Foreign exchange trading with instant settlement in central bank money

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Abstract: *The foreign exchange market is the largest financial market and would likely be among the main beneficiaries of central bank digital currencies (CBDC). CBDC would facilitate instant payment versus payment transactions in central bank money and greatly mitigate settlement risks, offer new business models for foreign exchange and supersede existing arrangements for trading and settlement. It could enable and advance a more effective distribution of central bank liquidity including in international settings and reduce financial risks globally. CBDC may lower annual costs related to foreign exchange settlement by an estimated US$130 billion. The present paper provides a preliminary high level discussion of the possible implications of instant and atomic settlement in foreign exchange transactions using central bank money.*

1. Introduction

The present paper offers a preliminary discussion about the implication of instant and atomic settlement for foreign exchange transactions in central bank money. The covid-19 induced crisis has served as a reminder about the risks of disorderly exchange rate adjustments. The possible adoption of central bank digital currencies (CBDC) could facilitate instant payment versus payment transactions in central bank money. This would greatly mitigate settlement risks in foreign exchange, offer new business models for foreign exchange transactions and could supersede existing arrangements for foreign exchange trading. It could enable and advance a more effective distribution of central bank liquidity and strengthen the international monetary system and reduce financial risks globally.

The foreign exchange market is the largest financial market and main user of central bank money. It endures relatively long delays between trading and settlement, lack of transparency and high and increasing risks. Daily gross foreign exchange transactions of about US$18,700 billion, important international financial interlinkages, trading and investments make foreign exchange one of the most important financial activities of the international economy. US$9,000 billion of payments remain at risk daily in foreign exchange trading (Bech

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& Holden, 2019).[1] The cost of payments at risk remain unexplored to the author's best knowledge. It is estimated preliminarily herein on the basis of the FDIC senior secured debt guarantee programme of 2008-2012 to amount in notional and annualised terms to about US$130 billion but likely to be significantly higher.

The risks in foreign exchange trading are systemic amid, as is well known, the very large trading positions that normally far exceed participants' capitals, fragmentation of the foreign exchange market and dissociation between trading and settlement cycles (BIS, 2008; Bronner, 2002; Schrimpf & Sushko, 2019a, 2019b). The market has developed a number of mechanism to mitigate those risks. However, the share of foreign exchange transactions that are not covered or only partially covered by those mechanisms, concerning in particular emerging markets currencies, remains large and has been increasing. The CLS bank, the most important mechanism, has 79 settlement members compared with about 12,000 banks and savings institutions in the Eurosystem and U.S. alone. The decline of the inter-dealer market as a share of total foreign exchange market implies that settlement risks increasingly affect end-customers. This may amplify transaction costs and deter financial market integration.

Central bank money remains the preferred settlement medium for large value transactions. However, central bank money—bank notes and reserves—is local. While bank notes can be held universally, access to central bank reserves is normally granted only to resident banks. For foreign exchange, existing arrangements imply that a bank buying a foreign currency will incur a claim on a correspondent bank—that may be a subsidiary of the parent bank—and not on the central bank issuing the foreign currency. The approach to settle large value payments through national payment systems, often real time gross settlement (RTGS) systems, to reduce counterparty and other risks normally is not extended to international payments (CPSS-IOSCO, 2012; SWIFT, 2014). CBDC is about broader access to and enhanced functionalities of central bank money.

CBDC is assumed here to rest on a value- or token-based approach. Tokenisation offers a new format for currencies, securities and other assets as digital bearer instruments allowing transferability of value similar to sending a text and comprehensive programmability. Tokens are considered to represent the most efficient and secure approach to manage broader access to central bank money, achieve new needed functionalities including native instant and atomic exchanges to eliminate any open positions in foreign exchange trading.[2] Works by the Banque de France, European Central Bank, Riksbank on CBDC and recent announcements by the Digital Dollar Project, Libra Association, J.P. Morgan and Société Générale seem affirmations that increasing considerations are given to token-based financial instruments (Central Bank of France, 2020; Central Bank of Sweden, 2019; Digital Dollar Foundation & Accenture, 2020; ECB, 2020; J.P. Morgan, 2019; Libra Association, 2020; Société Générale, 2020).

