

Central bank digital currencies for cross-border payments

Report to the G20

July 2021



Committee on Payments
and Market Infrastructures

Innovation
Hub



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Contents

Executive Summary.....	1
Introduction.....	2
1. Domestic CBDC designs and cross-border considerations: a primer	4
Improving cross-border payments efficiency is an important motivation for CBDC work.....	4
2. Stocktaking potential CBDC designs in cross-border payments	5
Current central bank thinking on cross-border CBDC use	6
Cross-border aspects of advanced retail CBDC projects.....	8
Enabling retail or wholesale interoperability of CBDC arrangements.....	8
CBDC arrangements in practice: current projects with cross-border focus.....	11
Central bank considerations regarding interoperability, mCBDC arrangements and FX conversion...	12
3. Opportunities and risks associated with cross-border use of CBDCs	13
Possible benefits of CBDCs with regards to existing frictions in payments.....	13
Existing frictions in cross-border payments	13
How CBDCs could help alleviate existing frictions	13
International macro-financial implications of cross-border CBDC use	15
Potential increase in cross-border flows.....	15
Potential financial stability risks and currency substitution	16
Reserve currency configurations and backstops.....	17
Early central bank thinking on risks associated with cross-border use of CBDCs	18
4. Conclusion and considerations for further work.....	19
Glossary.....	20
References.....	23
Annex 1: Projects for cross-border CBDC arrangements	25
Annex 2: List of building blocks for enhancing cross-border payments.....	29
Annex 3: Building block 19 - factoring an international dimension into CBDC design	31
Actions and milestones.....	31
Action 1: Stocktaking and analysis of different CBDC designs.....	31
Action 2: Development of options for access and/or interlinking	31
Action 3: Design study and dissemination	31
Annex 4: Composition of the Future of Payments Working Group (FoP).....	32

Executive Summary

The G20 has made enhancing cross-border payments a priority and endorsed a comprehensive programme to address the key challenges.¹ Faster, cheaper, more transparent and more inclusive cross-border payment services would deliver widespread benefits for citizens and economies worldwide, supporting economic growth, international trade, global development and financial inclusion. To that end, this report takes stock of the international dimension of central bank digital currency (CBDC, see glossary) projects and the extent to which they could be used for cross-border payments. The report also investigates possible macro-financial implications associated with the cross-border use of CBDCs. The analysis does not imply that central banks mentioned in this report have reached a decision about issuance of a CBDC.

To date, no major jurisdiction has launched a CBDC and many design and policy decisions are still unresolved. Also, most CBDC investigations by central banks focus on domestic issues and use cases. Given this early state of play, the considerations in this report are exploratory and examine cross-border implications of CBDCs in a situation in which CBDCs are widely used. In practice, domestic issuance of CBDC will be subject to considerable further economic and practical examination before exploration of cross-border use will gather pace. Furthermore, enhancements in other areas of the cross-border payments programme, such as aligning regulatory, supervisory and oversight frameworks for cross-border payments, Anti-Money Laundering/Combating the Financing of Terrorism (AML/CFT) consistency, Payment versus Payment (PvP) adoption and payment system access² will be critical for cross-border CBDC use.

Against this background, the report identifies a number of questions that would need to be taken into account in order for CBDCs to support the enhancement of cross-border payments. The report approaches these questions from two angles: first, from the practical perspective of how a cross-border payment infrastructure with CBDCs could be set up; and second, from a macro-financial perspective, examining the potential increase in cross-border flows, possible financial stability risks and currency substitution, and reserve currency configurations and backstops. Cross-border payments with CBDCs can be envisioned in two fundamentally different ways. The first scenario assumes availability of a retail³ CBDC of a given jurisdiction to anybody inside and outside of that jurisdiction, with limited to no coordination between the issuing central banks. In this case, if the design allows for anonymous payments like cash, it would by default be accessible to foreign residents. In practice, however, relatively few central banks are considering fully anonymous systems. In contrast to cash, various restrictions on cross-border use could be imposed via the technological and regulatory design of the CBDC. This first scenario is conditioned by the domestic design of a CBDC.

The second scenario assumes some degree of interoperability between CBDCs based on access and settlement arrangements to facilitate the cross-border use of CBDCs from two or more jurisdictions. Such arrangements can connect both wholesale and retail CBDCs across borders, imply strong cooperation among central banks, and include technological, market structure and legal aspects. This second scenario – which is the main focus of the report – relies on design choices of the interoperability infrastructure. Both scenarios are discussed in the report and illustrated with examples of ongoing projects.

Introducing a CBDC could have a range of macro-financial implications. Ultimately, those implications will depend on several factors, such as the level and nature of international adoption, and on

¹ See FSB (2020a, b, c), CPMI (2020a, b). See also Annex 2.

² These topics are addressed in building blocks 4, 5, 9 and 10, respectively. See also CPMI Stage 2 report to the G20 – technical background report, July 2020.

³ A retail (or general-purpose) CBDC could be used by individuals to pay businesses, shops or each other, while a wholesale CBDC would be designed for restricted access by financial institutions to settle trades in financial markets, similar to today's central bank reserve and settlement accounts.

the degree of collaboration among issuing and recipient countries. International use of CBDCs could potentially increase cross-border flows, but specific design choices of CBDCs could limit such use. The implications would differ for wholesale versus retail CBDCs. Hence, multilateral collaboration to agree on design principles will be key to addressing concerns of central banks regarding currency substitution risk, capital flow volatility, and contagion risk. These macro-financial implications of cross-border currency use are not exclusive for CBDCs, but also exist for privately issued forms of money. However, CBDCs could allow jurisdictions greater room of manoeuvre to mitigate potentially adverse macro-financial implications.

CBDCs have the potential to enhance the efficiency of cross-border payments, as long as their design follows the “Hippocratic Oath for CBDC design” and its premise to “do no harm”, as highlighted by the Group of central banks (2020). The coordination of national CBDC designs could lead to more efficient cross-currency and cross-border payments. Cross-border CBDCs could offer the opportunity to start with a “clean slate”, and address the frictions inherent in current cross-border payment systems and arrangements from the outset. The enhancements could be made by offering secure settlement (see glossary), reducing costly and lengthy intermediation chains throughout the payment process, and eliminating operating hour mismatches by being accessible 24/7.

It is necessary to continue deepening the analysis on CBDC designs, especially regarding options for access and interlinking of CBDCs, including interoperability with non-CBDC payment infrastructures and arrangements. Further actions in this workstream will continue to investigate these questions, both from a practical and theoretical perspective and by leveraging analytical synergies from other building blocks of the cross-border programme, such as the investigation into global stablecoin arrangements and the feasibility of new multilateral platforms for cross-border payments.

Introduction

Cross-border payments are commonly criticised for their high cost, low speed, limited access (see glossary) and insufficient transparency. With a view to addressing these challenges, the G20 in October 2020 endorsed a roadmap to enhance cross-border payments. The roadmap was developed by the Financial Stability Board (FSB), in coordination with the Committee on Payments and Market Infrastructures (CPMI) and other relevant international organisations and standard-setting bodies.

The frictions contributing to these challenges include fragmented and truncated data formats (see glossary), complex processing of compliance checks, limited operating hours, legacy technology platforms, long transaction chains, funding costs and weak competition. A CPMI report (CPMI (2020a, b)) describes the necessary elements of a response, in the form of a set of 19 building blocks (see Annex 2). Following the roadmap’s endorsement, the work has moved to advancing and implementing the building blocks outlined in the CPMI report.

Many of the roadmap’s building blocks seek to improve the existing payments ecosystem. As part of the more forward-looking work of the roadmap, one building block (19) considers how to factor an international dimension into CBDC design.

This report constitutes a response to action 1 of the roadmap for building block 19, which invited (i) the CPMI in collaboration with BIS Innovation Hub, International Monetary Fund (IMF) and World Bank⁴ to conduct a stock-take of provisional domestic CBDC designs and central bank experimentation and the

⁴ In line with the World Bank’s focus on cross-border payments and remittances as part of the IMF-World Bank Bali Fintech Agenda.

extent they could be used for cross-border payments (see Section 2)⁵, and (ii) the IMF in cooperation with other relevant stakeholders, to analyse international macro-financial implications of cross-border CBDC use (see Section 3).

It should be noted that, to date, there are just two live retail CBDCs (the Sand Dollar in The Bahamas and DCash in the Eastern Caribbean⁶), as well as several advanced projects. Indeed, most central banks have not taken firm design and policy decisions related to the potential issuance of a CBDC in their jurisdiction. This report should not be interpreted as an indication that central banks have decided to issue CBDCs.

The considerations in this report take as a given the establishment of CBDCs in more jurisdictions, and endeavour to anticipate the questions that would need to be addressed in order for CBDCs to support the enhancement of cross-border payments.

Considerations regarding security and resilience, identity management of CBDC users, governance, legal basis, regulatory standards (including AML/CFT), and interoperability with existing payment systems become more complex with the involvement of several jurisdictions. These questions, the political feasibility of each model, and the efficiency gains compared with improvements in existing payment infrastructures and arrangements go beyond the scope of this stock-take. However, they will be central to the future work of the cross-border programme.⁷

Many of the questions implied by the domestic access to and use of CBDCs are also applicable in potential cross-currency and cross-border CBDC use. Cross-border payments are those where the payer and payee reside in different jurisdictions. Many, but not all, of these are also cross-currency payments – that is, payments where the payer and payee are respectively debited and credited in different currencies. Payments within monetary unions or payments in a common invoice currency may be cross-border but not cross-currency (Bech, Faruqi and Shirakami (2020)).

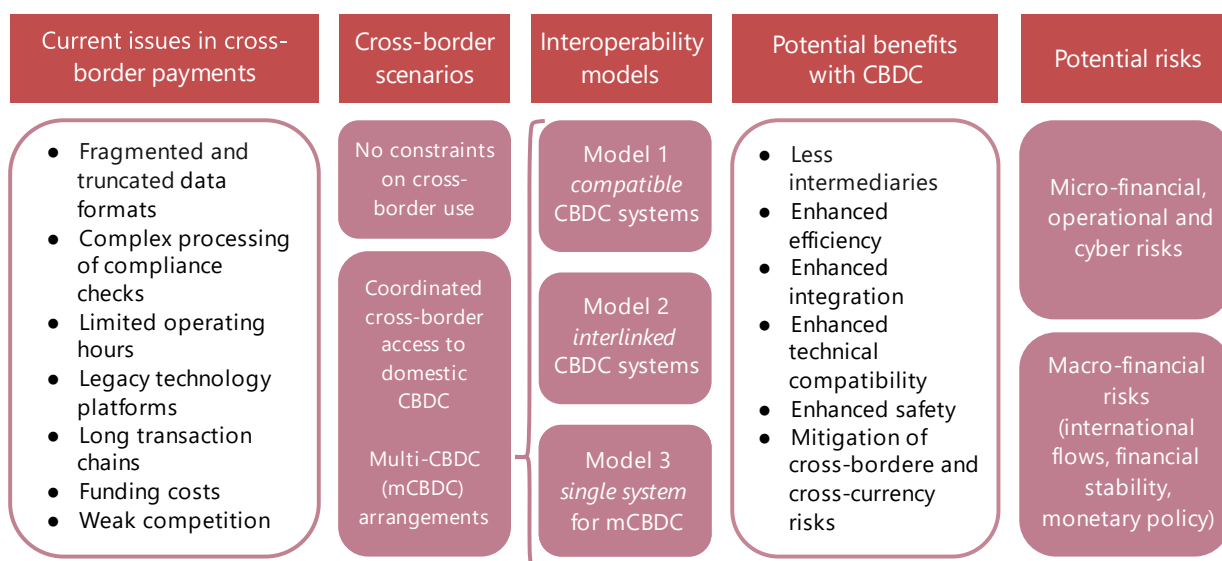
One key difference between CBDCs and the efforts of improving the existing payments infrastructure is the opportunity to start with a “clean slate”. This is an advantage in itself: if central banks take the international dimension into account while investigating their potential domestic CBDCs and commit to interoperability (see glossary), consistent standards and coordination of CBDC designs, many problems inherent in today’s legacy technologies and processes could be avoided. Conversely, if CBDCs are not designed with the international dimension in mind, fragmentation of CBDC systems similar to the existing fragmentation of payment systems is possible. Hence, in order to benefit from the potential of a clean slate, it is essential that central banks take interoperability issues into account when designing their domestic CBDC. Central banks are considering both retail and wholesale CBDC arrangements. Motivations for each differ as do their objectives.⁸ Current cross-border frictions, CBDC scenarios, potential benefits and risks are summarised in Graph 1.

