



GROUP OF TWENTY

**G-20 NOTE ON FINANCIAL PLATFORMS: WHAT ARE THEY AND WHAT ARE THEIR  
MACRO-FINANCIAL IMPLICATIONS?**

Prepared by Staff of the

**I N T E R N A T I O N A L M O N E T A R Y F U N D\***

\*Does not necessarily reflect the views of the IMF Executive Board

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## EXECUTIVE SUMMARY

Financial platforms are infrastructure supporting the interoperability of assets, between money and securities, and across borders. Platforms are not new; multiple proven and successful examples exist.

But platforms are again in focus as novel technologies enhance their features and feasibility. The public and private sectors are actively engaged in experiments and discussions. Adoption remains uncertain, but could be significant and global.

In that case, platforms could have macro-financial implications. Platforms could lower transaction costs, and boost market liquidity and competition, favoring market access, integration, and efficiency including for payments and foreign exchange. Effects on capital flow volatility and currency substitution are more ambiguous. However, platforms could challenge financial stability and fuel contagion.

Concerted public sector oversight, guidance, and possibly intervention may be warranted. Without these, because of market imperfections, platforms may fall short. Moreover, they could undermine the international monetary system (IMS) by fostering and cementing fragmentation, limiting access to assets and markets, and undermining integrity.

The public sector, central banks, ministries of finance, and others, may consider at least five actions.

First, further evaluate macro-financial implications of basic platform models, and develop views on a preferred model or constellation of models depending on assets, markets, and users.

Second, consider who should set the rules of such platforms, and which rules may best preserve the stability, efficiency, and integrity of the international monetary system.

Third, decide whether to build platforms, guide technology, or fill gaps left by initial developments. Moreover, decide how to oversee platforms.

Fourth, decide on which platform model to issue central bank money as a safe settlement asset and potentially to improve foreign exchange liquidity.

Fifth, swiftly establish clear and comprehensive legal foundations for platforms and the assets liable to be recorded and transferred on them.

The IMF stands ready to do its part in line with its mandate: to collaborate with other organizations and member countries to further explore policy implications of platforms, propose guidance on macro-financial cross-border payments policy to support the stability and efficiency of the IMS, offer its convening power to spur dialogue, build capacity in the field, and eventually assess policies or standards once these emerge.

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# CONTENTS

<b>EXECUTIVE SUMMARY</b>	<b>2</b>
Glossary	4
<b>INTRODUCTION</b>	<b>5</b>
<b>PLATFORM MODELS AND EXAMPLES</b>	<b>6</b>
A. Basic Platform Models	6
B. New Technologies and Platform Experiments	8
<b>MACRO-FINANCIAL IMPLICATIONS</b>	<b>10</b>
A. Implications for the Structure of the IMS	10
B. Implications for Financial Inclusion	11
C. Implications for Market Efficiency	11
D. Implications for Financial Stability	14
<b>POLICY CONSIDERATIONS</b>	<b>15</b>
A. Market Imperfections	15
B. Setting Platform Rules	16
C. Taking Action	17
D. Offering Central Bank Money	18
E. Building Sound Legal Foundations	19
<b>CONCLUSION</b>	<b>20</b>
References	21
<b>FIGURES</b>	
1. Three Basic Platform Models	7
2. Layers of Functionality and Vertical Integration of Current Ledger Operators	9
3. Central Bank Money Can Circulate on Any of the Three Platform Models	18
<b>TABLE</b>	
1. Summary of Pros and Cons of Different Options to Set Platform Rules	16

## Glossary

AML/CFT	Anti-Money Laundering and Combating the Financing of Terrorism
ASEAN	Association of Southeast Asian Nations
BIS	Bank for International Settlements
CBDC	Central Bank Digital Currency
CLS	Continuous Linked Settlement
CPMI	Committee on Payments and Market Infrastructures
CSD	Central Securities Depository
DeFi	Decentralized Finance
DLT	Distributed Ledger Technology
ECB	European Central Bank
EVB	Ethereum Virtual Machine
FSB	Financial Stability Board
GL1	Global Layer 1
IMF	International Monetary Fund
IMS	International Monetary System
MAS	Monetary Authority of Singapore
ML/TF	Money Laundering and Terrorist Financing
OTC	Over the Counter
RTGS	Real-Time Gross Settlement
SGD	Singapore Dollar
SME	Small and Medium Enterprise
T2S	TARGET2 Securities

# INTRODUCTION

**1. Interest in financial platforms is stoking policy discussions and experimentation.**

Platforms could improve cross-border payments, integrate markets, and enhance competition. The private sector is investing in platforms, making rapid progress and coordinating efforts. Many central banks are advanced in their own pilots, some of which have gone live. And an active developer community is building financial applications for platforms. Some experiments are motivated by the G20 Roadmap to enhance cross-border payments, others contribute to it inadvertently.

**2. At the request of the Brazilian G20 Presidency, this paper extracts basic platform models and identifies possible macro-financial implications.** The goal is to help clarify policy discussions by taking a step back from the many examples and experiments, and to highlight possible courses of action for countries to consider. This is not a normative paper. Its goal is to facilitate and encourage an early and systematic policy debate given the high stakes and costs of backtracking.

**3. Platforms are infrastructure allowing the interoperability of assets domestically and across borders.** This paper focuses on platforms for financial transactions, not platforms for communication, or the sale of goods and services, though similarities exist. Financial platforms facilitate interoperability, that is the transfer of a variety of assets including money (as in payments or foreign exchange) and securities (as in the purchase of an equity or bond) among a potentially wide array of owners, also across borders. Examples of existing platforms are central banks' real time gross settlement systems (RTGS) or Continuous Linked Settlement (CLS) for foreign exchange. Platforms can thus be domestic, regional, or global.

**4. This paper identifies three basic models of platforms.** These vary depending on whether parties to a transaction can easily interact, and whether the assets they wish to trade are easily accessible. Platforms help overcome the hurdles that stand in the way of transactions.

**5. New technologies bring opportunity (and risks) to platform models.** These technologies, often associated with tokenization, allow platforms to become more widely accessible by owners and assets, more easily programmable, and more cheaply implementable.

**6. As a result, platforms could be rapidly and widely adopted, though uncertainty is high.** Some suggest new platforms will be the backbone of tomorrow's payment and financial system. Others point to the slow pace at which infrastructure for financial services tends to evolve given inertia from legacy systems, general risk aversion, and entrenched interests of incumbents that profit from existing frictions (Agur and others, 2024).

