innovation Hub. This Note adds to these prototypes, linking design considerations to economic frictions and policy objectives, and extends the vision from settlement to programming and information management. Ultimately, it argues for a broader view of public goods. Payments, after all, do not just involve the transfer of funds from A to B. They also rely on a variety of complementary services, such as accessing foreign exchange, which can be programmed for greater safety and efficiency. And payments involve the transfer of information, which can be managed to overcome basic economic frictions.

The aim of this Note is to offer an initial blueprint for a novel class of cross-border payment and contracting (XC) platforms, hoping that the ensuing debate will help evolve the idea and provide a vision for countries to explore and eventually pursue, perhaps regionally to start. The blueprint is flexible. It can apply to low-value retail payments, such as remittances, where frictions are greatest, but can adapt to any type of payment flow. Gains grow with the number of participating countries and the volume of transactions. But for now, more work is needed, including to evaluate technology and features, consider legal requirements and reforms, and—importantly—discuss governance arrangements. With its large membership and experience in governance, the IMF seems like a strong partner to do so.

In a nutshell, platforms are akin to a digital town square, where people and businesses meet to transact under the auspices of local rules and laws. Similarly, XC platforms offer a trusted single ledger – a document representing property rights -- on which standardized digital representations of central bank reserves in any currency can be exchanged efficiently, and programmed to replicate basic financial contracts in a privacy preserving fashion, among selected public and private sector participants subject to strong governance, standards, and rules.

XC platforms offer key advantages: scalability and potentially wide participation; safety, by settling with central bank reserves; interoperability among national currencies and with legacy systems; greater competition and liquidity in certain payment corridors; efficiency and lower risks in devising and trading financial contracts; innovation, by allowing the private sector to tailor basic functions and financial services through programming; modularity and compliance relative to information management; and, of course, resilience and stability. In addition, XC platforms rest on transparent and rule-based governance supporting the stability of the international monetary system and the interests of member countries.

Improvements in cross-border payments can have notable macro-economic benefits. Small and medium businesses would benefit from lower transaction costs, and poorer households would receive remittances at lower cost. Certain exchange rate corridors might become more liquid, facilitating market integration. Monitoring capital flows would also become easier and facilitate policymaking, including the implementation of capital flow management measures and foreign exchange interventions. Finally, greater payment integration and transparent governance can facilitate the integration of financial and commercial flows, thus countering fragmentation pressures.

To deliver these advantages, XC platforms must leverage novel technologies—including a single ledger, programmability, and encryption—but not require them of countries or participating institutions. Platforms would be designed to be compatible with countries' existing payment systems, as well as arrangements between central banks and commercial banks. Platforms would work with the banking system, while aiming to inject more competition in correspondent banking. Importantly, XC platforms would allow a multicurrency system, without imposing a single or new settlement asset. The choice of currencies used on the platform would remain at the discretion of participants, within the realm of central bank reserves. Finally, XC platforms do not require countries to adopt a central bank digital currency (CBDC). They do, however, anchor their architecture and functionality in the insights and technologies developed around some CBDCs.

In fact, while XC platforms are designed with cross-border payments and contracting in mind, their basic design is sufficiently general to directly apply to domestic financial systems, where benefits could also be substantial. This as an evolution of the concept of wholesale CBDC. Platforms would allow the settlement of tokenized assets with safe central bank money, as well as interoperability among assets and money tokenized by the private sector. In addition, platforms would usefully instill standards and a safe environment with which to program financial contracts. Several central banks have begun experiments along these lines, such as those of Brazil, France, Italy, Singapore, and the UK. A recent speech by Agustin Carstens of the BIS (Carstens 2023) promotes a similar idea.

This Note draws heavily on a past working paper (Adrian, Grinberg, Mancini-Griffoli, Townsend, and Zhang 2022), as well as a blog (Adrian and Mancini-Griffoli 2023). The first provides more details and the second crystalizes the arguments, including the extension of the XC class of platforms to domestic financial systems. This Note also builds on Adrian, He, Garratt, and Mancini-Griffoli (2022), which builds conceptual foundations for the role of trust relations in payments.

This Note is structured in three sections. The first provides a backdrop on the anatomy of payments from domestic to cross-border, highlighting the role of trust, and explaining why cross-border payments lag domestic payments in resolving the problem of interoperability. The second section delves into the XC platform blueprint. It introduces the platform as an evolution of past payment innovations and provides details on each of the XC platform's three layers: settlement, programming, and information management. The section ends with a brief discussion of governance, which is an integral part of improving cross-border payments. The third section offers an extension of the XC platform to domestic financial systems. It emphasizes the common elements of both architectures, suggesting that countries interested in developing cutting-edge domestic platforms for settlement, exchange, and contracting should collaborate with those interested in pushing the frontier of cross-border payments.