⁵ To deliver on these innovation-related objectives, the CPMI established a working group including representatives from these institutions as well as central banks (“Future of Payments Working Group”; see Annex 4).

⁶ The DCash is being issued as part of a pilot arrangement. Participation in the pilot is voluntary and all participants are guided by specific terms and conditions which are agreed to prior to being enrolled to use DCash.

⁷ For instance, building blocks 4-8 aim for international coordination of regulatory, supervisory and oversight frameworks. Further work in the CBDC building block (19) will analyse different CBDC designs, access and interlinkage options (including interoperability with non-CBDC payment arrangements).

⁸ The potential merits of wholesale CBDCs for cross-border payments – as a settlement asset (see glossary) possibly based on novel technologies – are clear and go beyond the clean-slate argument. To enhance cross-border payment, wholesale CBDC would enable expanding the set of parties who have direct access to digital central bank money, and would likely be accessible 24/7, thus eliminating operating hour mismatches. In addition, they could serve as a secure settlement asset for payment versus payment (PvP, see glossary) systems or PvP could be built into CBDC designs, thus mitigating credit and liquidity risk of cross-currency payments.



Source: CPMI; BIS Innovation Hub; IMF; World Bank.

The remainder of this report is structured as follows: Section 1 presents some elementary considerations on CBDC designs in the cross-border context; Section 2 takes stock of potential CBDC designs in cross-border payments; and Section 3 reviews opportunities and risks related to cross-border use of CBDC. The report finishes with conclusions and considerations for further work.

1. Domestic CBDC designs and cross-border considerations: a primer

Improving cross-border payments efficiency is an important motivation for CBDC work

Most CBDC projects are focused on domestic needs. But improving cross-border payments efficiency is also an important motivation for CBDC work.

Cross-border payments, including remittances, are an important factor for economic development in a globalised economy. Today, on the retail side, most remittances are sent abroad through money transfer operators leveraging their own global network. International remittances raise a number of well-known issues, some of which could be tackled by appropriate CBDC solutions: first, fees are generally high; second, in some contexts remitters might not have a guarantee that funds reach the expected recipient in full; and third, international remittances suffer from the absence of interoperability between domestic payment systems. Money transfer operators and white-label platforms try to bridge this gap between domestic payment systems.

On the wholesale side, these inefficiencies due to a lack of payment system interoperability are patched by the correspondent banking network (see glossary), which can be costly and slow in the case

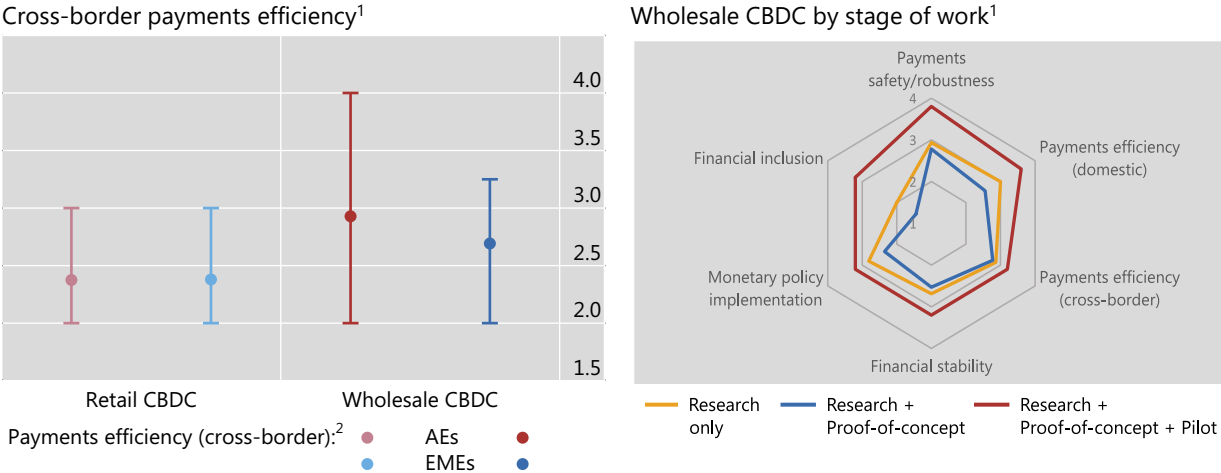
of long correspondent banking chains.⁹ Many obstacles to cross-border payments are rooted in differences among domestic legislations.¹⁰ Namely, differences in the implementation of AML/CFT standards, rules on settlement finality (see glossary), participation criteria for payment systems with central bank money settlement (see glossary), rules on the conflict of laws, and others.

In this context, CBDCs are seen by many central banks as an opportunity to simplify and enhance the performance of cross-border payments and make their ultimate settlement available 24/7 even outside closed-loop solutions (see glossary) or those money transfer operators which control the payment end-to-end.

The issuance and use of a CBDC for cross-border payments could potentially help simplify intermediation chains, increase speed and lower costs. And indeed, cross-border payments efficiency is an important motivation for CBDC issuance, according to a survey among central banks in late 2020, especially with regards to wholesale CBDC projects (Graph 2, left-hand panel). The importance of this motive also increases for central banks in advanced stages of CBDC work (Graph 2, right-hand panel). That said, most CBDC-development efforts are focused on domestic use.¹¹

Motivations for CBDC issuance

Average importance Graph 2



1=Not so important; 2=Somewhat important; 3=Important; 4=Very important.
¹ Importance of enhancing cross-border payments efficiency as a motive for CBDC issuance in a survey of 66 central banks. The distribution ranges from 1 (not so important) to 4 (very important). ² AE: Advanced economies; EMDE: Emerging market and developing economies. The dots indicate the average. The range indicates the interquartile range.

Source: C Boar and A Wehri, "Ready, steady, go? Results of the third BIS survey on central bank digital currency", *BIS Papers*, no 114, January 2021.

2. Stocktaking potential CBDC designs in cross-border payments

Cross-border payments with CBDCs can be envisioned in two fundamentally different ways:

⁹ The length of correspondent banking transaction chains can range from just over one intermediary on average for cross-border payments on SWIFT (Bouter et al (forthcoming)) to five or more intermediary banks for 20% of euro-denominated cross-border payments (ECB (2020a)).
¹⁰ See FSB (2020a) and CPMI (2020a).
¹¹ For example, an April 2021 stock-take of central bank research and design efforts finds that out of 47 current retail CBDC projects, only 11 are building in a cross-border dimension (see April 2021 update of Auer et al (2020)).

- A retail CBDC of a given jurisdiction becomes available to anybody inside and outside of that jurisdiction, with no specific coordination between the issuing central banks.
- Access and settlement arrangements are established among different retail and/or wholesale CBDCs, built on strong cooperation among central banks.

In the first scenario of international use, the CBDC, being digital, could be designed so that it faces no constraints on where and by whom it is used. If the design allows for anonymous payments like cash, it would by default be accessible to foreign residents. In practice, however, relatively few central banks are considering fully anonymous systems (Auer, Cornelli and Frost (2020)). Alternatively, and in contrast to cash, a CBDC could be designed so as to be subject to certain restrictions on cross-border use imposed by the issuing central bank.

In the second scenario, coordination and cooperation among central banks would favour less disruptive approaches. This could happen either by allowing foreigners from partnering jurisdictions to access the domestic CBDC solution or by means of multi-CBDC (mCBDC) arrangements.¹² These are coordinated design frameworks including technological, market structure and legal aspects, aiming to facilitate cross-border interoperability of multiple CBDCs from different jurisdictions.

In the case of granting participation in the domestic system, the same CBDC is used by the payer and payee independent of their residence and location. CBDCs could then be used by either commercial entities or individuals to hold and pay using CBDCs from various jurisdictions and in different currencies, potentially via “wallets” (see glossary) with CBDCs from different jurisdictions. In the case of an mCBDC arrangement, a currency conversion takes place: the payer could make a payment in one CBDC and the payee receives it in a different CBDC. Currency conversion could take place by exchanging one retail CBDC against another retail CBDC. Alternatively, wholesale CBDCs could be used as safe settlement assets in PVP mechanisms – both for the settlement of cross-currency retail CBDC transactions, and also for the foreign exchange (FX) settlement of cross-currency transactions either in commercial bank money or in central bank money. Below, the report briefly discusses how different CBDC arrangements could facilitate FX mechanisms, but more work in this area is warranted.

Current central bank thinking on cross-border CBDC use

A recent survey of 50 central banks in the first quarter of 2021 explored initial thinking on CBDCs’ cross-border use.¹³ The survey includes responses from 18 advanced economies (AEs) and 32 emerging market and developing economies (EMDEs) to questions on the potential role of a CBDC in cross-border payments, the use of a retail CBDC in currency areas other than the issuing country, interoperability features and specific cross-border risks. The survey results suggest that most central banks have not yet taken a firm position on either issue, as evidenced by the high share of “undecided” responses (Graph 3).

Among central banks that have expressed a view, there is a positive inclination for use by non-residents within the issuing jurisdiction, and somewhat more reluctance to allow use abroad. Specifically, more than 25% of central banks are considering allowing retail CBDC use by non-residents,¹⁴ and nearly 20% say that they are not yet considering this, but may do so in the future (Graph 3, left-hand panel). On the other hand, only 8% of responding central banks are initially considering allowing the use of a domestically issued retail CBDC in other jurisdictions; about a third may do so in the future (centre

¹² See BIS (2021) and Auer, R, P Haene and H Holden (2021).

¹³ See R Auer, C Boar, G Cornelli, J Frost, H Holden and A Wehrli (2021). The questionnaire was sent to 61 central banks during the first quarter of 2021. Of these, 11 central banks either did not respond or indicated that they are not able to provide answers at this time.