**7. Nevertheless, if widely adopted, platforms could have significant macro-economic implications.** Potentially lower transaction and access costs, and greater market liquidity and competition could impact payment and capital flows, market integration, and foreign currency use among others. Moreover, the links between regions, countries, firms, and assets that platforms can establish (or undermine) can shape the international monetary system. And further, platforms bring risks to financial stability such as new channels for contagion. Some of these effects may be common to other non-platform-based innovations leveraging similar technologies.

**8. This paper is organized as follows.** The next section defines platforms and offers three basic models to make sense of the many renditions and pilots of platforms. It illustrates these models with examples, then discusses how new technologies change some of the attributes of platforms. The following section reviews possible macro-financial implications of those attributes, starting with benefits and ending with risks. The last section identifies possible policy responses to counter market frictions that could undermine benefits and amplify risks. Less emphasis is placed on risks in this paper, as these are covered in part in companion papers to the G20 by the BIS and CPMI, as well as the FSB on tokenization.<sup>1</sup>

## PLATFORM MODELS AND EXAMPLES

**9. This section is split in two parts.** It begins by establishing definitions, basic platform models, and examples. And it proceeds to discuss new technologies and how these affect the attributes of platforms currently being explored.

### A. Basic Platform Models

**10. Platforms, in this paper, are infrastructure facilitating the interoperability of financial assets—whether money or securities.** Platforms cover a set of specifications and arrangements regarding how data is stored, accessed, and acted upon on ledgers to facilitate interoperability, that is a coordinated transfer of two or more assets between two or more owners independently of initial relationships. The remainder of this section unpacks this definition starting from the basics.<sup>2</sup>

**11. Ledgers are central to platforms.** That is because assets usually represent claims on an issuer. For instance, most of the money used today are claims on commercial banks. And bonds are claims to receive principal and coupon payments. Who owns and issues these claims is recorded on a ledger, akin to a database. As assets are transferred, ledgers are updated.

**12. A transaction recorded on a ledger thus involves three key players.** *Operators* are responsible for the safekeeping and updating of ledgers. *Issuers* create assets. And *owners* can access a ledger to the extent they are able to send instructions to the ledger operator(s), receive confirmation of their execution, take ownership of assets, and validate their balances any time.

**13. Transactions may consist of a simple payment, the payment for a security, or the exchange of securities or currencies (as in foreign exchange transactions).** These can result from any financial contract, including derivatives. Platform models are sufficiently general to cover the transfer of both money and securities. Both, after all, involve updating a ledger. For tractability, this paper carries forward the example of Alice wishing to purchase a bond from Bob. The example is isomorphous to that of Alice and Bob, or their intermediaries, exchanging two currencies or securities.

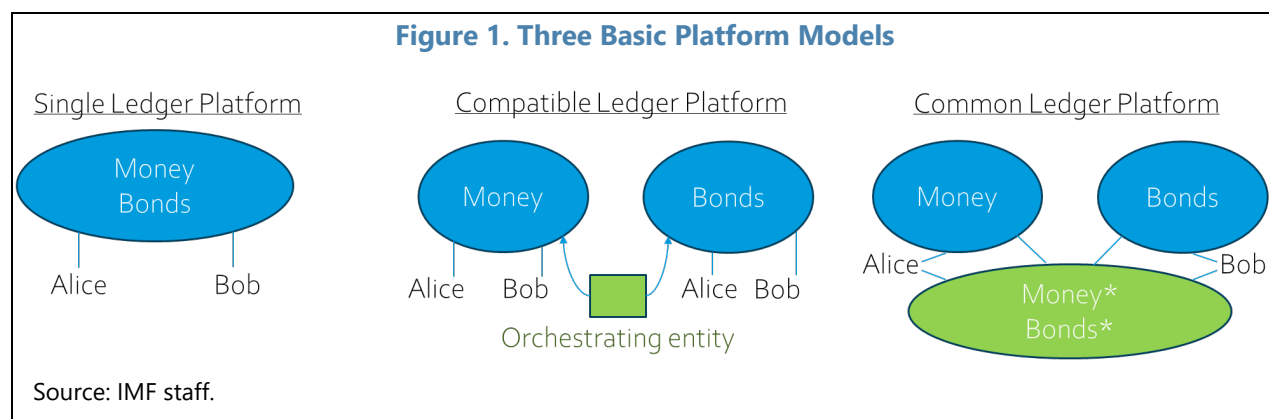
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<sup>1</sup> See BIS and CPMI (2024) and FSB (2024). While tokenization is a technology, it cannot be entirely dissociated from the infrastructure on which it resides—in most cases specific platform models.

<sup>2</sup> Platforms have been defined elsewhere and in other contexts with some nuances. See for instance Adrian and Mancini-Griffoli (2019), FSB (2019), BIS (2021), and CPMI, IMF, and World Bank (2023).

**14. Platforms come in three models depending on the relationship between owners and assets.** Specifically, do owners have access to the ledger(s) on which the assets being transacted are recorded? That is not always the case. Owners may be in different countries, and assets may be issued on separate ledgers. This opens gaps in asset interoperability that platforms come to fill. In fact, three possible relationships between owners and assets exist, giving rise to three basic platform models.<sup>3</sup>

**15. First, in the simplest case called the single ledger platform model, owners have access to the ledger on which the assets being transferred are recorded.** When Alice wishes to purchase a bond from Bob, she instructs the ledger operator to transfer the ownership of her money to Bob, who does the reverse for the bond (Figure 1). In this case, no additional specifications or arrangements are needed; the platform simply consists of the one ledger as accessed by relevant owners and issuers.



**16. However, this simple case is rarely encountered today.** Bonds may be recorded on the ledger of a central securities depository (CSD), but not money. A CSD may be the closest example of a single ledger platform, though a very imperfect one given limited asset coverage. Thus, two more models of platforms have emerged.<sup>4</sup>

**17. Second, the compatible platform model is relevant when assets are recorded on different ledgers, but owners can access both.** For instance, Alice and Bob may hold money balances with the same bank, and both may have access to the CSD where the bonds are recorded. Nevertheless, money and bonds are recorded on separate ledgers.

**18. The compatible platform model allows ledgers to coordinate transfers.** Bob gets paid (nearly) when Alice receives the bonds. The basic approach is to create an "orchestrating entity" that receives instructions from both owners, translates these into a language understood by each ledger operator, initiates concurrent settlement, and shares confirmation of execution.<sup>5</sup> The orchestrating entity is said to be involved in clearing, while settlement occurs on the two separate ledgers among owners. In this case the platform consists of the two ledgers and the orchestrating entity (Figure 1).