[1] All data unless otherwise indicated from BIS 2019 triennial survey based on average daily turnover in April 2019.
[2] An atomic transaction is a transaction by which different legs to an operation occur such that all occur or none occur.

The relationship between CBDC and payments has been reviewed mostly with regard to the impact of digital assets on financial stability (ECB, 2019; SNB, 2019). The possibility to make a retail CBDC interest-bearing has been considered to broaden the monetary policy transmission channel but with a focus only on domestic conditions (Bordo & Levin, 2017). The use of instant and atomic token exchanges has been developed in CBDC-related projects (Accenture et al., 2017; Accenture et al., 2018). The use of CBDC in foreign exchange transactions has been considered but its application, use for central banks' open market operations and impact on foreign exchange markets have remained underexplored (Bank of Canada & Monetary Authority of Singapore, 2019; Bank of Japan & European Central Bank, 2019; Bank of Thailand & Hong Kong Monetary Authority, 2020). This may limit understanding of the possible role of CBDC for the foreign exchange market and the international monetary system.

The note reviews briefly in the second section existing arrangements for foreign exchange settlement. The third section provides an overview of CBDC and discusses in the fourth section the notion of atomic and instant settlement. The fifth section outlines several use cases of CBDC related to foreign exchange trading and securities settlement. The last section offers some concluding remarks.

2. Foreign exchange market, risks and settlement methods

The foreign exchange market with daily gross foreign exchange transactions of US$18,700 billion and a net trading volume of US$6,600 billion is the largest financial market. Its main actors are commercial banks in various roles and the market is organised as an over-the-counter (OTC) market and lacks centralised organs. The largest customer segment are financial institutions representing about 55 percent of total market turnover followed by inter-dealers with 37 percent and non-financial customers with 8 percent with the share of inter-dealers prolonging a multi-year decline. The market comprises spot, foreign exchange swaps and other derivative transactions. Swaps have become the largest instruments for bank funding liquidity and hedging with 59 percent of foreign exchange trading followed by spot transactions with 30 percent. The dollar has remained the most traded currency with 88 percent of the total average daily turnover and the dollar euro pair being the most traded currency pair with 24 percent of daily averages of all currency pairs.

The main risks in foreign exchange trading, as is well known, is settlement risk. Settlement risk comprises credit and liquidity risks. Credit risks arises as counterparties may fail to deliver the currency (Herstatt risk) or default on a vostro account claim if subject to an insolvency procedure. Liquidity risk exists as the counterparty may not settle the full value in time impairing the payee's capacity to meet own commitments, requiring at short notice to obtain alternative sources of funds and reducing the ability to reuse committed funds. The large notional amounts involved imply that settlement risks can have systemic implications and foreign exchange payments could become important transmission channels for systemic strains.

The most important measures to reduce settlement risks comprise shortening the duration of the settlement exposure and reducing the amount of payments through netting. To achieve finality in settlement, payments need to be received in central bank money. The main settlement methods comprise using Continued Linked Settlement (CLS) and correspondent banking. CLS acts as a trusted third party between two counterparties where payments are made on a payment versus payment (PvP) basis. Correspondent banking is non-PvP based and involves the transfer of bought and sold currencies independently. Bilateral netting is used to reduce gross positions and is settled normally through correspondent banks. On-us settlement arises when a bank trades with its own customers or where a bank trades with a correspondent bank.

The daily gross payment obligations of US$18,700 billion are reduced through bilateral netting to daily payment obligations of US$15,200 billion.[3] US$6,300 billion is settled through CLS bank and the remainder through conventional settlement methods using correspondent banking. A continued large and increasing proportion of foreign exchange trading takes place outside CLS bank, representing about 60 percent of total foreign exchange trading, including amid the increasing share of currencies, mostly emerging markets currencies, in foreign exchange trading not covered by CLS bank. The current settlement arrangements imply that about US$8,870 billion daily remain subject to settlement risk.