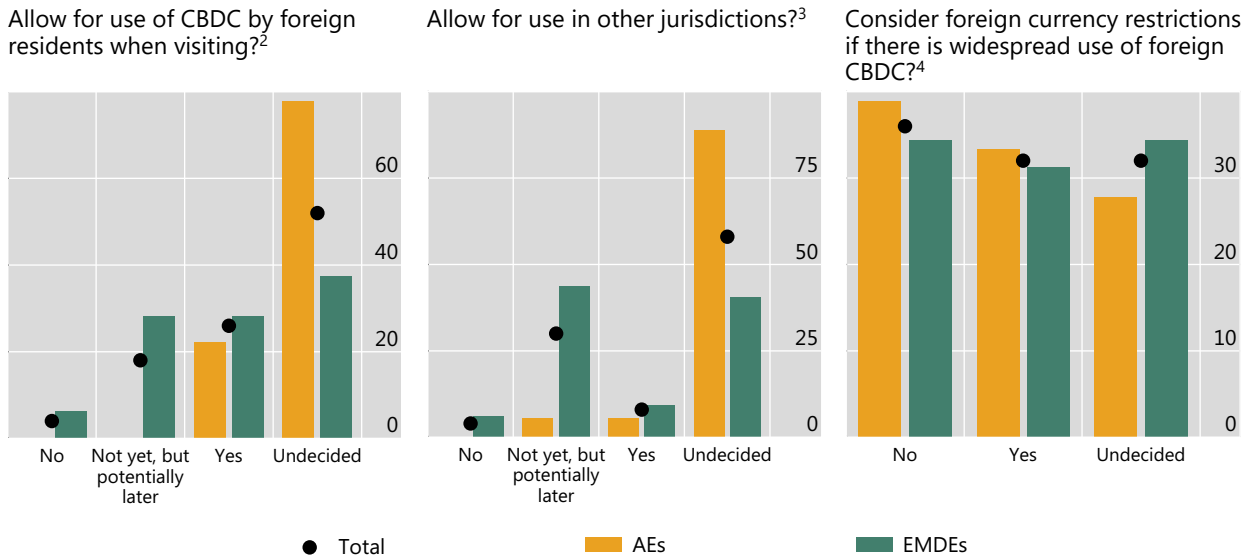
¹⁴ For example, tourists could apply for the lowest-tier digital wallets, which has balance and transaction limits.

panel).¹⁵ Notably, at least a third of responding central banks may reconsider their cross-border restrictions if there were widespread use of a foreign CBDC in their jurisdiction with a balanced picture between AEs and EMDEs (Graph 3, right-hand panel).

Central bank responses on use by non-residents, use abroad and foreign currency restrictions¹

As a percentage of respondents

Graph 3



¹ The sample includes 18 AEs and 32 EMDEs. ² The survey question reads “Do you envisage the design of a CBDC allowing foreign residents to use the CBDC inside your jurisdiction (eg tourists)?”. ³ The survey question reads “Should your jurisdiction decide to issue a retail CBDC, do you envisage allowing use of the CBDC beyond the borders of your jurisdiction in some form?”. ⁴ The survey question reads “Would widespread use of a foreign CBDC, stablecoin or cryptocurrency lead to a reconsideration? Relatedly, is this potential route for “digital dollarisation” a bigger concern in the future than it is today?”.

Source: R Auer, C Boar, G Cornelli, J Frost, H Holden and A Wehrli, “CBDCs beyond borders: results from a survey of central banks”, *BIS Papers*, no 116, June 2021.

If the technology permits tying the use of CBDCs to location, one option is to allow the use of CBDC by non-residents as long as the non-residents are physically located within the issuing jurisdiction, such as tourists or business travellers. This approach is being considered, inter alia, by the People’s Bank of China (PBC) electronic Chinese Yuan (e-CNY) project (Auer, Cornelli and Frost (2020)).

Effective identification of users is crucial to every payment system. It guarantees the system’s safety and integrity, by preventing fraud and bolstering efforts to counter money laundering and other illicit activities. Sound identification is further required to ensure equal access for all users (BIS (2021)). Identification at some level is hence central in the design of CBDCs. This could be addressed by tying the CBDC design to a digital identity, and including safeguards on data privacy.¹⁶ If the CBDC design foresees some form of identification of users, use by non-residents becomes a policy choice. For example, the issuing central bank can decide to grant access to CBDC-based wallets to residents only. Alternatively, it can set conditions under which non-residents can access it. Central banks participating in related CBDC arrangements may cooperate on know-your-customer (KYC) processes, AML/CFT monitoring and, relatedly, agree on the level of privacy granted to users when making/receiving cross-currency payments.

¹⁵ Survey responses reveal that several risks, such as currency substitution, and excessively volatile capital flows need to be evaluated before taking a decision on this issue.

¹⁶ See BIS (2021) for a more thorough discussion on identification and data privacy in CBDC design.

Cross-border aspects of advanced retail CBDC projects

The possibilities for cross-border use of retail CBDC are exemplified by the approaches in the advanced CBDC project in China, as well as the two live CBDCs in The Bahamas and the currency area of the Eastern Caribbean Central Bank (ECCB).

The PBC has been working on a digital yuan within the Digital Currency/Electronic Payment (DC/EP) project since 2014, currently called e-CNY, and the project is in a pilot phase. Internationally, the e-CNY would be connected to existing retail and wholesale payment systems. The primary aim for e-CNY is domestic retail use, while foreign tourists and business travellers could register for use of an entry-level e-CNY wallet with a foreign cell phone number during their stay in mainland China. Nonetheless, if an understanding can be reached with foreign jurisdictions to avoid spillover effects, interoperability could be enabled between e-CNY and other retail systems and the conversion of e-CNY and other fiat currencies would be processed at virtual borders between digital wallets. The PBC aims to work with the private sector to ensure ongoing compliance with relevant AML/CFT rules. Looking further into the future, the e-CNY could potentially be used for Renminbi-invoiced trade with foreign parties, but this is still subject to consultation with other central banks and entities. The Hong Kong Monetary Authority (HKMA) has confirmed that they are working with the Digital Currency Institute of the PBC on the technical preparations for making cross-border payments using the e-CNY (Yue (2020)).

The Central Bank of The Bahamas (CBoB) launched its “Sand Dollar” for residents on 20 October 2020. A key aim of the Bahamian CBDC project is to deepen financial inclusion. The CBoB has explicitly stated, at least thus far, that the Sand Dollar is only for domestic use and that non-domestic payees are excluded. Non-residents can transact and hold Sand Dollars when visiting The Bahamas by registering for the Tier 1 Sand Dollar wallet, with a holding limit of 500 Sand Dollars and a transaction limit of 1,500 Sand Dollars per month. The CBoB allows holders of a Sand Dollar account to integrate with traditional bank accounts, which can then be used to make cross-border payments using traditional channels. The CBoB further stated that commercial banks remain the only authorised actors for making payments in and out of Bahamian dollars, and the Sand Dollar will hence not affect the capital account restrictions that are currently employed by The Bahamas.

The ECCB launched its retail CBDC DCash as a large-scale, year-long pilot in March 2021. DCash allows purchases of goods and services across countries of the Eastern Caribbean Currency Union (ECCU), making it a cross-border CBDC from the outset. At this stage, the ECCB is focused on adoption of DCash among the members of the ECCU, with financial inclusion being the top policy goal. The ECCB sees cross-border aspects of their CBDC as a key consideration, given the importance of trade and international remittances for the countries in the ECCU. The ECCB has thus been in initial discussions with other regional central banks regarding the interoperability with other payment systems and platforms to enable remittances and trade in the region. The medium-term plan is to focus on cross-border integration within the ECCU before expanding beyond that.¹⁷

Enabling retail or wholesale interoperability of CBDC arrangements

Alongside the possibility of granting some form of international access to a jurisdiction’s CBDC for retail usage, a second scenario for the international use of CBDCs are arrangements for establishing interoperability between national CBDCs (CPMI (2020b), Carstens (2021) and Auer, Haene and Holden (2021)).

¹⁷ The ECCB has designed DCash to facilitate interoperability with other payments systems. Depending on what technology other central banks rely on, only minor adjustments will be needed to enable interoperability.

On the wholesale level, CBDC arrangements could closely mirror current efforts to make traditional payment systems interoperable.¹⁸ The arrangements could bridge the payment legs occurring in two jurisdictions. On the retail level, solutions that connect end user payments across borders could be envisioned. The arrangement would then allow payments in retail CBDCs between jurisdictions.¹⁹ These two scenarios of supplying cross-border CBDCs are not mutually exclusive and their interplay can influence the economic and monetary implications of CBDC issuance.

CBDC arrangements present means to mitigate cross-border and cross-currency risks and frictions (see section “Possible benefits of CBDCs with regards to existing frictions in payments”), while reinforcing the role of central bank money as an anchor for the payment system and as primordial settlement asset. As argued by Carstens (2021), mCBDC arrangements could be preferable to alternative proposals that involve the creation of private sector global stablecoins (see glossary, eg Diem proposed by the Libra Association (2019, 2020)). Rather than creating a new unit of account that competes with domestic currencies, mCBDC arrangements focus squarely on designing national CBDCs with access frameworks and interoperability options to facilitate efficient payments across borders and currencies.

Different levels of payment system interoperability can be used to group potential mCBDC arrangements into three stylised models: compatible CBDC systems (model 1); interlinked CBDC systems (model 2); and a single system for mCBDC (model 3) (Graph 4). These three models are intended as conceptual illustrations, rather than a normative framework.

Model 1 considers the interoperability of separate CBDC systems through adherence to common international standards and resembles traditional cross-border payment arrangements. Common technical standards, such as message formats, cryptographic techniques, data requirements and user interfaces can reduce the operational burden on financial institutions for participating in multiple systems. Aligned legal, regulatory and supervisory standards can simplify KYC and transaction monitoring processes. This applies to CBDC as much as to any other payment method. However, without coordinated policy action, achieving a sufficient degree of compatibility between national CBDC systems takes time.

Model 2 incorporates additional interlinkages, through either a shared technical interface or a common clearing mechanism (see glossary). A shared technical interface, supported by contractual agreements between the systems, allows participants – either retail or wholesale – in one system to make payments to those in another. A common clearing mechanism takes a different approach by linking systems through designated settlement accounts (see glossary). Although a wide choice of interlinking options exists, none are likely to be easy to implement. History shows that many projects do not deliver their anticipated benefits or even fail to reach an operational stage despite significant investments (World Bank (2014)).²⁰

Model 3 implies cooperation of a higher magnitude among central banks. It considers an arrangement where there exists a single mCBDC system across jurisdictions. The concept builds on having a single set of rules, a single technical system, and a single set of participants. This deeper integration allows for potentially more operational functionality and efficiency, but increases the governance and control hurdles (eg wider access might allow more efficient settlement but increases other risks) as well as policy issues. Creating a single mCBDC system would apply the concept of creating new multilateral

¹⁸ In the context of the G20 cross-border payments roadmap (CPMI (2020a, b), FSB (2020c)), these aspects are addressed on both the retail and wholesale level in building blocks 13 (“Pursuing interlinking of payment systems for cross border payments”) and 17 (“Considering the feasibility of new multilateral platforms and arrangements for cross-border payments”).