<sup>3</sup> Similar models are highlighted in Plooj and Neuhaus (2023) and are reflected in experiments undertaken by the ECB.

<sup>4</sup> Closed-loop systems (such as eMoney providers) only include one asset and thus not examples of single ledgers.

<sup>5</sup> The Bank of England refers to a similar concept and calls it a "synchronization operator" (Bank of England, 2024).



**19. An example of compatible ledgers today is the ECB’s T2S platform.** Its purpose is to orchestrate transfers of central bank reserves on the RTGS ledger with transfers of securities on CSD ledgers across the European Union.

**20. In the cross-border payment space, an example is the BIS Innovation Hub’s “project Nexus.”** The platform’s orchestrating entity clears payments among correspondent banks linked to countries’ domestic fast payment system ledgers where settlement occurs.

**21. Third, the common ledger model allows a coordinated transfer despite each asset being recorded on a different ledger and each owner only having access to that ledger.** For instance, Alice may have access to the bank where she holds her money, but not to the CSD where Bob records his bonds. And Bob may not have access to Alice’s bank. The configuration is actually rather common, though does not facilitate interoperability.

**22. To allow a coordinated transfer, the common ledger platform model adds a third ledger in the form of a connector or bridge.** The basic approach is to create corresponding assets on a third ledger which both Alice and Bob can access and use to settle (Figure 1). The process can take various forms. The simplest is to escrow the assets intended for transaction, then exchange a certificate of escrow on the third ledger. The most common is to transfer the assets to a third entity which issues corresponding liabilities that Alice and Bob can hold and transact on the third ledger. In practice, the ledger operator will often be the entity issuing those liabilities (vertical integration).

**23. Examples abound, often covering a limited set of assets given the complex contractual arrangements; a prominent example is central banks’ RTGS.** Commercial banks issue money (deposits) on their own ledgers. However, they prefer not paying each other directly as banks do not necessarily trust each other’s ledgers (or liabilities). So they sell (or pledge) an asset such as a government bond to the central bank which creates a liability of equivalent value on its ledger (central bank reserves on the RTGS), then transfers these from one bank’s account to the other’s. Banks can also pre-fund these operations.

**24. In the cross-border payments space, an example of the common ledger model is CLS.** This platform tracks, nets, then settles exposures on its common ledger among more than 70 member banks covering well over half the world’s foreign exchange transactions.

## **B. New Technologies and Platform Experiments**

**25. Platforms are adopting new technologies associated with public permissionless blockchains, distributed ledger technology (DLT), and tokenization.** Associations are often loose so this paper focuses on specific technologies as opposed to referring to any one popular term. Technologies include smart contracts, and a common data structure and execution environment.<sup>6</sup> By integrating these technologies, platforms can offer new features. However, the three basic models of platforms do not change as they are rooted in the relation between owners, assets, and ledgers.

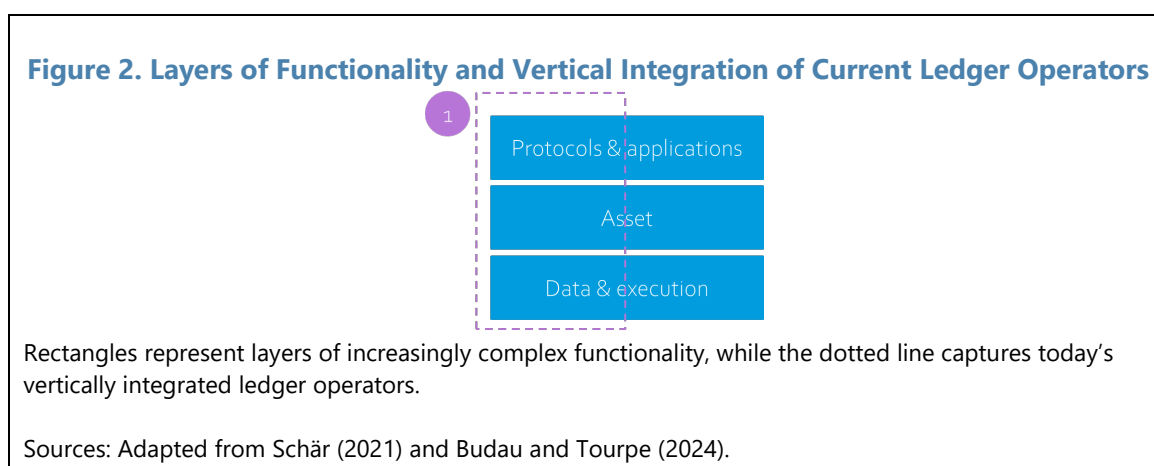
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<sup>6</sup> Public permissionless blockchains also introduced other innovations not emphasized here, such as self-custody of assets and new consensus mechanisms. These blockchains are open to any issuer, asset owner, and operator.

**26. Smart contracts are code-based instructions stored on the underlying ledger used to create an asset or financial application.** For instance, a smart contract can be used to create a transferable bond that pays coupons. Or it can be used to escrow and exchange assets. Smart-contract based assets are called tokens and smart contract-based financial applications are called protocols.

**27. Importantly, smart contracts can include immutable logic that can be automatically enforced every time an asset is transferred.** Logic can be used to strictly enforce certain rules, such as to comply with regulation like only allowing qualified investors to transact riskier assets.

**28. As a result, ledger operators need not be vertically integrated as today, and can focus on data management and execution.** Currently, operators of ledgers perform multiple functions such as specializing in certain assets, selecting participants, building and running applications (such as to transfer or escrow assets), then separately updating the ledger. This is illustrated in Figure 2 which illustrates layers of functionality from the data and execution environment, to the assets and applications (protocol) deployed on the ledger. With new technology, some of the functions undertaken today by the ledger operator can be transferred to the logic attached to assets or protocols.<sup>7</sup> And depending on legal arrangements (still in flux), responsibility could shift to the entity deploying the asset or protocol, away from the ledger operator.