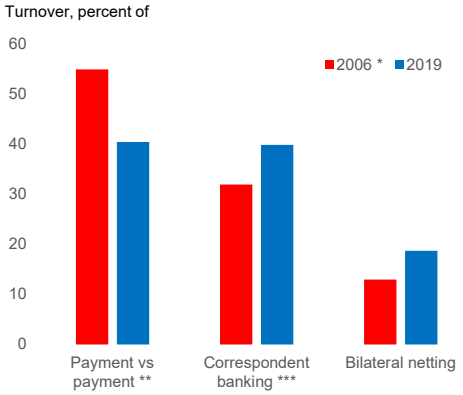
Settlement through CLS and similar PvP provisions constitute the most important settlement method representing about 41 percent of foreign exchange turnover (Figure 1).[4] The CLS bank offers settlement for 18 currencies.[5] PvP implies that a payment in one currency is received by the payer only when the payment in the other currency is also received by the payee. The multilateral netting is performed by CLS as settlement agent for payments on the due date by which each participant at most makes or receives one payment per currency across all counterparties and reduces to a small fraction actual obligations and greatly reduces settlement risk.[6] For direct participants, CLS offers settlement in central bank money as payments for each currency leg are conducted through the respective central banks' large value payment systems. Settlement and funding are separated whereby settlement is performed on a gross basis while payment obligations are netted. The CLS settlement cycle implies delays between trade execution and settlement as netting is performed and instructions are settled sequentially amid a staggered approach of settling net funding positions over a scheduled 12-hour period. CLS banks has normally sufficient funds to pay out in lieu of a defaulted counterparty. Not all obligations between CLS users can be settled using CLS involving certain next day trades and in/out swaps.[7]

Correspondent banking and on-us settlement account for about 40 percent of foreign exchange turnover. The method exposes each counterparty to principal and liquidity risk of

[3] Data from (Bech & Holden, 2019). The calculation is based on turnover of spot and forwards multiplied by two and turnover of currency swaps multiplied by four and whereby NDFs and certain options are settled with a single payment and not subject to settlement risk.
[4] For an explanation of CLS settlement see e.g. Mägerle and Maurer (2009).
[5] Australian dollar, Canadian dollar, Danish krone, euro, Hong Kong dollar, Hungarian forint, Mexican peso, New Zealand dollar, Norwegian krone, rand, shekel, Singapore dollar, sterling, Swedish krone, Swiss franc, U.S. dollar, won, yen.
[6] Estimates of the effect of netting varies. CLS banks estimates that funding requirements are reduced by 96 percent or more (CLS, 2020). The BIS estimates that obligations settled by CLS would have been reduced by about 64 percent instead of settling through traditional correspondent banks (BIS, 2008).
[7] In/out swaps allow to exchange large mutually off-setting balances, see e.g. BIS (2008).

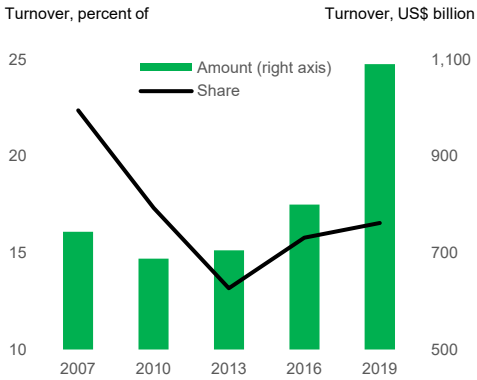
the full value of the trade, that is, full settlement risk. On-us settlement occurs where both legs of the transaction are settled by the same institution and incurs a settlement risk only if execution of payment on one account is not conditional on the correspondent payment in the other account. The duration of the exposure is critical to determine actual settlement risk. The exposure is initiated with an irrevocable commitment to make the payment and ends with receipt of the payment. The average duration depends normally on the currency pair and vary for pairs including the dollar from 25 to 47 hours and maximum durations can be significantly longer.[8]

Figure 1. Settlement of foreign exchange



Source: BIS. * BIS (2008). Settlement of OTC foreign exchange turnover in April 2019, gross-gross basis. ** CLS and other PvP. *** Non PvP and on-us accounts.

Figure 2. Non-CLS currency pairs



Source: BIS. OTC turnover currency pairs. Net-net basis, daily averages in April.

Bilateral netting represent about 19 percent of foreign exchange turnover. Netting is used to reduce the size and number of payment and credit risk. Amounts from foreign exchange transactions due on a certain date are netted for payment on the due day, whereby there is at most one payment for each pair of counterparties per currency, and net amounts are settled by other methods including PvP and correspondent banking. The share of bilateral netting in

[8] For an overview of the average and maximum durations by currency pair see BIS (2008).

total turnover has declined over time, from 29 percent in 1997, in large part due to the emergence of CLS bank.[9]

The decline in CLS settlement from 55 percent in 2006 implies an increasing proportion of foreign exchange trading that is exposed to settlement risk. The renewed increase and share in total turnover of currencies not eligible for settlement with CLS will also shift foreign exchange settlement towards increasing settlement risks in relative and absolute terms (Figure 2).