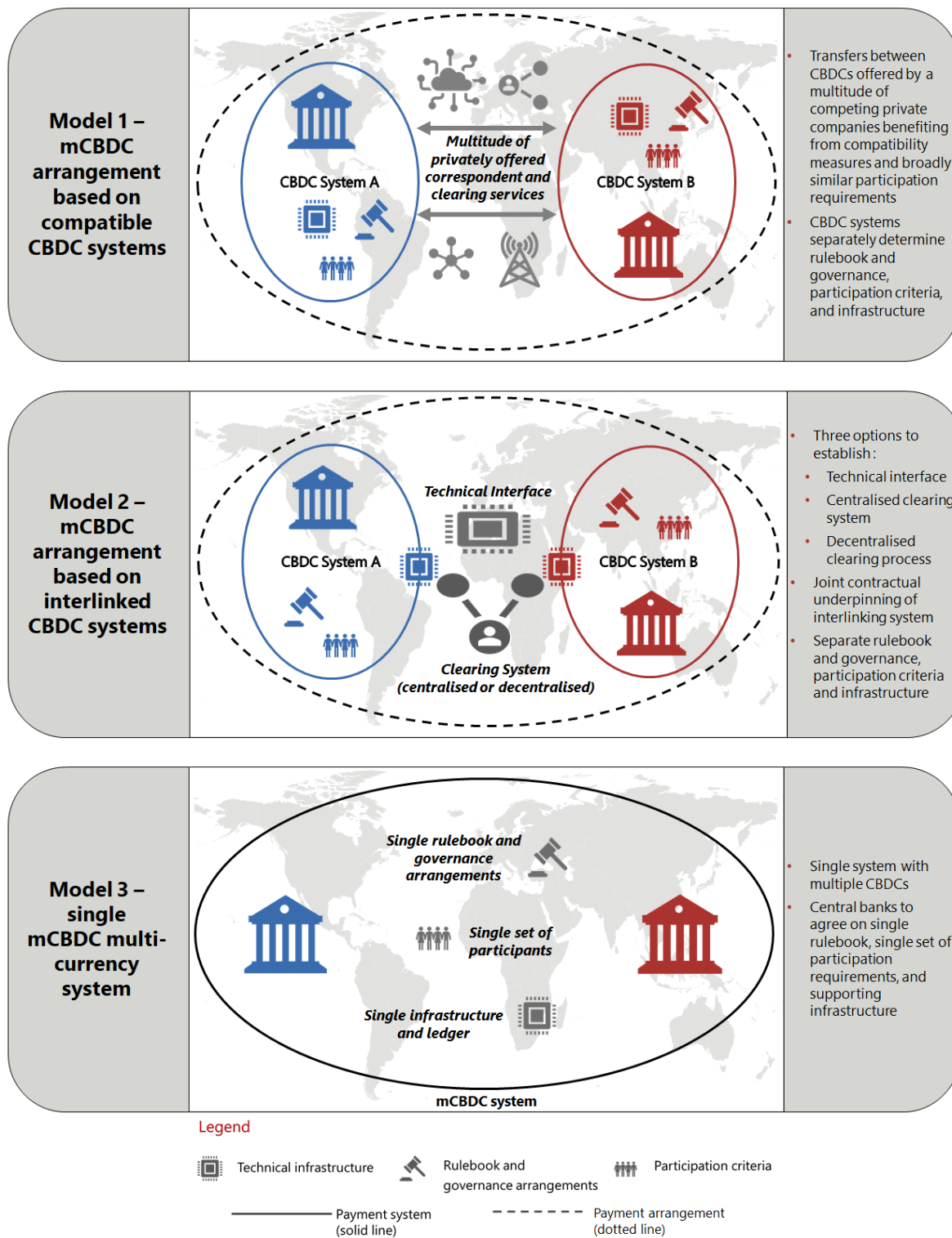
¹⁹ In the retail context, the identification process is a key aspect. It is not obvious that the digital certificates required to be identified on the retail wallet could be issued by foreign jurisdictions. Standardisation in digital identification would be needed in order to shape cross-border access both for foreigners as for transactions between different jurisdictions.

²⁰ The main barriers identified by the World Bank (2014) report are legal and regulatory incompatibilities, and differences in financial market organisation, practices and technical standards. Annex 1 of the report describes in detail several cross-border integration initiatives.

payment platforms – which is examined in building block 17 of the cross-border payments programme – to CBDCs.

Interoperability can be enabled via “multi-CBDC arrangements”

Graph 4



Source: R Auer, P Haene and H Holden, “Multi-CBDC arrangements and the future of cross-border payments”, *BIS Papers*, no 115, March 2021.

CBDC arrangements in practice: current projects with cross-border focus

Some central banks are already collaborating on projects and studies on the use of CBDC to facilitate cross-border payments and have launched experimentation programmes to explore CBDC arrangements.²¹

Most of the current projects focus on the interlinking of wholesale CBDCs. While this reflects the domestic focus of current retail CBDC projects, interlinking can also be implemented on a retail level. In such a scenario, CBDCs held by the general public would be transacted across borders allowing wider participant access.

The three stylised models for different levels of payment system interoperability introduced above can be associated with current CBDC projects, as follows. The projects mentioned are showcased in more detail in Annex 1.

Model 1 of enhancing compatibility among domestic CBDC systems is taken into account by many CPMI-member central banks. Ongoing efforts to coordinate regulatory, supervisory and oversight frameworks, as well as fostering common data and market practices to enhance cross-border payments are important to enable such CBDC arrangements, as their realisation relies on the adherence to common international standards. In this sense, central banks supporting the overall cross-border agenda are often implicitly endorsing this model's type of compatibility. More explicitly, a recent joint report of a group of central banks²² has underlined the importance of common data standards and compatibility and expressed their commitment to coordinate as they move forward with their CBDC work.

Model 2 of interlinking CBDC systems was the focus of the Jasper-Ubin project in 2019, a collaboration of the Monetary Authority of Singapore (MAS), Bank of Canada (BOC), and the financial industry. As part of the project, the domestic experimental wholesale CBDC networks of MAS and BOC were linked up by synchronising payment actions without the need for a trusted third party or a common platform. It was successfully demonstrated how wholesale CBDC could eliminate settlement risk under the realistic assumption that the CBDC systems in each country are using different technical DLT-platforms.²³ Subsequently, MAS expanded on this work to explore how multiple digital currencies could be issued and transacted on a single common platform (ie Model 3). Meanwhile, the Bank of France, Swiss National Bank, BIS Innovation Hub, and a private sector consortium collaborate to explore the potential benefits and challenges of wholesale CBDC for settling cross-border transactions. Known as Project Jura, the experiment will involve the exchange of a euro wholesale CBDC against a Swiss franc wholesale CBDC through a PvP settlement mechanism on a DLT-platform. These transactions will be settled between banks domiciled in France and in Switzerland, respectively.

Model 3 of establishing a single mCBDC system is the focus of several projects, eg Project Inthanon-LionRock,²⁴ Project Aber,²⁵ and the mCBDC Bridge and Dunbar initiatives coordinated by the BIS Innovation Hub and with the participation of several central banks.²⁶ In the Inthanon-LionRock

²¹ See ECB and Bank of Japan (2019), CBUAE and SAMA (2020), Bank of Canada, Bank of England and Monetary Authority of Singapore (2018) and Bank of Thailand and Hong Kong Monetary Authority (2020).

²² Group of central banks (2020). The report was compiled by the Bank of Canada, the Bank of England, the Bank of Japan, the European Central Bank, the Federal Reserve, Sveriges Riksbank, the Swiss National Bank and the BIS. See Group of central banks (2020).

²³ Corda in Canada and Quorum in Singapore.

²⁴ A joint initiative by the Bank of Thailand (BOT) and the Hong Kong Monetary Authority (HKMA).

²⁵ Led by the Saudi Central Bank (SAMA) and the Central Bank of the United Arab Emirates. (CBUAE). See SAMA and CBUAE (2019, 2020).

²⁶ mCBDC Bridge: Hong Kong Monetary Authority, Bank of Thailand, Digital Currency Institute of the People's Bank of China and Central Bank of the United Arab Emirates. Dunbar: Monetary Authority of Singapore and other central banks, financial institutions and technology partners.

operating model, cross-border payments are processed through a jointly operated “corridor network” which links up two separate domestic wholesale CBDC networks. On either side of this corridor, each central bank issues its own wholesale CBDC on its domestic settlement network, which is separated from cross-border transactions. The operating model of the mCBDC Bridge builds on the Inthanon-LionRock concept and explores the creation of an international settlement platform on which central banks can utilise CBDC for the execution of wholesale transactions. Dunbar, the project building on the experience of Project Ubin, will explore different governance and connectivity models for cross-border transactions using mCBDCs that could form the basis of a future international settlement network. Both mCBDC Bridge and Dunbar involve different technologies and different stakeholders and, in doing so, are expected to shed light on a wide variety of governance, implementation, and policy issues related to cross-border aspects.

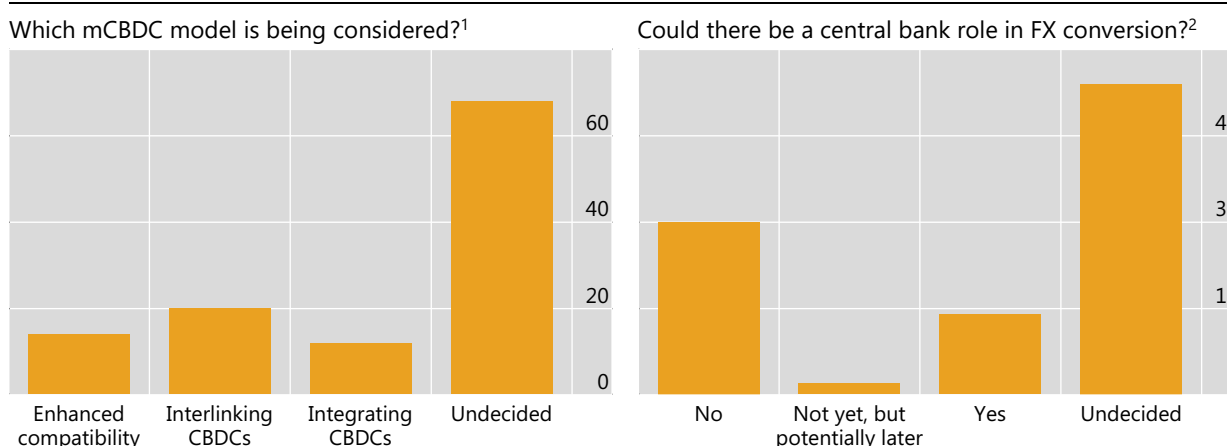
Central bank considerations regarding interoperability, mCBDC arrangements and FX conversion

Beyond these ongoing projects, responses to the survey highlight that about a quarter of central banks consider incorporating interoperable features to reduce frictions in cross-border and cross-currency settlement in designing their CBDC. Of those central banks, over half are undecided on the model (Graph 5, left-hand panel). Those undecided central banks report that they are still in stages of conceptual deliberation and will analyse the broad range of public policy issues relevant to CBDCs before pursuing a concrete plan. The remaining central banks are examining all three stylised models. The answers suggest that the most preferred choice is model 2 (an interlinking arrangement of the domestic CBDC system with a foreign system). Some 14% of responding central banks are also considering taking on operational roles, most notably in FX conversion (Graph 5, right-hand panel).²⁷ Responses to the survey indicate that central banks could take on several roles: including providing CBDC liquidity, and facilitation and monitoring the smooth operation of FX conversion.

Central banks responses on considered mCBDC arrangements and operational role in FX conversion

As a percentage of respondents

Graph 5



¹ The survey question reads “Which features are you considering?” Responses include: mCBDC arrangement 1: Enhancing compatibility with international standards; mCBDC arrangement 2: Interlinking your CBDC system with a foreign system; mCBDC arrangement 3: Integrating your CBDC into a single mCBDC system. More than one answer possible. For further details see Auer, Haene and Holden (2021). ² The survey question reads “Would the central bank take on a novel role in the FX conversion process?”.