**29. The change is not innocuous and could instill significant value especially in single ledger platforms, allowing these to become multi-asset and multi-function.**<sup>8</sup> Platform operators, by offering a common execution environment and data structure, could host a variety of assets and protocols, many of which could be deployed by separate financial entities. In fact, protocols could be combined and re-used in an internally consistent fashion (referred to as *composability*). For instance, an asset that is held as collateral in one operation cannot be re-used in another unless release conditions are fulfilled. Moreover, multiple steps to a transaction such as receiving one payment before initiating another can be executed in a single inseparable transaction (known as *atomicity*) thereby removing counterparty and settlement risk. To some extent, this was already possible on today's single or common ledger platforms. But atomicity is much more valuable among a greater set of assets in which any number of steps can be bundled unlike simple delivery-versus-payment

<sup>7</sup> For further discussion see Schuler and others (2024). Also, see the BIS Innovation Hub's project Mandala.

<sup>8</sup> Earlier discussions of single ledger platforms leveraging new technologies include Adrian and others (2022), Adrian and Mancini-Griffoli (2023), BIS (2023), and Carstens and Nilekani (2024).

arrangements (Schär, 2021). Finally, more users may decide to join the platform to the extent that the execution of smart contracts is easily verifiable, and the execution environment is neutral.

**30. Indeed, today the public and private sectors are actively experimenting with single ledger platforms.** The BIS' project Agora aims to transact commercial and central bank money on ledger. The Monetary Authority of Singapore's (MAS) Global Layer One (GL1) project in collaboration with various global banks also considers securities. Several large banks, including Goldman Sachs, HSBC, Société Générale, BNP Paribas, and UBS leverage public open ledgers such as Ethereum on which they develop private enclaves, or build closed and permissioned sub-ledgers to record and transfer their own assets (see Global Financial Markets Association and others, 2023).<sup>9</sup>

**31. New technologies also benefit the compatible and, to a lesser extent, common ledger platforms.** In the compatible model, the orchestrating entity is no longer essential as the same functionality can be achieved with technology. If two ledgers share the same execution environment, they can run the same smart contracts so transactions can be triggered across ledgers. However, these cannot be perfectly synchronous (atomic) or logically connected (composable) since ledgers can exhibit lags or become compromised while a transaction occurs. Compatibility across ledgers can also allow an asset to be burnt on one ledger and minted on another, so it may be accessible by more transacting parties for instance. On common ledgers, the escrowing of assets and the creation of corresponding assets for settlement can be automated and made more transparent, as tested by various brokers making money market fund shares more widely available.

## MACRO-FINANCIAL IMPLICATIONS

**32. This section considers implications in four areas.** The first is the structure of the IMS. The second is financial inclusion. The third is market efficiency, after considering the impact on intermediate variables such as transaction costs. And the fourth is financial stability. Today's platforms already have macro-financial implications, such as RTGS systems and CSDs drastically lowering settlement and counterparty risks and spurring market activity, and CLS reducing settlement risks in the foreign exchange market, though for a small set of currencies.

### A. Implications for the Structure of the IMS

**33. The IMS is a rather loose concept encompassing institutions, rules, and principles focused on monetary and financial interoperability between countries.** To stylize, the IMS provides guidance on *who* (or which countries) should have access to international payments and capital markets, on *what* assets (including foreign exchange) should be available for transaction, and on *how* transactions should occur. A stable, efficient, and integrity-compliant IMS is one that stands for broad inclusion, for few restrictions on international payments, for exchange rate stability, for data to

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<sup>9</sup> The single ledger model can comprise multiple sub-ledgers (called layer 2) built on top of a base layer. These can be established for greater scalability, privacy, control of the consensus-relevant nodes, application efficiency, or ease of supervision. Nevertheless, sub-ledgers can always leverage the base layer for interoperability and as a dispute resolution mechanism. Thus, the single ledger model does not necessarily literally imply a one ledger, but a single base layer and single state of asset and protocol allocation.<sup>10</sup> The term "platform rules" is broader than "governance" which is typically focused on operational stability and efficiency. Rules do not include asset, application, or owner-specific regulations that would continue being enforced.

be transparent and readily available for monitoring, for compliance with relevant standards including those for anti-money laundering and combating the financing of terrorism (AMF/CFT), for disputes to be treated systematically and fairly, and for backstops, such as lending by the IMF, to be available in an evenhanded and commensurate fashion. The IMF and other international bodies such as FATF were established in great part to support these features of the IMS.

**34. Platforms, if used to transfer money and securities across borders, and if adopted widely, could impact the IMS.** The coverage, interoperability (or fragmentation), and ultimately rules of platforms would be exactly about the *who, what, and how* of international finance. The more global the platforms the bigger the effects. Platforms could establish which countries can be connected, which firms and households can participate, which assets including currencies can be transacted and how much, which applications can be deployed, which laws apply, and how rules can change.<sup>10</sup> These closely resemble the principles of the IMS if applied on a large scale and could thus reshape the IMS.

## B. Implications for Financial Inclusion

**35. The compatible ledger model of interlinking countries' fast-payment systems seems the most feasible solution for now to improve cross-border retail payments.** Some of its key characteristics are transparency including of the costs charged by intermediaries, message harmonization, compliance checks effected prior to a transaction thereby reducing risks of payment failing, and front-end convenience provided by fast-payment systems to the extent these are implemented effectively and benefit from significant take up.<sup>11</sup>

**36. These platform characteristics have already shown to decrease transaction costs and improve speed, boosting remittances.** For instance, the bilateral link between Singapore and Thailand has lowered costs of sending SGD 200 from 13 percent to 3 percent, and the time from 3 days to seconds (ASEAN+3 Macroeconomic Research Office, 2023). Costs above 10 percent are common in sub-Saharan countries (FSB, 2023). Cerutti, Firat, and Perez-Saiz (forthcoming) shows that a 60 percent reduction in transaction costs can increase remittance flows in countries with high initial costs (up to 20 percent) by nearly 23 percent or about 5 percent of GDP (a likely lower bound).

**37. More efficient cross-border payments would alleviate poverty and spur trade of small and medium enterprises (SMEs).** The link to poverty is amply studied (Azam and others 2016, Tsaurai 2018, Azizi 2019, and World Bank 2022) and payment frictions are a key barrier to the expansion of firms across borders (Méjean and Schwellnus 2009, Panetta 2023, Li, and others 2024).

## C. Implications for Market Efficiency

**38. Single ledger platforms offering composability and atomicity among a potentially large set of assets could lower transaction costs.** As argued earlier, these features can lower counterparty risks for a greater set of assets and transactions relative to today's security settlement systems, as well

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<sup>10</sup> The term "platform rules" is broader than "governance" which is typically focused on operational stability and efficiency. Rules do not include asset, application, or owner-specific regulations that would continue being enforced.