# I. Interoperability and the Anatomy of Payments, from Domestic to Cross-Border

Money is debt—in most cases. Money is the liability of an issuer that someone accepts to discharge an obligation. Cash is the liability of the central bank, a deposit is a liability of a commercial bank, and a check drawn on a money market account is a liability of the issuing fund. Commodity money—coins worth their weight in gold, literally—is not debt, but is seldomly used.

Because money is debt, it must be recorded. It is essential to the very existence of money for the record to be unique, clear, tamper proof, and sufficiently flexible to be updated as money passes from one hand to the next.

Money is recorded on ledgers—documents that show proof of the money's existence and, in most cases, of its allocation. One exception is cash—the notes and coins issued by central banks. Because these are bearer instruments, the central bank merely notes how many it issues, but not who holds them. Most other forms of money are not anonymous, so detailed ledgers are kept. The ledger is the history book of money.

The ledger represents a consensus view among participants of who owns what share of debt. Participants are those who can access the ledger. In other words, those who can hold property rights on the ledger, verify these, and pass these on to others. Making a payment amounts to updating one or more ledgers.

In the simplest case, the sender cedes to a recipient his or her rights to an issuer's debt. That is the case of a single ledger to which both the sender and recipient have access. For instance, both could have an account at the same bank. The sender merely instructs the bank to update its books, and the recipient is notified that his or her account has been credited.

While innocuous and rather common, the transaction rests on three essential conditions related to trust. First, both the sender and recipient must trust the settlement process—the technology and governance around the updating of ledgers. For instance, the recipient must know that his or her newly received rights to the issuer's debt are final and unique. Second, the recipient must trust the sender's money. Since obligations are usually denominated in national currencies, accepting money to discharge an obligation means trusting the money will retain a stable nominal value over time. Third, the issuer of the sender's money must trust that the recipient satisfy anti-money laundering and combatting the financing of terrorism (AML/CFT) requirements.

In the simple example above, these conditions are satisfied. Since senders and recipients are clients of the same bank, they presumably trust the bank and its internal settlement process. And they trust the stability of the bank's money. Conversely, the bank trusts them as it undertakes due diligence of all its clients and monitors transactions for suspicious activity.

But payment transactions quickly get a lot more complicated, because many different forms of money exist. Each bank, for instance, issues its own money and operates its own ledger. Some payment service providers also issue money, such as eMoney available on mobile phones. And some new products are vying to be recognized as money, such as certain stablecoins. See Adrian and Mancini-Griffoli (2018) for an early taxonomy and discussion.

As soon as the sender and recipient no longer have access to the same ledger, payments require interoperability. That boils down to the three trust conditions having to be maintained across ledgers. The settlement process must involve a trusted and synchronous update of both ledgers. The recipient must trust money that is not necessarily native to his or her ledger. And the issuer of the money used for settlement must trust both the sender and recipient—one of which is unlikely to be its client.

The need for interoperability—and the difficulties attached to it—also arises for domestic payments; the issue is not just endemic to cross-border payments. The solutions, however, are more advanced in the domestic case.

Generally, there are two basic models of interoperability: the intermediated and the platform model. In the intermediated model, the recipient's issuer of money has access to the sender's ledger. It can therefore hold the sender's money on behalf of the recipient. It must do so while still satisfying trust conditions. In other words, it must trust the sender's money—or receive adequate compensation for risks—and convince the sender's issuer that it complies with AML/CFT requirements.

The platform model itself has two variants distinguished by whether the platform issues its own money. The platform can be conceived as an institution offering a ledger that is compatible with the sender's and recipient's ledgers. The first variant entails the platform receiving money from the sender's issuer, holding it in escrow, then issuing a claim to that money that the recipient, or his or her issuer, can hold. In the second variant, the platform issues its own money, which both the sender's and recipient's issuers hold. A payment amounts to transferring that money from one to the other on the platform's books, then updating all other ledgers.