Source: R Auer, C Boar, G Cornelli, J Frost, H Holden and A Wehrli, “CBDCs beyond borders: results from a survey of central banks”, *BIS Papers*, no 116, June 2021.

²⁷ See the section on the Inthanon-LionRock project in Annex 1 for examples of how FX conversion could be handled.

3. Opportunities and risks associated with cross-border use of CBDCs

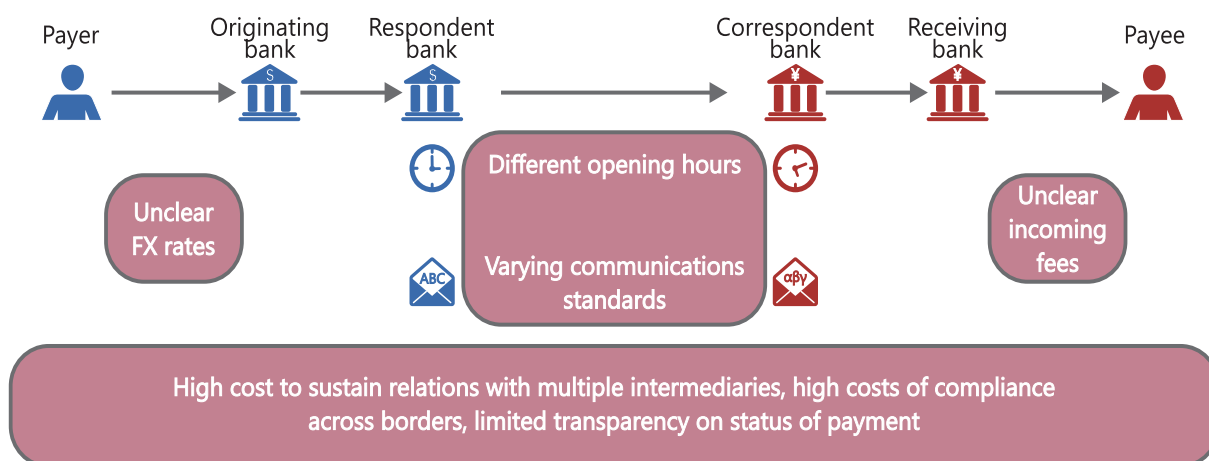
Possible benefits of CBDCs with regards to existing frictions in payments

Existing frictions in cross-border payments

Although improvements are underway, frictions along many corridors remain. Cross-border payments suffer from long transaction delays and can be particularly costly due to the involvement of a high number of intermediaries across different time zones along the correspondent banking process. In addition, cross-border payments suffer from low traceability and lack transparency, causing frictions regarding AML/CFT checks. Also, the decline of cross-border banking relationships for the past decade might leave some jurisdictions with inadequate access to the global financial system (Rice, von Peter and Boar (2020)). Finally, the traditional correspondent banking model detailed below does not offer sufficient interoperability and standardisation to smoothen cross-border transactions. These frictions result in numerous risks and operational complexities to manage (Graph 6).²⁸

Frictions in current correspondent banking arrangements

Graph 6



Source: R Auer, P Haene and H Holden, "Multi-CBDC arrangements and the future of cross-border payments", *BIS Papers*, no 115, March 2021.

How CBDCs could help alleviate existing frictions

The three stylised models for cross-border use of CBDC outlined earlier in this report do not prescribe FX mechanisms. Yet they could, in different ways, allow for improvements in the arrangements in place today. As noted, by issuing CBDCs taking into account the three models, central banks could design from the beginning interoperable cross-border CBDC systems.

Compatible CBDC systems (model 1) could provide an additional means to settle transactions from existing markets in central bank money across borders. Coupled with developing open, competitive and compatible domestic payment systems, allowing a more diverse group of banks and non-banks wholesale access to central bank money for settling payments, a broader variety of "front-end" cross-border and cross-currency payment services could be possible. This might reduce both fragmentation and concentration in payments.

Interlinked CBDC systems (model 2) could build on these potential improvements to offer additional safety. Specifically, PvP settlement could be included through a technical interface between domestic systems. New technologies could allow this to be implemented through novel means

²⁸ See also FSB (2020) and Coelho et al (2020).

(eg BOC and MAS (2019)). Common clearing mechanisms could also add efficiencies, especially when linked with FX trading venues.

Finally, a single mCBDC system (model 3) could offer the same improvements as interlinking systems but with additional integration. For example, all FX settlements would be PvP by default, rather than requiring routing or specific settlement instructions through an interface (see glossary). Trading venues could also be integrated into mCBDC systems, which could (assuming the right designs) further reduce complexity, fragmentation and concentration in currency markets (Bank of Thailand and Hong Kong Monetary Authority (2020)). Such a model has, for instance, been adopted for Project Dunbar and in Project Aber (see SAMA and CBUAE (2019, 2020)), which even goes a step further via the joint issuance of a CBDC that is used in the single mCBDC arrangement. Because both the Saudi riyal and UAE dirham are pegged to the US dollar, the issued CBDC was effectively guaranteed to have a fixed exchange rate to both local currencies for the duration of the proof of concept.

Table 1 lists the potential improvements of different CBDC arrangements to current frictions in cross-border payments.

Potential improvements of different mCBDC arrangements to frictions in correspondent bank arrangements for cross-border payments

Table 1

Potential improvements			
Frictions cross-border payments	Model 1–mCBDC arrangement based on compatible CBDC systems	Model 2–mCBDC arrangement based on interlinked CBDC systems	Model 3–single mCBDC multi-currency system
Legacy technology platforms	Compatible systems allow for efficiency gains in existing banking relations	A common clearing mechanism could reduce the number of relationships and provide economies of scale	A single system does not require such relations (however, a single system may add to operational costs)
Limited operating hours	CBDCs can be open 24/7, eliminating any mismatch of operating hours		
Fragmented and truncated data formats	Compatible message standards allow payments to flow without data loss or manual intervention	The message standard (eg ISO 20022) adopted by the interlinkage would act to harmonise standards across systems	Single message standard across the system eliminates mismatches
Unclear FX rates and unclear incoming fees	Compatibility requirements for wallet providers could enable users to calculate fees and rates prior to a payment	Common calculation of rates and fees for transfers using any interlinkage would aid transparency	A single system would likely be designed to include options for FX conversion
Long transaction chains	CBDCs could settle instantly, reducing the need for status updates		
Complex processing of compliance checks	Compatible compliance regimes reduce uncertainty and costs	Interlinking systems do not impact multiple or conflicting compliance requirements	Single set of access requirements means compliance could be equivalent across the system

Source: Adapted from R Auer, P Haene and H Holden, "Multi-CBDC arrangements and the future of cross-border payments", *BIS Papers*, no 115, March 2021.

Furthermore, CBDCs could, by design, alleviate a certain number of risks, notably counterparty risks (see glossary) as CBDCs represent a claim on the central bank and constitute, therefore, the safest settlement asset available. And such an increased offer to central bank money in a digital form could, by

facilitating liquidity flows across borders, allow for a more efficient allocation of resources on a global basis and help with financing growth in some regions.

International macro-financial implications of cross-border CBDC use

The macro-financial implications of cross-border CBDC use will ultimately depend on several factors such as the level and nature of international adoption – ranging from niche adoption to facilitate remittances in certain corridors to widespread currency substitution. In turn, adoption will depend on the design of CBDC and on the degree of collaboration among issuing and recipient countries. This level of collaboration is likely easier among national authorities than it is among private issuers of money.

This section will focus on CBDCs rather than other forms of digital payments, and discuss possible macro-financial effects of different models of cross-border use of CBDC. Ultimately, the net effects will depend on potential feedback loops with productivity, market integration and arbitrage, international trade, and labor market mobility. But this section offers an early assessment, and a more extensive and dynamic analysis that takes more factors into consideration will be necessary in the future.²⁹

All three models for cross-border CBDC use could give rise to the international macro-financial implications discussed in this section. All else equal, the more integrated are CBDCs, and the larger and more widespread are cross-border flows, the more significant the potential macro-financial implications. However, the tight integration of CBDCs and the uniformity of design (as in models 2 and 3) could facilitate risk-mitigating measures, such as limitations on foreign CBDC holdings and transfers.

Potential increase in cross-border flows

The integration of capital markets has supported cross-border flows, risk-sharing, and growth for at least half a century. However, it has also allowed for contagion effects, and sudden capital flow reversals that have undermined economic and financial stability. Financial regulations and, in some cases, capital flow management measures have therefore been devised to balance benefits with risks.

Similarly, CBDCs' availability across borders and across currencies also comes with benefits and risks. Cheaper and more accessible remittances will benefit senders and recipients, help to buffer economic shocks, and stimulate growth. Markets should also become more integrated thus offering investment and risk-sharing opportunities. This would facilitate hedging, though it could increase contagion risks. Importantly, large gross foreign asset positions imply higher leverage and greater valuation effects, with knock-on effects on current account balances and potential balance of payments problems (Obstfeld (2004, 2012)). In addition, capital flow volatility could increase as herd effects from less-informed investors materialise. However, the pattern of net capital flows is more difficult to predict, and would need further analysis, especially since it relates to countries' savings and investment behaviour.

Relatedly, existing capital flow management measures could potentially be circumvented by new digital forms of payments, including CBDCs, if this has not been precluded through design or regulation. New payment instruments and service providers may render existing mechanisms of transaction verification ineffective. Existing regulations and implementation practices will need to evolve so capital flow management measures remain robust in the digital age. However, careful design of CBDCs and new technologies could help.

For instance, CBDCs could be designed by issuing central banks to preclude or limit their use outside the issuing country, or wallets in recipient countries could be designed to allow local authorities to implement certain capital flow management measures. In addition, the programmability of CBDCs

²⁹ The macro-financial effects of CBDC associated with its domestic usage, including a potentially negative impact on financial stability resulting from banks' disintermediation and their funding cost increase, among others, are not discussed in this section and are assumed to be mitigated through appropriate design (see Group of central banks (2020)). When subject to cross-border use, CBDCs may reintroduce such risks in the foreign jurisdiction(s) and pose implications for the domestic context as well.

(see glossary) could potentially be used to limit their circulation. Finally, these solutions could make the implementation of capital flow management measures more effective than today, certainly compared to the use of cash.

With higher gross capital flows and potentially less effective capital flow management measures if they can be circumvented, countries may find it harder to manage their financial conditions and exchange rates, or freely choose their exchange rate regime. Global financial conditions could be transmitted more readily around the world, complicating policy tradeoffs. Hence, today's large share of countries managing their exchange rates could be pushed towards more open capital accounts and flexible exchange rates, thus needing to maintain an effective and independent monetary policy.

Effects and solutions are likely to differ, however, for wholesale versus retail CBDC (though this will depend on the design of any retail CBDCs). Under a wholesale CBDC arrangement, which aggregates retail transactions before funnelling them through regulated financial institutions, who would then enact the cross-border leg of the payment via a CBDC, there would be a smaller number of larger transactions. As such, the application of controls is likely to fit more readily within the existing framework. Were the public have access to a retail CBDC in which the public can move CBDC cross-border directly, that is likely to lead to a greater number of small transactions, and the ability of the authorities to oversee transactions will be further from the existing framework. In both cases, specific design choices and international cooperation to limit macro-financial risks and negative spillover effects would be important.