<sup>11</sup> Pre-conditions to establish links between payment systems can be onerous and require alignment on messaging standards, application programming interfaces (APIs), compliance frameworks, governance, oversight, and fraud detection. However important, these are beyond this paper's scope.

as settlement risk.<sup>12</sup> Also, more predictable settlement can help investors improve capital allocation. Common ledger platforms offer similar types of gains, though likely of smaller magnitudes given the more restricted asset coverage. Commercial banks are exploring these new technologies to save on the automated portfolio redeployment of cash and on asset servicing costs involving the collection and distribution of dividends, coupon, and interest payments.

**39. Market liquidity could improve especially on single ledger platforms which unify a greater set of assets.** Compatible ledgers could also leverage smart contracts to openly compare prices and potentially move assets to where liquidity is greatest. Either way, platforms could make it easier to access liquidity and assets. For instance, dollars used to exchange euros in one application can also be used to exchange yen in another application. Liquidity has a lower risk of being contained to a specific ledger, and thus fragmented. By the same argument, search frictions should also shrink especially if assets are recorded on widely available platforms, as opposed to being traded over the counter (OTC) as is the case for many bonds, derivatives, and foreign currencies.<sup>13</sup>

**40. Competition among intermediaries should also increase across platform models.** First, the functionality offered by escrow agents is likely to migrate to ledgers. Second, brokers might continue to provide households and non-financial firms access to platforms, in part to satisfy regulation. However, the portability of assets between ledgers should strengthen competition among brokers. For instance, asset owners could easily change brokers without having to liquidate then recreate positions. Likewise, broker underwriting fees should decrease. Leung and others (2023) find 25.8 percent lower fees on new technology platforms. And third, while custodians would remain necessary to bridge ledgers and keep track of proofs of asset ownership (private keys), standardization of services and the option to self-custody would likely heighten competition.

**41. Moreover, most platform models should strengthen competition among correspondent banks involved in cross-border payments.** First, single ledger platforms (or a dedicated common ledger platform) could allow the creation of a market for correspondent banking services. Claims issued among correspondents to settle cross-border transactions could be standardized, issued, and traded on a platform. As a result, credit exposures could be offloaded more easily and absorbed by those most able to take risks. Second, correspondent banks could bid for business on any of the platform models, therefore enhancing competition. On a compatible ledger platform, for instance, such bidding could be done through the orchestrating entity. On single or common ledger platforms banks could bid directly. Third, any of the platform models could offer greater transparency regarding the price (mark-ups) for correspondent banking services, without necessarily revealing the identity of correspondents. Lastly, competition could come from central banks, if these made CBDC more widely available on any of the platform models, as discussed in more details later.

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<sup>12</sup> Importantly, atomic transactions do not necessarily require immediate settlement. They can occur at a pre-set date and time in the future, or once assets become available. Immediate settlement instead entails liquidity costs as transactions must be pre-funded. Instead, hash-time lock contracts that govern settlement across ledgers as on compatible platforms do immobilize funds until the time of settlement, thus inducing liquidity costs. The Swiss DLT Act (2021), for instance, provides legal certainty to the settlement of securities on DLT platforms.

<sup>13</sup> Leung and others (2023) find that bonds traded on platforms come with 23.9 percent lower yield spreads and 5.3 percent lower bid-ask spreads on average. Liu and others (2023) find that asset backed securities have 25 basis points lower yields than comparable securities traded outside platforms. Allen and Wittwer (2023) and Pintér and Üslü (2022) simulate significant gains from centralizing trade.

**42. Cross-border payments may grow only little in the short-term with lower transaction costs.** Cerutti and others (2024) assumes unchanged elasticities of payments and finds that if transaction costs decrease by 60 percent, volumes rise only by about \$5.8 trillion—a 3 percent increase, or about 6.1 percent of world GDP. That is because most cross-border payments are wholesale, and, while opaque and difficult to measure, face relatively low costs and elasticities. However, the result is likely a lower bound as elasticities could be higher over time and could be much higher for certain countries, types of intermediaries, or specific currency corridors for which disaggregated data does not exist.

**43. Larger and potentially non-linear effects could materialize at the extensive margin as lower transaction costs spur firm entry.** For instance, a preliminary study suggests that lower foreign exchange costs (from accessing CLS) stimulate entry and competition to the point of overturning the benefits to incumbents from lower trade costs (Qiu and Mancini-Griffoli, forthcoming).

**44. Market integration and risk sharing opportunities could improve substantially, though alter the behavior of investors.** Fundamentally, market access will continue to be conditioned by legal frameworks. Platforms enlarge the potential set of owners with access to assets, but not necessarily the actual set. However, lower transaction and access costs, as well as lower search frictions, should facilitate market integration, especially on single ledger platforms. More work is needed to study a potential change in aggregate investor behavior (possibly involving more herd behavior and rapid reallocations of portfolios).

**45. Foreign exchange markets could benefit from lower costs and volatility, higher liquidity, and potential stabilizing effects on inflation and trade.** A recent FSB report (2023) finds that more than half of the total cost for cross-border payments stems from foreign exchange trading. If trading moved to platforms (single or common), away from OTC markets, spreads and volatility could come down. Currently, these seem driven in part by the balance sheets of dominant dealers, as well as other sources of transaction costs and market illiquidity.<sup>14</sup> Platforms open the door to more currencies being traded on a payment-versus-payment basis which is key to lowering transaction costs.<sup>15</sup> However, market liquidity also depends on whether foreign exchange dealers find it profitable to warehouse and offer more currencies, as well as hedge risks. Project Mariana, for instance, uncovered the feasibility of new foreign exchange links, but liquidity remains to be explored. Should more currencies be actively traded, however, macro effects would be notable. Gopinath and others (2020), for instance, documents that pricing in a dominant currency such as the dollar significantly increases exchange rate pass-through to prices and trade globally.

**46. Capital flow volatility could also be affected, though depending on the type of shock.** Prima facie, lower transaction and access costs may well increase countries' gross foreign asset positions. And Fu (2023) suggests that countries with more foreign asset exposure may face larger and

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<sup>14</sup> See Rinaldo and Santucci (2022) and Reitz and Umlandt (2021). The latter documents a highly concentrated market structure whereby the top three foreign exchange dealers had a 25 percent market share in 2017.