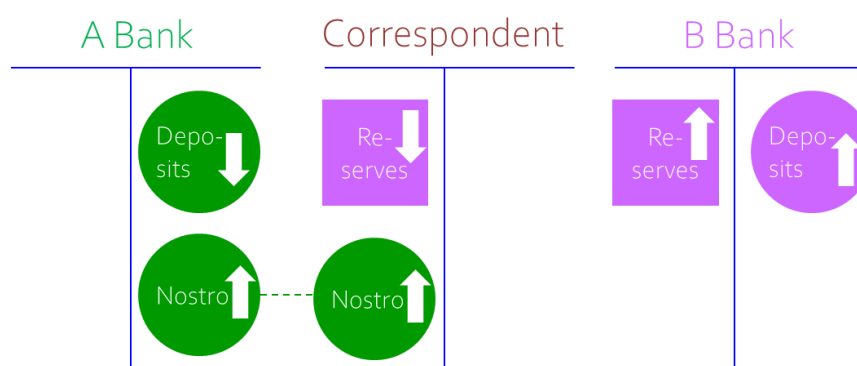
In Renaissance Italy, the intermediated model became widespread. The “lettere di cambio” were notes issued by banks against hard currency held in vaults. To merchants following the spread of commerce, these notes were much more convenient and safer to use than cash. And when necessary, merchants could exchange the notes for cash at their local bank, often distant from the note's issuer. Banks thus built large positions against each other through these notes. As a result, payment convenience went hand in hand with bankruptcies and contagion.

The solution evolved gradually over time in the form of platforms offering a common asset. Central banks created these platforms on which banks could hold and exchange safe and liquid assets called central bank reserves. These became the backbone of domestic payment systems and solved the problem of interoperability while retaining gains from exchanging immaterial claims, not gold florins. Banks trusted the settlement process and the central bank's money, and the central bank trusted the banks as their supervisor. In this model, the sender's bank debits the sender's account (burns money),

transfers central bank reserves to the recipient's bank account at the central bank, and the recipient's account is credited (money is minted).

But across borders, the solution to payments remains the intermediated model. The recipient's bank in one country extends credit to the sender's bank in another country by way of a foreign currency deposit ("Nostro") account, then credits the recipient's account, as illustrated in Figure 1. Banks specialized in holding each other's claims and managing ensuing risks—counterparty, foreign exchange, and liquidity risks—have emerged. These are called "correspondent banks," and relatively few exist worldwide. The industry is concentrated due to the substantial fixed costs required to build trust and manage risks, and services are expensive as a result.

**Figure 1: Cross-Border Payments Via Correspondent Banking**



*When a customer of the green bank in the green country wishes to pay a customer of the purple bank in the purple country, a correspondent bank from the purple country steps in to extend credit to the green bank by holding a "Nostro" account with it and transferring central bank reserves to the purple bank.*

Source: Authors.

Some crypto projects sprung up to overcome these hurdles, though with significant drawbacks. Even Bitcoin can be thought of as a platform offering a widely accessible common asset. Many users trust the settlement process—after all, the Bitcoin network has been running uninterrupted for over a decade without serious glitches. However, the process is onerous—if anything to the environment—and other trust conditions break down rather spectacularly. Bitcoin remains highly volatile, and the network does not comply with AML/CFT requirements as transactions aim to be anonymous. A better solution is needed, certainly from a public policy perspective.

However, a cross-border platform with its own common asset, as in the domestic case, seems out of reach, at least for now. To facilitate payments and accommodate spikes in payment needs, the common asset would need to be created elastically. Doing so requires a balance sheet that can expand significantly and suddenly, and thus the ability to create money on the fly. But with great power comes great responsibility and the need for complex arrangements involving mandates, institutions, personnel, oversight, and accountability. All of these are possible at the domestic level, as evident in central banks

bound by the responsibilities of managing inflation. But replicating all these institutional arrangements at the supranational level is asking a lot of sovereign countries.

A more plausible solution comes from the escrow model of platforms. The idea is to offer a common ledger and governance arrangements, but to leverage existing forms of money—to leave the responsibility of monetary creation in the hands of those with the capacity and mandate to do so. Two forms of money stand out as options: commercial bank money and central bank reserves.

Commercial bank money could be escrowed, then represented digitally on a common ledger, and transferred there among participants. The digital representation would be standardized, and the ledger widely accessible by institutions complying with AML/CFT requirements. In one equilibrium, participation may be high as institutions save on monitoring and access costs (paid once to the platform, not multiple times to each bilateral partner). And participants may find the settlement process more trustworthy on the platform than on the books of partner institutions.

The solution could improve correspondent banking, though likely incrementally. Banks could more openly compete for correspondent banking services on the platform. And banks having extended credit to partner institutions to facilitate payments would be able to offload these claims more easily to institutions outside their proprietary network, and without needing to wait for an offsetting payment. Liquidity and foreign exchange management could thus become easier.

However, risks remain related to the creditworthiness of the claims exchanged on the platform. In brief, the second condition—of trusting the money used in settlement—may not be fully satisfied. And the banks able to ascertain and manage related risks may remain relatively few. While this design of platforms has merits and may be pursued further including by consortiums of banks in parallel to XC platforms.