Bilateral and multilateral netting can significantly reduce actual exposures. In an example, the gross exposures without netting of A is €200, ¥12,020 and $98; of B €200, ¥12,250 and $198, of C €100 and $198 (Figure 3). After bilateral netting, the exposures are of A €102, ¥12,020 and $98; of B €198, ¥12,250 and $198, of C €100 and $198. After multilateral netting, the exposures are of A €2, ¥12,020 and -$100; for B -€2, ¥230, for C €100 and -¥12,250 (Figure 3).[10]

Figure 3. Bilateral and multilateral netting

Transactions

Bank	Pays	Receives	Counterparty
A	€ 102	$100	B
B	€ 100	$98	C
A	¥12,020	€ 100	B
A	$98	€ 100	C
A	€ 100	$98	B
B	¥12,250	$100	C

Without netting

A	€ 102	B
A	¥12,020	B
A	€ 100	B
A	$98	C
B	$100	A
B	€ 100	A
B	$98	A
B	€ 100	C
B	¥12,250	C
C	$98	B
C	€ 100	A
C	$100	B

Bilateral netting

A	€ 102	B
A	¥12,020	B
A	$98	C
B	$198	A
B	€ 100	C
B	¥12,250	C
C	€ 100	A
C	$198	B

Multilateral netting

A	€ 2	Settlement agent
A	¥12,020	Settlement agent
A	-$100	Settlement agent
B	$0	Settlement agent
B	-€ 2	Settlement agent
B	¥230	Settlement agent
C	$100	Settlement agent
C	-¥12,250	Settlement agent

Source: Bronner (2002).

[9] See (BIS, 2008).
[10] The examples are based on Bronner (2002).

The cost of settlement related to payments at risk is estimated very preliminarily to amount to about US$130 billion per year. The cost, excluding all other costs like replacement costs, rests on the assumption that for non-PvP settlements the full value of the currency bought is at risk during the settlement period as a claim against a commercial bank and can be approximated as the difference between the cost of a risk-free claim, that is a claim on a central bank denominated in its own currency, and a claim against a commercial bank, a foreign exchange-related deposit claim.[11] It is calculated here on the basis of the FDIC Debt Guarantee Programme of 2008-2012 under which against a fee, a guarantee was issued to cover issuance of certain senior unsecured debt issued by commercial banks and other financial entities.[12] The fees normalised for the duration of the guarantee and the amount of debt guaranteed and weighted by the amount of debt stand at 83 basis points per year and for guarantees for a duration of less than 7 days, as a proxy for a very short-dated exposure, at 53 basis points per year. The total estimated costs rests on the 53 basis points applied to the US$9,000 billion in payments at risk daily and an average of 48 hours to settle a foreign exchange transaction. The costs are born through margin, collateral posting and other hedging mechanisms. The cost estimation is based on the U.S. and likely to be significantly higher where the average credit quality of banks is lower.

3. CBDC

CBDC represents a third format of central bank money fully fungible with other central bank monetary liabilities. The token format can assume properties akin to a bearer instrument and aims to facilitate more versatile access to and additional functionalities for central bank money. The programmability of tokens allows to embed needed prudential and other monetary policy and financial stability parameters to safeguard orderly CBDC circulation. CBDC is also seen to promote financial innovation by supporting functionalities for token-based financial ecosystems including settlement in token-based financial market infrastructures and advance greater diversification in payments. The token format would facilitate conducting foreign exchange trading and settlement in central bank money, between a resident and a non-resident entity, and off-shore, between two non-resident entities, extending the same quality of settlement in central bank money for resident as for non-resident entities.