<sup>15</sup> As studied in Dowd and Greenaway (1993), Hartmann (1998), Rey (2001), and Goldberg and Tille (2008). Notably, the CLS platform currently only trades 18 currencies and up to 1/3 of global foreign exchange trades are not settled on a payment-versus-payment basis (BIS, 2022).

faster capital outflows as foreign investors respond more strongly to domestic shocks.<sup>16</sup> Moreover, valuation effects would be larger in countries' balance of payments (Obstfeld, 2010). However, new model results (Reuter and others, forthcoming) suggest that effects, including on foreign exchange rates, may depend on whether shocks are real or financial.

**47. Lower barriers to holding and transacting foreign assets could increase currency substitution, though capital flow management measures could become more efficient.** Currency substitution, especially if it involves saving and not just paying in foreign currency can lead to a loss of monetary policy effectiveness as well as lower seigniorage revenue and higher risks of banking instability.<sup>17</sup> However, capital flow management measures which can temporarily shield countries from destabilizing capital flows (to the extent they do not delay needed macro-economic reforms), can be implemented more efficiently on platforms, except if there are leakages. Countries can use smart contracts to code and automate limits on foreign currency holdings and transactions, lowering trading frictions in the process (see also He and others, 2023 for a similar discussion related to CBDC).

## D. Implications for Financial Stability

**48. As discussed, this section briefly reviews the most salient risks, with a focus on new risks.** A more detailed and comprehensive assessment can be found in related papers to the G20 on tokenization from the BIS and CPMI as well as FSB. Agur and others (2024) also discusses new risks with an emphasis on market frictions. Finally, as with all new arrangements and technologies, unforeseeable risks could materialize.

**49. Platforms may well lower some existing risks.** As discussed, counterparty and settlement risks may decrease for a larger set of assets and transactions (notably on the very large foreign exchange markets) to the extent that single ledger models are widely adopted.

**50. But many current risks would remain.** To start, platforms are not void of operational risks, including cyber risks, that might increase especially if development is rapid and broad-based. Resilience could improve, especially in a compatible ledger model where assets can be moved among ledgers. A single ledger model could instead undermine resilience if it grew sufficiently large while relying on a few dominant operators. Also, existing national legal risks could be exacerbated in cross-border platforms. Finally, liquidity and credit risks related to any of the on-ledger assets, as well as risks to financial integrity would remain.

**51. New risks could also arise, including to financial stability especially in countries with weaker capacity.** First, contract contingencies (composability), especially on single ledger platforms, could introduce contagion effects. If one contract fails, others could follow suit. Greater settlement speeds and automated trading behavior would only exacerbate this risk. Second, layers of contingent or bundled contracts could become difficult for regulators to track, thereby introducing hidden risks in the financial system (Nadler and Schär, 2022). Third, a faulty code snippet could affect multiple contracts before the fault is discovered. Fourth, greater competition among intermediaries, and

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<sup>16</sup> FDI seems more resilient to outflows, while bank loans and trade credits may experience more severe drops and take longer to recover (see for instance Levchenko and Mauro, 2007, and Tong and Wei, 2011).

<sup>17</sup> See, for example, Yeyati and Sturzenegger (2002), Salvatore, Dean, and Willett (2003), and Gulde and others (2004).

possibly higher foreign exchange exposures, could undermine financial stability in the transition. Fourth, new legal risks might arise given the novelty of platforms and assets recorded on them.

**52. Finally, platforms (especially single ledger models) could lead to much higher interconnectedness between assets, countries, and owners, with ambiguous effects on risks.** This harks back to an old debate suggesting that more interconnected systems are more stable as more parties can absorb shocks (for instance Brunnermeier and Pederson, 2009, and Geanakoplos, 2009). But incomplete information about exposures might induce greater risks of runs when systems are highly interconnected (Shin, 2009, for instance). Where platforms end up depends in part on how transparent information will be at the aggregate level regarding prices, exposures, and balance sheets.

## POLICY CONSIDERATIONS

**53. This section is divided in five short parts.** The first identifies market imperfections that could interfere with the development of platforms and thus warrant public sector involvement. The remaining parts discuss possible types of public interventions: setting platform rules, taking direct action, offering central bank money, and building sound legal foundations. Behind these reflections are important policy questions for countries.

### A. Market Imperfections

**54. Platforms can help support the stability, efficiency, and integrity of the IMS, but could also undermine these key objectives.** Three main market imperfections could stand in the way: coordination failures, network effects, and externalities.

**55. First, coordination failures means that parties fail to develop a product that would actually benefit the collective.** Individual countries or financial institutions could hesitate to move first or invest the necessary resources in platforms as their returns depend on others joining. Alternatively, the option requiring least coordination becomes dominant or in some cases coordination mechanisms may simply be lacking, by way of industry or policymaker associations.

**56. Second, network effects stem from similar dynamics, but instead of sluggish adoption they favor convergence around the first or dominant entrant.** Network effects lock users into one technology standard or platform, making it difficult to backtrack or develop parallel solutions. Network effects can create social value, but can also undermine it if, for instance, one platform model was developed hastily due to an excessive focus on operationalizing technology, as opposed to considering longer-term policy implications. For the same reason, shifting transactions away from a rent-extracting private platform can be difficult once it has become dominant.

**57. Third, externalities refer to private interests overshadowing public or global interests.** For instance, platforms may be developed rapidly by large private sector firms, while leaving out unprofitable countries, firms, assets, or users which would otherwise benefit from being included in international finance. Similarly, groups of countries could develop regional platforms to facilitate large trade corridors without considering the loss from excluding smaller countries. Moreover, systemic risks including from the lack of a safe settlement asset, contagion and spillover effects, and generally social



costs from fragmentation, opacity, glitches, or outages might not be fully taken into account by private firms, or possibly even by individual countries.

**58. As a result, some public sector intervention seems warranted.** Development could otherwise be sluggish despite social benefits of platforms. Or it could be hasty, overlooking wider stability risks. Lower-income countries (unprofitable use-cases more generally) could be excluded from platform arrangements. And the stability, efficiency, and integrity of the IMS could suffer.

## B. Setting Platform Rules

**59. Platform rules are important for any model, but have farther reaching implications and are likely harder to establish for single ledgers which include more participants and assets.** Despite the possible benefits of single ledger platforms, reviewed earlier, the difficulty of establishing common rules may undermine the feasibility of this platform model, or at least contain its coverage of assets and potential owners. Any yet, rules are essential to reinforce the stability, efficiency, and integrity of the IMS. Generally, three options exist to set platform rules, each with its pros and cons (captured in the table).

**Table 1. Summary of Pros and Cons of Different Options to Set Platform Rules**

	+	-
Public	Legitimacy	Feasibility
Private	Efficiency	Fairness
Open	Inclusion	"Commons," concentration

Source: IMF staff.