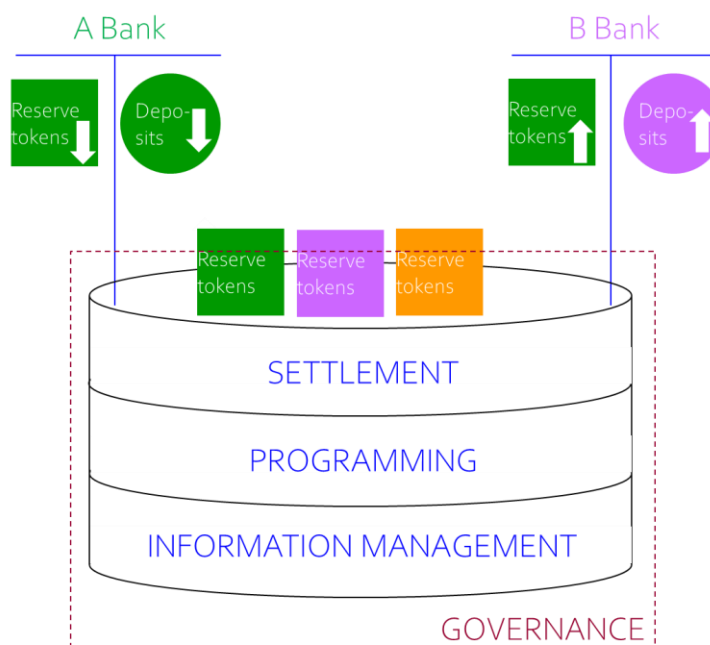
## II. XC Platforms

The investigation of the escrow model of platforms continues, but attention is now turned to escrowing and transferring safer central bank reserves on-ledger. This is a key characteristic of XC platforms and underpins the platform's settlement layer related to transferring money from A to B. Other layers are also important. Payments are not just about transferring value today, but about complementary services, such as obtaining foreign currency, synchronizing or delaying payments, managing risks, and even implementing capital flow management measures (CFMs). These services are associated with the programming layer of platforms. And finally, the information management layer adds further functionality related to users' identities. All layers contribute to attenuating economic frictions associated with payments, such as limited contract enforceability and asymmetric information. This section discusses each layer in turn and ends with an overview of the objectives and challenges related to governance.

### **The settlement layer—transferring tokenized central bank reserves**

An XC platform settles token representations of central bank reserves from member countries. The platform is not designed to issue its own safe settlement asset. It instead creates on-ledger representations of existing assets—central bank reserves—held in escrow in central banks. Importantly, the creation of a new settlement asset, a new currency, or a new unit of account is not being advocated here. Rather, existing currencies and units of account are favored. The only difference is that these would be tokenized on a platform.

To make a payment, participating banks deposit reserves in this escrow account and the platform creates a digital certificate of escrow for the bank to transfer on the ledger among other participants. In the simplest case, the recipient bank would receive a tokenized reserve from the sender's bank and would credit the recipient's account in parallel, as illustrated in Figure 2. The recipient's bank could then sell the tokenized reserves to any other participant on the platform in exchange for domestic reserves. Many other operations beyond simple settlement are possible and discussed later, including foreign exchange transactions.

**Figure 2: A Simple Cross-Border Payment Via the XC Platform**

*When a customer of the green bank in the green country wishes to pay a customer of the purple bank in the purple country, the green bank transfers central bank reserves to an escrow account and receives a tokenized version of them which it can exchange and transfer on the XC Platform to the purple bank. Tokenized versions of all participating countries' reserves (depicted in different colors) can also be exchanged on the platform.*

Source: Authors.

The XC settlement layer draws several advantages from relying on a single ledger. First, settlement is safe, final, and efficient. Transactions are validated on the platform in what is called a permissioned system. Only the platform operator or entities designated by the operator validate transactions. Second, the single ledger ensures a single and unique information set is shared by all participants regarding the allocation of money. The arrangement excludes double spending, minimizing risks of dispute. And third, tokenized reserves exist in standard forms, so all are interoperable with each other. This contributes to improving market liquidity.

Furthermore, by shifting settlement to the platform and tokenizing existing reserves, XC platforms require very little technology of participating central banks and are compatible with legacy systems.<sup>1</sup> Importantly, central banks are not required to issue CBDC in either retail or wholesale form. However, the tokenization of central bank reserves on the XC platform arguably offers a platform-specific CBDC available only to participants.

<sup>1</sup> In the context of this Note, "tokenization" means writing property rights to a digital ledger that is widely accessible, easily verifiable, immutable, and optimized for cheap, immediate, safe, and final transactions among participants to the ledger.