Potential financial stability risks and currency substitution

Depending on design and regulations, the cross-border availability of CBDCs could lower the costs of obtaining, storing and spending foreign currency. There are already significant network effects for international currencies, and lower costs could therefore make already established international currencies even more attractive. Issuance of CBDC by foreign central banks could enhance the status of those international currencies at the expense of others.³⁰ This could contribute to more widespread currency substitution via the adoption of a foreign CBDC, especially in countries with high inflation and volatile exchange rates. As discussed in IMF (2020), currency substitution is already widespread and persistent (foreign currency deposits are higher than 50% in more than 18% of countries worldwide). While the root cause of currency substitution is the lack of confidence in a country's own currency, due to domestic conditions, rapid currency substitution could undermine countries' efforts to redress domestic policies.

Widespread currency substitution would undermine monetary policy independence and involves risks for both the issuing and receiving countries. For the issuing country, shifts in foreign demand for CBDC could mean large movements in capital flow, which might also interfere with monetary policy. For the receiving country, currency substitution reduces the domestic central bank's control over domestic liquidity by reducing the proportion of money in circulation that it has direct influence over. Further, it reduces the stability of money demand (El-Erian (1988)). This might weaken the monetary transmission mechanism – ie the mechanism through which policy-induced changes in monetary instruments such as short-term nominal interest rates affect macroeconomic variables.

To the extent that foreign currencies are issued by countries with business cycles not correlated to the receiving country, the latter will suffer from ineffective monetary policy control and more volatile inflation, with a disproportionate impact on the poorer and more vulnerable households.

Currency substitution can also undermine the ability of the domestic central bank to carry out the lender of last resort function. The reason is that if domestic banks have large liabilities in non-domestic currency, which might occur as the result of extensive currency substitution, the central bank will not be able to create foreign currency in order to provide liquidity assistance and must instead rely on currency reserves or liquidity provision from foreign central banks.

³⁰ ECB (2020b) for example, discusses the international role of the euro as a factor reinforcing the region's economic autonomy.

Cheaper and faster cross-border transactions, all else equal, might increase risks for runs on both domestic banking sectors and currencies. Currency substitution, as in runs away from a currency, could be rapid. For many emerging markets and developing countries, even at present, a run on the banking system is often effectively a run on the national currency as funds leave the country (Laeven and Valencia (2018)). In addition, lower costs to transact in foreign currencies could lead to higher exposures to foreign currency risk among households and firms, and potentially banks, with negative effects on financial stability.

Countries are already beginning to consider measures they can adopt to limit heightened – and expected – pressures of currency substitution from the introduction of CBDC outside their borders. The predominant question is: how should countries deal with spillover effects from CBDC? This is an important question as it draws countries lagging in CBDC adoption, and potentially with weaker institutions and capacity, much faster than expected to the frontier of policy debates. Hence, there is a risk of a widening gap between countries which are able to more quickly adapt to changing circumstances and countries that lack the means to safeguard themselves from potential adverse effects.

Additional questions emerge on the technical implementation of limiting CBDC circulation, transactions, and holdings. Questions also touch on the policy desirability and appropriateness of imposing restrictions on cross-border transactions in CBDC. Design choices, as previously discussed, might also be important to reduce risks of financial stability and currency substitution. For instance limits on non-resident holdings, requisite onboarding protocols for users and merchants, or tactical pricing mechanisms (eg fees on very large or frequent cross-border transactions) could limit cross-border use. To date, the literature has mostly focused on limiting CBDC adoption domestically, but such measures might also reduce international implications by limiting the amount of total CBDC in circulation.³¹

Multilateral collaboration will be key. It may be possible to agree on design principles to allow foreign authorities to set basic parameters of wallets or networks to limit currency substitution. However, these design principles would need to be coordinated at the global level to contribute so that they meet the needs of all countries, and are widely adopted to limit arbitrage. Collaboration will also be important to bridge the gap mentioned above, also through technical assistance provided by international organizations.

Reserve currency configurations and backstops

Currencies used for international transactions, such as invoicing and paying for imports, could change with the advent of CBDC. In one scenario, reserve currencies such as the dollar or euro could become even more dominant if available digitally at a lower cost and to a wider user base.

The question is whether new reserve currencies would arise, or if some of the reserve currencies used less often today would become more ubiquitous if they offered significant advantages in terms of costs and ease of use. CBDCs could be designed, for instance, through programmability in ways that make them more appropriate and easier to use in different processes in global trade and finance. This would naturally affect demand for them.

Widespread use of a currency is indeed a first (though not sufficient) step towards its internationalisation. The self-reinforcing cycle, depicted in Gopinath and Stein (2019), begins with wanting to hold the currency in which one is paid, thus requiring safe assets in that currency, decreasing interest on these assets, incentivising issuance, and thus pricing in that currency to hedge. Use of currencies in trade thus tends to drive market development in a self-reinforcing cycle.

But, importantly, the credibility and stability of institutions, degree of financial openness, and the rule of law, as well as geopolitical forces, remain essential ingredients to currency internationalisation and tend to move slowly.

³¹ See, for instance, Bindseil (2020).

Thus, the advent of CBDCs may accelerate changes to the configuration of reserve currencies, but may not change it dramatically over a short period. Regional patterns, where trade connections are tighter, and political pressures stronger, may instead evolve more rapidly. These tendencies already exist today, but a new CBDC issued in the region and with more attractive features compared with present versions of the national currency, could tip the balance towards the establishment of a new regional reserve currency.

Questions will thus arise on the need to potentially redesign backstops. Regional backstops may be reinforced and become more credible, in addition to global backstops as provided by the IMF. Cooperation between these various backstops may become increasingly important.

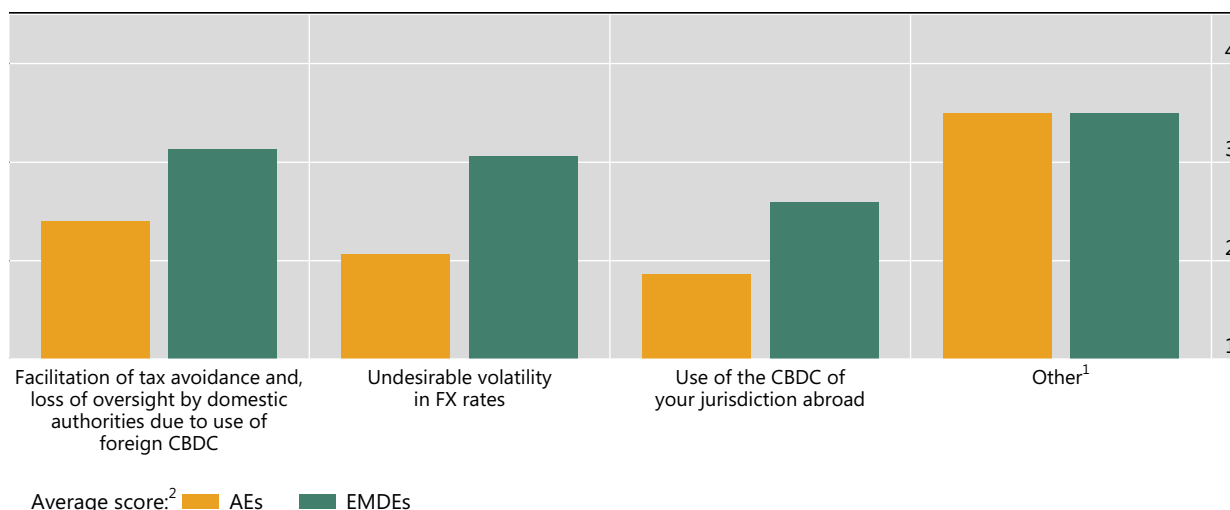
Early central bank thinking on risks associated with cross-border use of CBDCs

Given the above analysis, it is useful to consider an overview of central bank thinking at present on the topic. A set of questions in the survey among central banks covers the perceived importance of specific risks from cross-border use of CBDCs. Central banks ranked the relative importance of cross-border risks to their domestic CBDC motivations on a four-point scale from “not so important” to “very important”.

How important are the following risks?

Relative score, 1–4

Graph 7



¹ Includes AML-CFT, cyber-risk, ease of settlement, and emergence of a foreign CBDC as a dominant vehicle in the domestic market, imbalance of capital outflows, monetary control and financial stability, significant non-domestic use due to lack of control, redundancy of payment systems, remittances, security and USD parity. ² 4=Very important; 3=Important; 2=Somewhat important; 1=Not so important. The sample includes 18 AEs and 32 EMDEs.

Source: R Auer, C Boar, G Cornelli, J Frost, H Holden and A Wehrli, “CBDCs beyond borders: results from a survey of central banks”, *BIS Papers*, no 116, June 2021.

Their responses show that facilitation of tax avoidance and loss of oversight emerge as key concerns (Graph 7). Central banks also rated undesirable volatility in exchange rates as an important concern. Outside the predefined choices, central banks indicated other important risks such as ease of settlement, AML/CFT, cyber risk and emergence of a foreign CBDC or a global stablecoin as a dominant vehicle in the domestic market. “Other” risks associated with cross-border use include illicit finance, consumer protection (data privacy), cyber risks and operational risks. Several of these concerns are closely related to digital dollarisation.

4. Conclusion and considerations for further work

Many central banks are currently investigating risks, benefits and various designs of CBDCs, but with a strong focus on domestic needs. Only a few central banks have made firm design choices so far. Implications of CBDCs, even if only intended for domestic use, will go beyond borders, making it crucial to coordinate work and find common ground. If coordinated successfully, the clean slate presented by CBDCs might – in time and in combination with other improvements – be leveraged to enhance cross-border payments.

This report has shown how CBDC could facilitate enhanced cross-border payments conceptually, and how efforts in practice are taking these considerations forward. The arrangements facilitating such payments imply different degrees of international integration and cooperation, ranging from basic compatibility with common standards to the establishment of international payment infrastructures. The analysis highlights both the need for multilateral collaboration and the importance of interoperability between CBDCs.

In order to achieve the potential benefits for public welfare while preserving financial stability, further exploration on CBDC design choices and their macro-financial implications is essential. Various important and complex questions are still to be further analysed, for instance as regards the interoperability between existing and new infrastructures, the access to and control of central bank money, the distinction between wholesale and retail CBDC, the role of private industry actors, and many others.

While CBDCs have unique features, enhancements in the other building blocks of the cross-border payments programme, such as aligning regulatory, supervisory and oversight frameworks for cross-border payments, AML/CFT consistency, PvP adoption and payment system access³² will be critical for cross-border CBDC use. This reinforces the importance of the overall G20 roadmap to comprehensively enhance cross-border payments. For example, the idea of encouraging interoperability between CBDCs has strong structural similarities to establishing links between the payment infrastructures of different countries and the investigation into the feasibility of new multilateral cross-border payment platforms.³³ Also, the eventual international adoption of CBDCs is likely to proceed at different speeds in different jurisdictions, calling for interoperability with legacy payment arrangements. Hence, the subsequent action of this building block (19) calls, among others, for the analysis of interoperability with non-CBDC payment arrangements.³⁴

³² These topics are addressed in building blocks 4, 5, 9 and 10, respectively. See also CPMI (2020b).

³³ See CPMI (2020a, b) and FSB (2020c), building blocks 13 and 17.

³⁴ This report constitutes the response to action 1 of building block 19. See FSB (2020c). Starting in August 2021, with completion in July 2022, action 2 will cover the development of options for access to and interlinking CBDCs that could improve cross-border payments. This study will be complemented with an assessment (action 3) of the practical and technological complexities of implementing different CBDC arrangement designs and interoperability types, as well as trials and experiments of arrangements that facilitate efficient cross-currency CBDC payments. See Annex 3.