The issuance and trading of CBDC are assumed here to be best achieved using a permissioned distributed ledger technology (DLT)-enabled network to ensure adequate performance, security, transferability and privacy in transactions (Accenture, 2019). While issuance of CBDC would be solely under the control of the central bank, the network would be maintained by the central bank and a number of resident financial institutions being operators of network nodes that validate and record all transactions. The tokens would be controlled by private keys stored in electronic wallets. The electronic wallets could be held

[11] The cost of settlement are difficult to estimate. 43 percent of institutions surveyed did not measure the overall cost of settling foreign exchange trade (BIS, 2008).
[12] The Debt Guarantee Programme (DGP) was implemented in October 2008 by the U.S. Federal Deposit Insurance Corporation (FDIC) as a guarantee to cover in full certain newly issued senior unsecured debt of financial corporations. Under the programme 122 entities issued guaranteed debt in 9327 transactions. At its peak, the DGP guaranteed US$346 billion of outstanding debt. The DGP guarantee on all debt that had not already matured expired on 31 December 2012.

outright or through a custodial relationship including by resident banks of the issuing currency country.

The circulation of CBDC would rest on existing provisions for bank notes. CBDC would be issued against reserves to resident institutions operating the DLT-enabled CBDC network. The distribution of CBDC to financial entities outside the network would be possible on the basis of existing banking relationships. Non-resident financial institutions would be allowed to hold CBDC in electronic wallets but would not operate the network. Acquisition of CBDC by non-resident entities would be on the basis of existing financial transactions and know-your-customer provisions. The programmability of tokens would afford restricting circulation of CBDC by entity, transaction venue or type of transaction.

The effect of CBDC on the central bank's balance sheet would be similar to issuance of bank notes. Distribution would be determined by reserves and acquisition of CBDC would represent a mere substitution of central bank monetary liabilities and not alter the size of the central bank balance sheet. CBDC unlike reserves could be used as collateral by entities outside the national payment system and may help alleviate possible collateral shortages amid large scale issuance of reserves by some central banks.

The token format offers versatility and control. Central bank money can be transacted peer-to-peer irrespective of space and time, that is, transactions would take place regardless of the location of the counterparty, opening hours of large value payment systems and time zones. The tokens could be tightly controlled and programmed to safeguard set prudential standards. All entities would interact with the tokens only. The distinction between network node operators and wallet holders maintains a strict separation between CBDC network participants and CBDC users. Possible custodial relationship for the wallets would offer flexibility for the location and management of the wallets. Privacy could be managed at the token level to ensure transaction data are shared only selectively to afford needed anonymity in payments.

4. Instant and atomic settlement

The adoption of tokens enables the simultaneous execution of trading and settlement in one transaction in an instant and atomic settlement through simple exchanges of tokens (atomic swaps). The programmability of tokens can ensure that transactions can be instant and performed only upon meeting certain conditions. The atomic swaps enable PvP of CBDC versus CBDC and delivery versus payment (DvP) transactions of a tokenised security or other asset versus CBDC. Instant and atomic PvP and DvP transactions imply the elimination of open positions and all settlement risk. All settlements would be in central bank money and final.

The atomic swaps would obviate risk mitigation measures and any deferment between trading and settlement. Both currency legs would be available at the same time and allow for real time reuse. Liquidity management would be simplified as trading positions would not impair liquidity amid the immediate availability of funds. The application by CLS bank of haircuts, pay-ins and

measures to mitigate exposure to intra-day exchange rate movements would not be required. The simplified trading and settlement processes is expected to eliminate settlement costs and reduce other transaction costs.

The advantages of bilateral and multilateral netting would become void under instant and atomic settlement. As all funds would be available instantly for both counterparties there would be no need to phase settlement and net transactions in particular for transactions involving end-customers affording a convergence of trading and settlement cycles (Figure 3). Inter-dealer transactions may require some elements of deferred settlement if instant trading and settlement impair their ability to maintain open trading positions during the trading day.