The tokenization of reserves opens the door to greater access, and thus to more competition for cross-border payments. Today, only selected banks can obtain reserves from the central bank—namely, domestic banks with reserve accounts (in some countries certain non-banks can also be granted access to central bank reserves). These selected banks borrow reserves against collateral, or exchange reserves with the central bank for assets in outright purchase or sale operations. Reserves can also be lent among these banks typically over short durations and for a fee.

On XC platforms, foreign entities not directly supervised by the domestic central bank can trade tokenized domestic central bank reserves. However, they would not directly hold the reserves, but rather just claims on the platform, and would not be able to deal directly with the central bank, nor redeem tokens for reserves held in escrow. So central banks remain in charge of their own domestic reserve access policies. Banks with access to central bank reserves would be responsible for providing liquidity to the platform, which they can do at will by borrowing reserves from their respective central banks. This is an important feature of XC platforms as it allows the elastic provision of liquidity to deal with unexpected payment needs on the platform, without requiring the platform to be its own central bank issuing credit to participants.

Settlement on XC platforms still requires trust conditions to be satisfied. That is, participants must trust the settlement process, trust the money used in settlement, and trust each other to comply with AML/CFT requirements. The first and second conditions are enhanced by relying on central bank reserves—safer and more liquid assets than commercial bank liabilities. However, who operates the platform, and how it is operated (including how reserves are escrowed and tokenized) also matter. The “who” is touched on here and discussion of the “how”—that is, governance—is left for later.

A strong argument can be made for the public sector to operate, or be closely involved in operating, XC platforms. Such platforms are inherently a public good, and an operator void of profit motives will instill trust in settlement and in the tokenization and escrow process, just as central banks do today for domestic payments. Whether the operator is a consortium of central banks, or a new or existing international institution will depend on participant preferences. Managing concentration risk will be important in crafting the model of operation.

Other options to operate XC platforms are possible, though come with drawbacks. The first is for a consortium of banks to operate the platform. By nature, however, this is an exclusive arrangement only available to a few players. The gains from greater access, interoperability, and competition would thus be limited. Building a common platform among a consortium of banks raises hurdles relative to coordination. Finding common solutions and establishing consensus is a complex problem and requires substantial sunk costs in governance arrangements, an area in which the public sector has more experience.

Another option is to rely on existing public blockchains (not to be confused with ledgers offered by the public sector). Some, like Ethereum, are already widely adopted and users are coordinating around standards. These chains avoid single-point-of-failure risk and are backed by an active developer community seeking to improve quality and functionality. But the approach comes with at least three important limitations. First, agents involved in validating transactions can extract rents and undermine

efficiency. Agents may jam the system, for instance, to increase the price of validating legitimate transactions. Second, security is a concern. The designers of the ledger do not necessarily internalize the costs of a technical failure or cyber-attack, and often cannot be held accountable for these, thus leading to under-investment in security. And third, the technologies available for distributed validation are not especially scalable, efficient, or private. Proof of work, as used in Bitcoin, uses excessive energy. And proof of stake, such as in Ethereum, can be costly in terms of validation fees and remains relatively untested.

### The programming layer—offering complementary services

Payments go beyond just moving value from person A to B; they also include a variety of complementary services, especially across borders. These include synchronous payments (payment-versus-payments, or PvP), whereby the sender's money is released only when the recipient makes an offsetting payment. PvP payments are common in foreign exchange transactions, for instance. Conditional payments, triggered when a certain price is met or a time has arrived, is another example of a complementary service. More complex services are also possible, including managing risks associated with a payment (for instance foreign exchange risk), participating in an auction to obtain foreign exchange, or implementing CFMs.

These services can be provided by a mix of basic functions on XC platforms. Technically speaking, these functions are available as object libraries within the platform, which can be called and bundled by programs.<sup>2</sup> Object libraries can be thought of as off-the-shelf templates that one can access, tailor, and embed in programs to offer richer functionality. Possible functions include escrow and release, or transfer upon meeting conditions. With those, for instance, a conditional PvP transaction involving the escrowing and synchronous release to the transacting parties of tokenized reserves in two currencies can be programmed and automatically executed.

Offering additional services on the platform and allowing these to be programmed and automated has multiple advantages overcoming economic frictions. First, it may be easier for agents to trust technology as opposed to a third party to undertake a transaction for them. Sending a transaction order means giving up valuable information. For instance, an order to purchase foreign currency when a certain price is met gives information on one's reservation price. A market maker could take advantage of that information by potentially front running the transaction. A computer could do the same, but its behavior could be more easily monitored without revealing the underlying transactions or the identities behind them. The technology to do so, however, is still nascent.