**60. The first option is for public entities—country or regional authorities, or international financial organizations—to set platform rules.** The advantage would be *legitimacy*: alignment with policy objectives as well as strong oversight and buy-in. The disadvantage would be *feasibility*: the difficulty of agreeing on rules, decision-making powers, and which assets or applications to include. Moreover, some domestic legal frameworks may require that platform rules be formalized in, or supported by, an international treaty or new laws, adding complication. The approach may lead to fragmented regional ledgers covering a limited class of assets, with little interoperability between them. However, international organizations could facilitate a dialogue among countries aiming to achieve a common view of platform rules, and ensure that these account for IMS implications.

**61. The second option is for private entities to build and establish rules for single ledger platforms.** The advantage is mostly one of *efficiency* as ledgers would be designed to exactly meet the interests and use-cases of financial firms, and could be built quickly. The disadvantage is *fairness* – lack of representation as profit motives could leave smaller financial firms and countries by the wayside. Moreover, single ledger platforms operated by a few financial firms could undercut competition and open the door to rent-extraction as well as hold-up problems in settlement. However, public oversight could guide the private sector to reach a better outcome, and especially to integrate

features and designs supporting the stability, efficiency, and integrity of the IMS. Examples of cooperation between private and public sectors on global platforms are encouraging (as in Swift for messaging platforms, and CLS for foreign exchange settlement platforms).

**62. A third option exists, for the base layer of a single ledger platform to be open with very few restrictions.** As discussed earlier, financial institutions and central banks are also exploring this option. Each country, for instance, could operate its own nodes (or open permissionless ledgers could be leveraged; many other configurations are possible). The role of the base layer would mostly be to establish a consistent data structure and execution environment. The main advantage would be *inclusion*: the ability (not necessarily the obligation or even the presumption) to create financial links between any country, firm, individual, asset, or application today or in the future as conditions evolve. Restrictions to meet legal and regulatory requirements could instead be established on assets or applications by the countries, regions, or regulators with jurisdiction over them.<sup>18</sup> As a result of fewer restrictions on the base-layer, the platform would stand a better chance of including more assets, applications, and participants. The disadvantage involves typical “*commons* or free-rider problems.” Namely, innovation of base layer functionality including cyber security requires the good-will of developers. Moreover, a more open development process does not rule out dominant entities making proposals in their preferred direction (Fracassi and others, 2024).

**63. Given the far-reaching implications of who sets platform rules, and the difficulty of backtracking, policy discussions should start early and proceed swiftly.** They could begin by comparing the above general approaches, then evolve into identifying principles for which rules are most conducive to a stable, fair, and efficient IMS. Possible tradeoffs between platform rules and preferred platform designs should also be discussed. For instance, if countries preferred a single platform approach, but did not think that the public could set platform rules, nor that other options were acceptable, then efforts to establish other platform models could be prioritized instead.

## C. Taking Action

**64. The public sector may take action beyond setting platform rules—or at least establishing principles for these.** This section surveys possible actions to redress or overcome market imperfections. The term “public sector” is used broadly to represent country or regional authorities including central banks and ministries of finance, with the support in some cases of standard setters and international organizations.

**65. The public sector may wish to build platforms to overcome coordination failures and act as a catalyst.** Which one it builds, however, will support one platform model over another and may require the public sector to set platform rules, with potential implications for which assets and participants join, as discussed earlier.

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<sup>18</sup> The identity of transacting parties can remain private or disclosed to a selected set of entities if necessary. Parties can also choose which nodes can be involved in consensus building or leverage privacy enhancing protocols (called zero knowledge proofs as in Buterin and others, 2024) though currently at the cost of some throughput. Innovation in this space is still ongoing and financial firms are still exploring how to satisfy their privacy requirements. Other options are possible, such as creating closed and permissioned sub-ledgers (layer 2s) or creating a regulated enclave on the base ledger for a subset of regulated entities and/or clients to transact. As such, the option of more open platform rules should not be equated with today’s Decentralized Finance (DeFi).

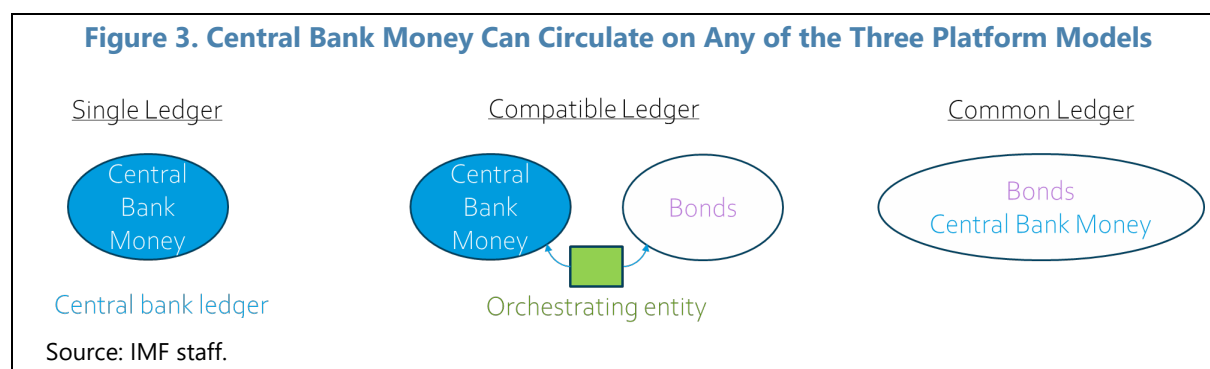
**66. The public sector could also facilitate convergence on common technologies or features, again to overcome coordination failures.** For instance, it could facilitate the adoption of a given execution environment (such as the Ethereum Virtual-Machine or EVM) so newly developed platforms could be more broadly compatible. Similarly, the public sector could require platforms to provide key features such as sufficient transparency to monitor capital flows and the ability to tailor capital flow management measures.

**67. Or, the public sector could decide to build platforms to fill gaps left by initial developments.** For instance, if regional single ledger platforms emerged, or blocks of platforms led by different consortia of banks, the public sector could consider building common ledgers or orchestrating entities to bridge these. Arguably, the role could also be left to the financial sector.