Glossary

Access: As used in this report, this can mean the access of households and businesses to payment services and in general the ability to use the services of a financial market infrastructure's services by participants, other market infrastructures and, where relevant, service providers.

Central bank digital currency (CBDC): A digital payment instrument, denominated in the national unit of account that is a direct liability of the central bank.

See <https://www.bis.org/publ/othp33.pdf>

Central bank money: A liability of a central bank which can be used for settlement purposes. The widespread use of central bank money for large and critical settlements is pivotal to the functioning of the global financial system, offering safety, availability, efficiency, neutrality and finality.

See <https://www.bis.org/cpmi/publ/d101.htm>

Clearing: The process of transmitting, reconciling and, in some cases, confirming transactions prior to settlement, potentially including the netting of transactions and the establishment of final positions for settlement.

See <https://www.bis.org/cpmi/publ/d101.htm>

Closed loop: A closed-loop proprietary system relies on both payer and payee opening an account in or otherwise using the same closed-loop system, and can therefore offer services to both and control the end-to-end payment.

Correspondent banking network: Correspondent banking is an arrangement whereby one bank (correspondent) holds deposits owned by other banks (respondents) and provides those banks with payment and other services (CPMI (2016)). Correspondent banking networks are critical for firms and households that conduct business or send payments internationally.

See <https://www.bis.org/cpmi/publ/d147.htm>

Counterparty risk: Counterparty risk is the risk of one or more parties in a financial transaction defaulting on or otherwise failing to meet their obligations on that trade.

Cross-border and cross-currency payments: Cross-border payments are those where the payer and payee reside in different jurisdictions. Many, but not all, of these are also cross-currency payments – that is, payments where the payer and payee are respectively debited and credited in different currencies. Payments within monetary unions or payments in a common invoice currency may be cross-border but not cross-currency.

See www.bis.org/publ/qtrpdf/r_qt2003h.htm

Financial inclusion: Universal access to, and frequent use of, a wide range of reasonably priced financial services, in particular transaction accounts.

See <https://www.worldbank.org/en/topic/financialinclusion/brief/achieving-universal-financial-access-by-2020> and <https://www.bis.org/cpmi/publ/d191.pdf>

Fragmented and truncated data formats: Data standards and formats vary significantly across jurisdictions, infrastructures and message networks and the amount of data that is carried in most cross-border messages is extremely limited. This prevents high rates of automated "straight-through processing" and leads to delays in processing and releasing cross-border payments and increases technology and staffing costs.

See <https://www.fsb.org/wp-content/uploads/P090420-1.pdf>

Interoperability: The technical or legal compatibility that enables a system or mechanism to be used in conjunction with other systems or mechanisms. Interoperability allows participants in different systems to conduct clear and settle payments or financial transactions across systems without participating in multiple systems.

See <https://www.bis.org/cpmi/publ/d92.htm>

Money transfer operators: Non-deposit-taking payment service provider where the service involves payment per transfer (or possibly payment for a set or series of transfers) by the sender to the payment service provider (for example, by cash or bank transfer) – ie as opposed to a situation where the payment service provider debits an account held by the sender at the payment service provider.

See https://www.bis.org/publ/qtrpdf/r_qt2003c.pdf

Payment versus payment (PvP): A settlement mechanism that ensures that the final transfer of a payment in one currency occurs if and only if the final transfer of a payment in another currency or currencies takes place.

See <https://www.bis.org/cpmi/publ/d101.htm>

Permissioned distributed ledger: Distributed ledger that allows only trusted third parties to be involved in the updating process. Because validators are trusted, less computationally intensive mechanisms can be used to validate transactions.

Programmability: As used in this report, this refers to transfers of money for which the time, payment amount and/or type of transfer are determined by conditions specified in advance rather than being set ad hoc during the payment process.

See <https://www.bundesbank.de/resource/blob/855148/ebaab681009124d4331e8e327cfaf97c/mL/2020-12-21-programmierbare-zahlung-anlage-data.pdf>

Retail (or general-purpose) CBDC: A CBDC for use by the general public.

See <https://www.bis.org/publ/arpdf/ar2021e3.pdf>

Routing: Routing instructions determine the path a payment takes through the intermediation chain of payment system stakeholders.

Settlement: The discharge of an obligation in accordance with the terms of the underlying contract.

Settlement account: An account containing money and/or assets that is held with a central bank, central securities depository, central counterparty or any other institution acting as a settlement agent, which is used to settle transactions between participants or members of a commercial settlement system.

Settlement asset: An asset used for the discharge of obligations as specified by the rules, regulations or customary practice for a financial market infrastructure.

See <https://www.bis.org/cpmi/publ/d101.htm>

Settlement finality: Settlement finality is defined as the point when the irrevocable and unconditional transfer of an asset occurs. Final settlement is a legally defined moment.

See <https://www.bis.org/cpmi/publ/d101.htm>

Stablecoin: A crypto-asset that aims to maintain a stable value relative to a specified asset, or a pool or basket of assets.

See <https://www.fsb.org/wp-content/uploads/P131020-3.pdf>

Wallet: Electronic wallets are payment arrangements that enable end users to securely access, manage and use a variety of payment instruments issued by one or more PSPs via an application or a website. The electronic wallet may reside on a device owned by the holder, eg a smartphone or a personal computer, or may be remotely hosted on a server but is anyway under the control of the holder.

See <https://www.bis.org/cpmi/publ/d191.pdf>

Wholesale CBDC: A CBDC for use by financial institutions (wholesale transactions) that is different from balances in traditional bank reserves or settlement accounts.

See <https://www.bis.org/publ/arpdf/ar2021e3.pdf>

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Annex 1: Projects for cross-border CBDC arrangements

Model 2 (interlinked systems)	
<p>Project Jasper-Ubin</p> <p>Monetary Authority of Singapore (MAS) and the Bank of Canada (BOC) linked up their respective experimental wholesale CBDC networks, Ubin and Jasper, in 2019 to demonstrate how wholesale CBDC could efficiently eliminate the settlement risk inherent in cross-border, cross-currency transactions, by synchronising payment actions without the need for a trusted third party or a common platform.</p>	
<i>Context</i>	<i>Operating Model</i>
<p>In 2016, BOC and MAS embarked on Project Jasper and Project Ubin, respectively, to explore the use of DLT for the clearing and settlement of payments and securities. BOC and MAS subsequently collaborated to demonstrate the interoperability of their respective experimental networks, and investigate the potential benefits of greater efficiencies and reducing risks.</p>	<p>MAS and the BOC linked up their respective experimental wholesale CBDC networks, Jasper (owned by BOC) and Ubin (owned by MAS), to enable atomic transactions for Canadian dollar – Singapore dollar payments across the two systems using Hash Time-Locked Contracts (HTLC).³⁵</p>
<i>Key considerations</i>	
<p>This project demonstrated cross-platform interoperability given the realistic assumption that DLT-based real-time gross settlement (RTGS) systems in each country sit on different platforms – in this case, the Jasper network (in Canada) sat on Corda and the Ubin network (in Singapore) sat on Quorum.</p> <p>In 2020, Project Ubin expanded on this work to explore how multiple digital currencies could be issued and transacted on a single common platform (ie Model 3).³⁶ With the conclusion of the experimental phases of Project Ubin in July 2020, industry players are building on the results of the project to move towards the commercial development of a DLT-based multi-currency payments network aimed at enhancing commercial cross-border clearing and settlements globally. One example is Partior, a joint venture by DBS Bank, JP Morgan and Temasek. Unlike Project Ubin, Partior will be based on digitised commercial bank money rather than CBDCs.</p>	
<p>Project Jura</p> <p>Another project with a wholesale focus, Project Jura, conducted by the Bank of France, the Swiss National Bank and the BIS Innovation Hub, together with a private sector consortium, explores cross-border settlement with two wholesale CBDCs and a digital security on a DLT platform. It will involve the exchange of a French digital security and euro wholesale CBDC through a delivery versus payment (DvP) settlement mechanism and the exchange of euro wholesale CBDC against Swiss franc wholesale CBDC through a payment versus payment (PvP) settlement mechanism.</p>	

³⁵ HTLC uses smart contracts to synchronise all the actions making up a transaction across two or more systems, such that either they all happen, or none happens. Their basic constructs involve locking or encumbering the asset to be transferred, secret disclosure to the counterparty to complete the acceptance process, and a timeout mechanism to release the encumbrance should the counterparty fail in its acceptance process.

³⁶ MAS and its industry partners developed a production grade blockchain-based multi-currency settlement network, which enabled issuance or distribution of digital currencies (both wholesale CBDC and commercial bank money) in various currencies and which included interfaces for other blockchain networks to connect and integrate seamlessly. This network featured expanded use of smart contracts to more efficiently serve commercial use cases such as DvP with private exchanges, conditional payments and escrow for trade, and payment commitments for trade finance.

Model 3 (single system, multiple CBDCs)	
<p>Inthanon-LionRock Project Inthanon-LionRock is a joint initiative by the Bank of Thailand (BOT) and the Hong Kong Monetary Authority (HKMA).</p>	
<i>Context</i>	<i>Operating model</i>
<p>Following prior CBDC projects with a domestic focus by both central banks, Inthanon-LionRock explored the application of CBDC to cross-border payments.</p>	<p>In the Inthanon-LionRock operating model, cross-border payments are processed through a “corridor network” which links up two separate domestic wholesale CBDC networks and provides cross-border settlement services.</p> <p>On either side of this corridor, each central bank issues its own wholesale CBDC on their domestic settlement networks which are separated from cross-border transactions.</p> <p>The corridor is operated by a joint BOT-HKMA body.</p>
<p><i>Key considerations</i></p> <p>Settlement mechanism: The settlement of cross-border transactions takes place with the help of depository receipts. For the settlement of the cross-border transactions, each central bank facilitates the conversion of their wholesale CBDC into a special vehicle called depository receipt (DR) denominated in domestic currency and vice versa.³⁷ The DR is then used for transferring value amongst all participants in the corridor network.</p> <p>FX: The model involves a choice of three options for FX conversion: (1) seeking the best FX bid-offer rate from other participants in the corridor network; (2) selecting specific counterparties within the corridor network; or (3) FX dealing outside the corridor network between participating banks and non-participating (off-corridor) banks. All options settle in an atomic PvP fashion, and smart contracts are developed to track the settlement process of the trade.</p>	
<p>Project mCBDC Bridge The mCBDC Bridge project is run by the BIS Innovation Hub in collaboration with the HKMA, BOT, Digital Currency Institute of the People’s Bank of China and the Central Bank of the United Arab Emirates.</p>	
<i>Context</i>	<i>Operating model</i>
<p>The initiative builds on the experience of the Inthanon-LionRock project. It will study the potential of distributed ledger technology (DLT) to enhance the financial infrastructure for cross-border payments.³⁸</p>	<p>The mCBDC Bridge is a multi-currency CBDC platform that adopts DLT to facilitate real-time cross-border funds transfers and pursues the path of atomic payment-versus-payment for FX transactions. The project includes exploration of scalability, interoperability, privacy and governance.</p>

³⁷ A depository receipt (DR) is a negotiable certificate issued by a bank representing shares in a foreign company traded on a local stock exchange. This is how links between CSDs are established currently allowing securities listed in an exchange in one jurisdiction to be traded in another jurisdiction – for example American Depository Receipts of Glaxo SmithKline listed in the London Stock Exchange or ADR of HDFC Bank listed in Bombay Stock Exchange (India).