Second, automation can lower counterparty risks and the occurrence of settlement failures. For instance, one might agree to undertake a future transaction with another party, but when the time comes, the other party reneges. Instead, if the transaction is programmed based on money that is already

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<sup>2</sup> For a systematic treatment of the building blocks of programmable contracts, see Schaer (2021). The ways in which programs and libraries interact to provide services on the platform can be regulated by protocols. In software development, protocols are a set of rules and guidelines that govern how different software components or systems communicate and interact with each other. The most common ones are the Hypertext Transfer Protocol (HTTP), and the Transmission Control Protocol/Internet Protocol (TCP/IP), which forms the backbone of communication on the internet. It defines how data is divided into smaller packets, transmitted across networks, and reassembled at the destination.



escrowed, the transaction is much more likely to happen. In fact, it would be very difficult to interfere with it at all. That is a double-edged sword and suggests that not all transactions will be automated. Especially where contracts are incomplete, human intervention will still be needed.

Third, programming makes space for innovation and customization, though in a controlled and safe setting. Object libraries can be tailored, such as by writing conditions for a transaction to take place. And they can be combined creatively to replicate basic financial contracts such as swaps, forwards, loans, and insurance policies. However, participants would not be able to write programs that go beyond the object libraries provided by the platform. This is very similar to app developers for smart phones who have access to some of the phone's functionalities, such as touch screen and GPS, but cannot interfere with the phone's operating system. This ensures a high level of safety, while still allowing for innovation and customization. However, the platform operator would need to carefully vet its object libraries to ensure the highest standards of stability while still evolving these over time in line with the needs of participants. The investment to do so should not be underestimated.<sup>3</sup>

Fourth, programs would be consistent with one another as they would run on the same, single ledger. For instance, a contract to receive a payment tomorrow could be pledged as collateral today, thus reducing liquidity and contracting costs to participants, and improving transparency and monitoring capacity for financial stability purposes. Beyond greater efficiency, there is also an element of safety as programs can only be written on money that is in one's possession by way of a verifiable claim (existing or future) on escrowed money. However, the complexity of contracts being written on other contracts and related risks would need to be carefully studied. Relatedly, cyber security becomes all the more important as the hacking of one contract could have repercussions for several others.

Fifth, programs can facilitate public policy objectives, such as improving foreign exchange liquidity and implementing CFMs. XC platforms could offer foreign exchange auctions for certain currency pairs in which bids could be hit automatically according to the auction's design. By concentrating order flows on the platform, by making auctions possible and optimizing their design, and by offering contracts to share risks, liquidity of certain currency pairs could improve. Participants would remain free to go through more liquid vehicle currencies if they so wished. More liquid currency pairs might be traded in a spot market also possible on the platform, or on the basis of prices pulled in real time from external markets. Similarly, XC platforms could be designed to allow participating countries to implement CFMs. Because platforms can monitor and aggregate payment flows (in a privacy preserving manner as discussed later), limits on transaction sizes, cumulative transactions, or holdings of foreign currency could all be automatically deployed and customized by countries.

### **The information management layer—preserving privacy to improve efficiency**

The third and last layer of XC platforms has to do with information management and encryption technology. In addition to a payment involving the transfer of value and complementary services, it also

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<sup>3</sup> Similar initiatives have been adopted in other sectors, such as GovTech with the Digital Building Blocks approach as a part of the [GovStack](#) initiatives or [Digital Public Infrastructure \(DPI\)](#) initiatives in digital ID, education, and health sectors.

entails the movement and processing of information from one individual to another, from one institution to another, and from one country to another. A transaction involves information on the amounts being sent, and on the sender and recipient as needed for AML/CFT or CFM compliance. Information is also generated and exchanged relative to the services bundled with a transaction, such as foreign exchange and risk management operations.

XC platforms allow the unbundling of settlement and non-settlement services, including compliance checks. This leads to a cleaner separation of responsibilities and for countries to retain jurisdictional control over compliance checks. Central banks would have a say over which firms can participate on the platform. And these firms would remain responsible for knowing their customers and properly monitoring transactions. The platform could impose a minimal level of compliance on behalf of participants, as a “top-up” to national regulation. However, monitoring such compliance will remain costly, as experienced by the IMF when it undertakes safeguards assessments of countries’ institutions and financial sectors in the context of a lending program. More work is needed to investigate whether, and how, the platform itself could contribute to enhancing the monitoring of transactions for AML/CFT purposes.

Once on the platform, firms would be able to transact in a privacy preserving way, thereby further reducing key market frictions. For instance, agents would have the incentive to bid truthfully in a foreign exchange auction without being concerned with revealing private information, without having an incentive to mislead others, and without fearing that a market maker or private auctioneer would front-load their orders. And while individual identities can be hidden in the transactions that occur on the platform, information can nevertheless be shared transparently and in real time.<sup>4</sup> For instance, participants in a foreign exchange auction will gain from having access to anonymized, yet binding, bids and to the order book that stem from these. The literature (see Evans and Lyons [cite]) documents that foreign exchange market makers earn rent from trading as compensation for liquidity provision. Efficient trading arrangements would provide order book information without revealing the identities of bids and offers.