**68. Another action will be to regulate, oversee, and supervise platforms to limit risks.** The topic is multifaceted but one important question stands out – whether platforms (or which parts of platforms) undertake the functions of systemic financial market infrastructures (FMIs) and should be regulated as such. In some cases, the answer may be the underlying data ledger and its operator(s), and in others it may be the protocols and applications deployed on a platform. More work, in line with the CPMI-IOSCO Principles for Financial Market Infrastructure (PFMI, 2012) is needed. In preparation, the public sector may wish to more actively participate in platform pilots and more closely observe private sector and open platform experiments.

## D. Offering Central Bank Money

**69. The public sector could decide to make central bank money available on platforms to reduce counterparty risk and in so doing spur platform development.** In fact, central banks could favor one platform model over another, or elicit to make their liability available on more than one model as all three are feasible (Figure 3, see also Bank of England, 2024). Making safe central bank money available for settlement would be in line with the PFMI.



**70. Central banks could make their money available on a single ledger platform which they operate.** They could build the platform infrastructure to settle their own money (wholesale central bank digital currency, wCBDC), then induce issuers and financial firms to record and transact their own assets on the same ledger. The Brazilian DREX experiment seems to go in this direction.

**71. Alternatively, central banks could leverage the compatible ledger model.** In fact, this path seems to have been the most explored to date, in part because setting platform rules is easier – each operator can do so freely. Central banks have established orchestrating entities and common execution environments to transact concurrently over two or more ledgers. Examples include project

Ubin and the BISIH's project Icebreaker that exchanged CBDCs across borders. Likewise, the Bundesbank's "trigger solution," and Banca d'Italia's "TIPS Hash-Links" tested compatibility between CBDCs and securities recorded on CSDs using "hash-time-lock contracts" (that lock outgoing funds until incoming funds are received on both ledgers).

**72. And finally central banks can opt for common ledgers on which they can make their money available directly and indirectly.** The SNB opted to make its wCBDC available on third party ledgers (thus far only one) while retaining control over participants and transactions. The question is whether central banks could agree on which constraints to impose on the data structure, execution environment, consensus mechanisms, ledger operators, and potential owners so several could issue their liabilities on the same common ledger and thus create a liquid market to exchange currencies. Another model introduced by the Bank of England is for the common ledger operator to hold an omnibus account at the central bank where it can receive reserves from transacting parties. In turn, the operator can hold reserves in escrow, and issue its own fully backed private liability for settlement on its ledger. The extension of this model to a global common ledger could facilitate the direct trading of currencies with potentially low counterparty risks. Key would be the legal regime so assets held by common ledger operators would be bankruptcy remote.

## **E. Building Sound Legal Foundations**

**73. Platforms must be established on sound legal foundations including clear, comprehensive, and enforceable rules.** Operators, providers of assets, and of course owners, would all be liable to follow the established rules. This section remains focused on broad legal principles and does not go into the specificities of regulation.

**74. First, some general challenges will emerge to a solid legal basis for platforms.** The first is whether the establishment of the platform is legally feasible. First, issuers, operators, and owners must be allowed within their governing laws and regulation to undertake these roles. This includes central bank laws and central banks mandates when applicable. Second, the platform should be established by the most appropriate legal instruments for instance through bilateral or multilateral agreements between entities or through international treaties among countries.

**75. Second, the platform's structure, accountability, and regulatory and transparency framework should be legally robust.** The following four areas are relevant. The first is determining the legal nature, ownership, and registration of the platform as well as that of the operating and governing entities. The second area is an efficient dispute resolution mechanism able to produce enforceable agreements and decisions. The third is clarity of the powers (such as contractual, regulatory, or disciplinary) of the operating and governing entities over the platform's participants and transactions. The fourth is a decision-making and governance structure among the different entities on the platform, including clear, fair and transparent voting rules among all relevant stakeholders.

**76. Third, there should be a clear legal framework around the assets recorded and transacted on platforms.** This is especially true of newer technologies covering smart contracts, on-chain applications, commercial bank deposits, CBDC, and even possibly regulated crypto assets. All assets and applications would need to benefit from legal certainty in terms of their nature and legal treatment. Such legal certainty is also a prerequisite to determine the adequate regulatory treatment and allow for a secure operation of the platform.

**77. Finally, applicable rules and laws as well as their enforcement should be consistent across countries.** If the operating rules and legal arrangements establishing the platform and its related entities cannot be enforced in a participant's jurisdiction due to conflicts with rules existing in applicable national laws, this would create a significant legal risk of unenforceability and invalidation of the transactions executed on the platform (or any regulated market). Inconsistencies could also exist among applicable national laws. The main legal areas that are prone to such frictions are financial regulation, AML/CFT, tax, data privacy and protection, capital flow management, dispute resolution, settlement finality, and access to payment systems. International standards can help by providing a basis for harmonized regulations.

**78. Moreover, safeguarding the integrity of transactions on platforms is essential.** Transactions are vulnerable to being misused for criminal purposes such as to facilitate illicit finance including money laundering and terrorist financing (ML/TF). To mitigate this risk, effective AML/CFT measures need to be implemented.

**79. The nature and intensity of the required AML/CFT measures depend on the level of ML/TF risks, which in turn depends on several elements, including the platform model.** Compatible ledger platforms that only provide their participating financial institutions with messaging services and other supporting infrastructure to coordinate transfers in different ledgers might face low levels of indirect ML/TF risks. In these instances, limited AML/CFT measures may be required. However, common and single ledger platforms that allow for settlement and for the transfer of a wider array of assets including peer-to-peer face greater ML/TF risks. In these instances, a range of AML/CFT measures would need to be implemented effectively to ensure that the risks are mitigated.

**80. In light of the above, AML/CFT considerations should be an integral part of early platform design deliberations.** In particular: (i) a clear determination should be made as to the purpose and policy mandate of the platform; (ii) the level of ML/TF risks of the model under consideration should be appropriately assessed; (iii) the assessment should identify necessary mitigating measures, and the allocation of responsibilities for their implementation; and (iv) the criteria for access to the platform, asset, and protocol should be clearly defined, both for jurisdictions and for potential owners (individual participating entities), and should reflect the degree of ML/TF risk.

## CONCLUSION

**81. This paper is a start.** It offers simple platform models and a review of macro-financial implications. Significant space remains to better understand platforms and converge on a coherent vision for future development. Given the complexity and potential implications, that journey should begin swiftly.

**82. The IMF stands ready to serve its role and mandate.** It will actively collaborate with other organizations and members to further explore policy implications, propose guidance on macro-financial cross-border payments policy for platform rules to support the stability and efficiency of the IMS, offer its convening power to spur dialogue, build capacity in the field, and eventually assess policies or standards once these emerge.

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