³⁸ The mCBDC Bridge is an initiative run by the BIS Innovation Hub in collaboration with the HKMA, BOT, Digital Currency Institute of the People’s Bank of China and Central Bank of the United Arab Emirates.

<i>Key considerations</i>	
The project aims to enhance the cross-border corridor network prototype to support CBDCs of multiple jurisdictions. It will further explore business use cases in cross-border trade settlement and capital market transactions. It is anticipated that more banks and large corporates will join the trials with real trade transactions.	
Project Dunbar Project Dunbar is an initiative by the BIS Innovation Hub Singapore Centre in collaboration with MAS and plans to work with central banks, financial institutions and technology partners.	
<i>Context</i>	<i>Operating model</i>
Project Dunbar will develop new connectivity models and a prototype of multi-currency DLT-based settlement platform.	The platform will include the native issuance of multiple wholesale CBDC, while being interoperable with other DLT platforms and traditional payment rails. This will allow the platform to accommodate wholesale CBDC from central banks that issue on their own platform, and from central banks that wish to issue wholesale CBDC but do not have their own platform.
<i>Key considerations</i>	
The project explores enhancements to a multi-CBDC platform through: (i) the use of smart contracts to automate FX exchange based on discovery of and matching with the best available rates, and to manage liquidity and FX risks, ³⁹ and (ii) exploring how different multi-currency settlement platforms could be designed to link up with one another. This includes a study of governance models, such that central banks have control over access to and use of their issued CBDCs in a multilateral setting. ⁴⁰	
Project Aber The project is led by the Saudi Central Bank ⁴¹ and the Central Bank of the United Arab Emirates. Commercial banks (three Saudi and three UAE) were selected to participate in the development of the currency.	
<i>Context</i>	<i>Operating model</i>
The initiative uses DLT and a new, dual-issued digital currency as a unit of settlement between commercial banks in the two countries and domestically.	The model adopted a new CBDC issued by both central banks as a unit of settlement between commercial banks in the two countries and domestically. The Aber model is based on a permissioned DLT that enables a high level of decentralisation and enables commercial banks to settle with each other even in cases where the central bank is unavailable or disconnected from the network.

³⁹ This includes on-chain liquidity providers, automated market making through liquidity pools managed by smart contracts, use of intermediate settlement assets for illiquid currency pairs, and optimisation of algorithms for price matching, including through different intermediate currencies or alternative settlement assets.

⁴⁰ Detailed in article "Multi-CBDCs: Designing a digital currency stack for governability", accessible at <https://opennodes.com/2021-04-22-02-40-28-multi-cbdcs-designing-a-digital-currency-stack-for-governability>.

⁴¹ Formerly Saudi Arabian Monetary Authority (SAMA).

Key considerations

Aber uses three types of ledgers for transferring funds: (i) primary ledger, where all the banks (commercial as well as central) participate in this ledger, and the CBDC is issued by central banks through a special "issue" transaction on the primary ledger; (ii) bilateral ledgers, where the peer-to-peer transactions between each pair of commercial banks are stored; and (iii) a private ledger between a commercial bank and its central bank.

Annex 2: List of building blocks for enhancing cross-border payments

Focus area A: Public and private sector to commit jointly to enhance cross-border payments

1. Develop common cross-border payments vision and targets

- Develop a common vision and expanding the range of agreed targets beyond remittance costs to include enabling faster, cheaper, more transparent and more inclusive payments for wholesale and retail alike.

2. Implement international guidance and principles

- Ensuring that international guidance and principles lead to the implementation of effective and efficient payment and ICT infrastructures and the achievement of agreed targets are applied.

3. Define common features of cross-border payment service levels

- International guidance on eg technical standards, settlement finality provisions, rules for exception handling to drive standardisation and support competition and innovation in payment schemes.

Focus area B: Coordinate regulatory, supervisory and oversight frameworks

4. Align regulatory, supervisory and oversight frameworks

- Building on the principle of "same business, same risk, same rules". Consistent jurisdictional approaches will ensure greater clarity for market participants.

5. Apply AML/CFT rules consistently and comprehensively

- Ensuring more effective and robust implementation and application of AML/CFT frameworks while continuing to pursue a risk-based approach.

6. Review interaction between data frameworks and cross-border payments

- Identifying and addressing real or perceived tension between financial regulatory requirements on the one hand and restrictions on cross-border data flows and data storage on the other hand.

7. Promote safer payment corridors

- Reducing the the burden associated with compliance checks and facilitate market entry determine lower risk corridors and types of cross-border payments via rigorous and effective risk assessments.

8. Foster KYC and identity information sharing

- Reducing silos within and across jurisdictions to prevent identity duplication, ultimately benefiting both the end-user and market participants.

Focus area C: Improve existing payment infrastructures and arrangements to support the requirements of the cross-border payment market

9. Facilitate increased adoption of PvP

- Reducing settlement risk on the majority of FX transactions can help cross-border payments which rely on them.

10. Improve (direct) access to payment systems

- Widening the eligible candidates for settlement accounts by changing access policies, technical standards and supervisory or oversight regimes.

11. Explore reciprocal liquidity arrangements

- Analysing the feasibility of bilateral arrangements between large-value payment system operators and central banks to enable collateral posted in one jurisdiction to support liquidity issuance in another.

12. Extend and align operating hours

- Adapting operating timetables for critical infrastructures and market participants to enable greater overlap of settlement windows.

13. Pursue payment systems interlinking

- Decreasing the dependency on traditional correspondent banking by establishing links between payment infrastructures of different countries.

Focus area D: Increase data quality and straight-through processing by enhancing data and market practices

14. Adopt harmonised version of ISO20022 for message formats (including rules for conversion/mapping)

- Promoting the adoption of common message formats, such as a harmonised version of ISO 20022 and common rules of mapping/converting data between different data formats.

15. Harmonise API protocols for data exchange

- Harmonising API protocols for data exchange across payment infrastructures and jurisdictions to enable more efficient payment data and digital identifier exchange in cross-border payments.

16. Establish unique identifiers with proxy registries

- Providing a globally standardised approach supporting the global Legal Entity Identifier for legal entities and a similarly standardised identifier for individuals

Focus area E: Explore the potential role of new payment infrastructures and arrangements

17. Consider the feasibility of new multilateral platforms and arrangements for cross-border payments

- To complement or substitute traditional correspondent banking links or bilateral interlinking of payment infrastructures of different countries new multilateral cross-border payment platforms could address problems inherent to legacy technologies and processes.

18. Foster the soundness of global stablecoin arrangements

- Fostering appropriate risk management within global stablecoin arrangements, and sound legal underpinning, as a basis for their use in multiple jurisdictions.

19. Factor an international dimension into CBDC designs

- Providing domestic CBDC implementations with the necessary guidance to enable cross-border transactions via access of non-residents and/or interlinking with international infrastructure.

Annex 3: Building block 19 - factoring an international dimension into CBDC design

In the following the full actions and milestones for building block (BB) 19 based on the G20 roadmap is listed (FSB (2020c)). The dates for each milestone in the following table indicate the start date and completion date for the steps described in the milestone. For all actions in 2021: actions and dates are committed deliverables. The content of actions and dates of milestones beyond end-2021 are indicative.

Actions and milestones

Action 1: Stocktaking and analysis of different CBDC designs

CPMI in collaboration with BISIH, IMF and WB to conduct a stock-take of provisional domestic CBDC designs and central bank experimentation and the extent they could be used for cross-border payments.

IMF, in cooperation with other relevant stakeholders, to analyse international macro-financial implications of cross-border CBDC use.

November 2020 - July 2021

Action 2: Development of options for access and/or interlinking

CPMI in collaboration with BISIH, IMF and WB to identify and analyse options for access to and interlinking of CBDCs that could improve cross-border payments, covering different CBDC designs, access and interlinkage options (including interoperability with non-CBDC payment arrangements). BB17, 18 and 19, given that they will be addressing in part similar issues, will share relevant analysis and emerging thinking.

August 2021 - July 2022

Action 3: Design study and dissemination

BISIH to assess the practical and technological complexities of implementing different multi-CBDC arrangement designs and interoperability types; conduct trials, experiments and prototyping of arrangements that enable access and interlinking and facilitate efficient cross-currency CBDC payments.

BIS in collaboration with IMF and WB to organise a conference to share information exchange/encourage collaboration on cross-border payments across (planned) CBDC implementations.

January 2022 – December 2022

IMF and WB to provide technical assistance on how to facilitate cross-border use of CBDC if requested.

From July 2022 onwards

Annex 4: Composition of the Future of Payments Working Group (FoP)

Chair

Sveriges Riksbank Cecilia Skingsley

Members

Central Bank of Argentina	Luis d’Orio
Reserve Bank of Australia	Chris Thompson Cameron Dark (alternate)
National Bank of Belgium	Filip Caron
Central Bank of Brazil	Lucio Oliveira Emerson Schmitz (alternate)
Bank of Canada	Alejandro Garcia Scott Hendry (alternate) Francisco Rivadeneyra (alternate)
The People’s Bank of China	Changchun Mu Lyu Yuan (alternate)
European Central Bank	Andrea Pinna Arnaud Mehl (alternate)
Bank of France	Valérie Fasquelle** Thomas Argente* (alternate) Anne-Catherine Bohnert* (alternate) Adeline Bachellerie* (alternate)
Deutsche Bundesbank	David Ballaschk Inga Schultze (alternate)
Hong Kong Monetary Authority	Nelson Chow Yvonne Tsui (alternate) Jessica Szeto (alternate)
Reserve Bank of India	Anuj Ranjan Brijesh Baisakhiyar (alternate)
Bank of Italy	Giuseppe Bruni Michela Tocci (alternate) Ferdinando Del Vecchio (alternate)
Bank of Japan	Masami Inoue Masaki Bessho (alternate)
Bank of Korea	Lee Hyung Koo Boram Kim (alternate)

Netherlands Bank	Peter Wierts Marc van der Maarel (alternate)
Central Bank of the Russian Federation	Anastasia Yanovskaya Denis Baryshkov (alternate)
Saudi Central Bank	Mohannad Alshehri Khalid Alotaibi (alternate)
Monetary Authority of Singapore	Tze Hon Lau Chan Shu Ying (alternate)
South African Reserve Bank	Annah Masoga Pearl Malumane (alternate)
Bank of Spain	José Manuel Marqués
Sveriges Riksbank	Martin W Johansson André Reslow* (alternate) Hanna Armelius* (alternate)
Swiss National Bank	Benjamin Müller Raphael Reinke (alternate)
Central Bank of the Republic of Turkey	Büşra Ercan Baran Aytaş (alternate)
Bank of England	Christina Segal-Knowles Emma Butterworth (alternate)
Board of Governors of the Federal Reserve System	David Mills Jackie Cremos (alternate) Jean Flemming (alternate)
Federal Reserve Bank of New York	Joey Patel John Rutigliano (alternate)
Observers	
Bank for International Settlements	Raphael Auer*
Basel Committee on Banking Supervision	Stefan Hohl
Financial Stability Board	Alexandre Stervinou Kieran Murphy (alternate)
Financial Action Task Force	Ken Menz
International Monetary Fund	Tommaso Mancini Griffoli* Federico Grinberg (alternate) Gabriel Soderberg (alternate)*

World Bank Group

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