### **Governance—establishing rules and principles**

Any platform arrangement would need solid, transparent, and effective governance accepted by participants as being fair and representative. Governance covers multiple issues, including the following. First is the legal framework: under which law would the platform be incorporated and how would conflicts of law with participating jurisdictions be managed? Would the platform need to be licensed in all participating countries and what legal arrangements would it need to strike with participating central banks? Some legal issues may still need to be elucidated, such as the exact nature of tokenization on the platform and how it compares to the still evolving notion of digital tokens in national laws. More generally, legal reforms may be needed in countries participating in the platform. Second is the operating and oversight bodies: what roles and responsibilities would each participating country, firm, and institution have, and how would decisions be made, and disputes be resolved? Related is the important point of

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<sup>4</sup> While other participants may not be able to access identity and transaction information, the platform operator could make that information available to authorities with designated responsibilities for AML/CFT, such as the financial intelligence unit, law enforcement agencies, and AML/CFT supervisors in case of suspicious activity.

transparency—to what extent will the procedures and codes of the platform be available for public scrutiny? High transparency would help instill trust, but participants must ultimately decide.<sup>5</sup> Third, access criteria and participation requirements: how would new members be onboarded and what might lead to some being offboarded? Fourth, financing: how would investment and running costs be covered? Fifth, operating rules, discussed to some extent in prior sections: would the platform impose its own minimum standards for AML/CFT checks, what foreign exchange auctions would be designed, how would the stability of object libraries be assessed, and how would cyber-security be ensured, among other such questions?

To establish clear governance arrangements, agreeing on high-level principles first may be useful. These might include ensuring that relevant international standards are adopted by all participating countries and firms. Or they might specify general approaches, such as countries being able to manage transactions of their citizens and domestic firms, but not those between two other countries (or at least not without reaching a pre-defined threshold of support among other participants).

Examples of existing governance arrangements in the public and private sectors may offer guidance. The Continuous Linked Settlement (CLS) system, for instance, which plays a critical role in the global foreign exchange market, has very strong governance arrangements among its more than 70 settlement members. Private payment scheme operators have built extensive experience. Arguably, the governance arrangements developed over decades by card companies like Mastercard and Visa to resolve disputes and investigate transactions are the real barriers to entry for other companies contemplating this market.

International organizations can provide guidance given their own well-developed governance arrangements, such as those of the IMF. The institution was set up to govern parts of the complicated interactions between countries stemming, for instance, from foreign exchange regimes and capital flows. The institution itself has well-oiled rules, conflict resolution mechanisms, processes for harmonization and consensus building, and requirements for transparency and accountability. With its broad membership, an institution like the IMF would be well positioned to help countries establish effective governance of international payment and contracting platforms.

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<sup>5</sup> The important discussion of whether the code underpinning the platform should be open for developers to scrutinize and possibly to contribute to, is beyond the scope of this Note. However, repercussions could be important on adoption, flexibility, and innovation.

### III. Domestic CBDC Platforms

While this Note already drew on solutions to domestic interoperability problems to motivate a cross-border payments and contracting platform, it is possible to come full circle and draw on the platform to suggest an overhaul of domestic payment systems. This is an evolution of wholesale CBDC, which is both a settlement asset and infrastructure—a platform, really. This platform can offer interoperability among domestic tokenized forms of money and assets, as well as a safe settlement asset and an environment to allow safe and consistent programmability and information management. In the language introduced in this Note, the CBDC platform can be a mix of an escrow and common asset platform.

One of the trends today is the tokenization of assets and monies. Banks and brokerage firms are building ledgers on which to issue and trade assets such as stocks, bonds, and commodities. While payment providers continue to experiment with stablecoins (and indeed regulation is increasingly stringent and clear), banks are considering tokenizing their deposits. All these cases have in common the notion of writing property rights to assets and cash streams in standard form on ledgers that are widely available for transacting, immutable, and programmable, though not anonymous—thus still compliant with AML/CFT requirements.

These transformations potentially come with significant benefits to some markets. If anything, they allow a renewal of legacy systems which, with the passage of time and iterations, have often become a patchwork of workarounds with their share of inefficiencies and occasional bugs. In addition, the upgrade to tokenization could bring benefits to some markets, including atomic settlement, wider participation, lower trading costs, automation, fractionalization of assets, and improved monitoring. The size of these improvements, and the feasibility, including from a legal standpoint, are still being explored, however. But the sector seems poised for some degree of change.

However, significant limitations also arise. One is the lack of interoperability from incompatible ledgers, each provided by a different institution aiming to capture customers and needing to be accountable to them—the so-called problem of “walled gardens.” Another is the lack of safety from payments done in tokenized commercial bank money or other forms of private money such as stablecoins. Yet another is limited efficiency as contracts written on one ledger would not be compatible with those on another.

The same problems of interoperability, safety, and efficiency noted in cross-border payments also permeate innovations in domestic financial markets. So perhaps a similar solution, based on the XC class of platforms, may be applicable.

The intermediated model of interoperability would not seem to work well. Institutions accessing each other’s ledgers and holding assets on behalf of clients does not seem scalable due to the number of bilateral connections and trust relationships that would need to be established. Also, holding assets is one thing, but paying for them is another. The arrangement would not easily allow for the synchronous payment of assets on a compatible ledger.

A platform approach seems more promising, leveraging both the escrow and common asset architectures. The CBDC platform could be leveraged for one firm to pay for the assets of another. The payment leg would involve safe and liquid central bank money (the common asset) on a ledger compatible with that of the tokenized asset. And the asset could be escrowed temporarily on the platform for long enough to ensure a synchronous transaction minimizing counterparty and settlement risks (called “delivery-versus-payments”). In another use case, the platform could orchestrate the exchange of one asset for another initially written to a different private ledger. Two options are possible in line with prior discussions. First, the assets could be escrowed temporarily, until they are destroyed on the senders’ platforms (burnt) and created on the recipients’ platforms (minted). Second, the assets could be escrowed more durably on the platform and tokenized versions could be held and traded on the platform among participants, just as central bank reserves in the cross-border case.

The platform could offer complementary services through a programming layer, as discussed earlier. Basic operations may be possible, such as swapping and lending assets. Again, object libraries would offer safety and internal consistency. And they could serve as a guide to instill some standardization in the programming capabilities introduced by private firms on their own ledgers. Indeed, the CBDC platform should not bar the private sector from operating its own ledgers offering settlement and programming functionalities. On the contrary, the private sector must continue innovating. The point is that some degree of standardization in tokenization and programming on private ledgers could facilitate interoperability even without going through the CBDC platform (by instead leveraging the ledgers’ “doors” to outside requests and instructions, called application programming interfaces). In that sense, the platform’s own standards could be catalytic for greater standardization throughout the financial system.

Finally, the information management layer of the platform would ensure that all participants met high and common standards of compliance and would be able to interact on the platform in a privacy preserving fashion. As before, the platform would serve as an incentive to comply with regulation in order to access to the platform’s services.

Establishing clear governance arrangements would likely be easier at the domestic level than internationally. However, some negotiation among national public sector agencies and with the government would be needed. Widespread engagement with the private sector would also be essential. For instance, the central bank may be involved in-so-far as offering the settlement asset—wholesale CBDC on the ledger. And the central securities depository might be involved by potentially operating or overseeing the ledger used for the transfer, escrowing, and programming of assets. The platform’s multiple layers might call for multiple institutions to collaborate.

Some countries are already thinking along these lines and have begun experimenting, if not building infrastructure resembling the XC class of platforms applied to domestic use cases. See for instance Campos Neto (2021), Araujo (2022), and other publications from the Banco Central do Brasil on a vision for CBDC. See also the Monetary Authority of Singapore’s recent project Orchid (2023) for a vision of a programmable platform. And Carstens (2023) echoes a similar view of a unified ledger.

## Conclusion

As innovation tugs ahead, and payments evolve, the public sector too should consider renewing its infrastructure. New technologies, new entrants, and new needs have opened a window of opportunity to think ambitiously and improve domestic and cross-border payment systems, while continuing to pursue public policy objectives, such as financial and monetary stability.

This Note sketches a blueprint for a new class of platforms to bring interoperability, efficiency, and safety to cross-border payments, as well as to domestic financial markets. This infrastructure involves a single ledger for settlement and a safe settlement asset, as well as programming standards and information management capabilities leveraging encryption. This ultimately boils down to expanding the vision for public goods in payments for mere settlement, as has been the case to date, to programming and information management. More work is needed to test architecture, technology, and features, but also to develop legal underpinnings and governance arrangements.

The IMF seems like a strong partner in this endeavor. It can leverage its convening power to build momentum around these suggestions and evolve them in a direction consistent with the interests of member countries. It can draw on its wide membership and experience to help establish governance arrangements. And it can build on its policy expertise to suggest platform designs that would support the stability of the international monetary system. And to the extent it is involved, the IMF can help bolster trust in the governance, oversight, and functionality of cross-border platforms.

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