5. Use cases

The uses cases for CBDC foreign exchange-related trading can be illustrated on the basis of the life cycles for CBDC and security tokens through a number of set participants and transactions:

The entities participant in the possible transactions include:

1. Domestic central bank issuing a domestic CBDC
2. Foreign central banks issuing a foreign CBDC
3. Domestic commercial banks (DBs), including a domestic commercial bank issuing a tokenised security
4. Foreign commercial banks (FBs)

The possible transactions include (Figure 4):

1. DB1 exchanges reserves for a domestic CBDC at the domestic central bank.
2. DB2 sells a security to DB1 against domestic CBDC in an instant and atomic DvP transaction
3. FB1 exchanges reserves for a foreign currency CBDC at a foreign central bank
4. DB2 sells domestic CBDC to DB1 against a foreign currency CBDC in an instant and atomic PvP cross-border transaction
5. DB1 sells a security to FB1 against domestic CBDC in an instant and atomic DvP cross-border transaction
6. FB2 exchanges reserves for a foreign currency CBDC at a foreign central bank
7. DB1 sells domestic CBDC to FB2 against foreign currency CBDC in an instant and atomic PvP cross-border transaction
8. FB1 sells a security to FB2 against domestic CBDC in an instant and atomic DvP off-shore transaction
9. FB1 sells domestic CBDC to DB1 against foreign currency CBDC in an instant and atomic PvP cross-border transaction

10a. FB1 sells domestic CBDC to DB2 against foreign currency CBDC in an instant and atomic PvP cross-border transaction

10b. FB1 sells domestic CBDC to foreign central bank against reserves

11a. DB1 exchanges domestic CBDC for reserves at the domestic central bank

11b. DB1 sells domestic CBDC to foreign central bank in an instant and atomic DvP cross-border transaction.

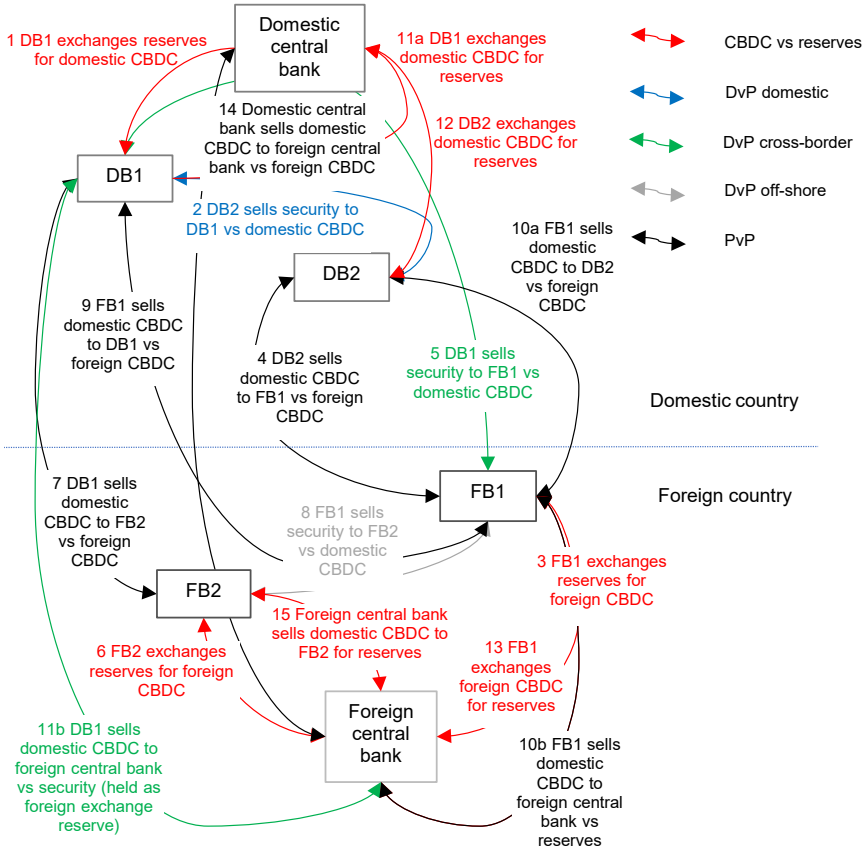
12. DB2 exchanges domestic CBDC for reserves at the domestic central bank

13. FB1 exchanges foreign currency CBDC for reserves at a foreign central bank

14. Domestic central bank sells domestic CBDC to foreign central bank against foreign CBDC in an instant and atomic PvP cross-border transaction

15. Foreign central bank sells domestic CBDC to FB2 against reserves

Figure 4. Possible CBDC and securities life cycles



Foreign exchange spot trading

The adoption of instant and atomic settlement in foreign exchange and possibility to transact in CBDC would transform the foreign exchange market, disrupt existing market arrangements and offer reduced risks, greater speed, lower transaction costs and greater transparency in trading and settlement. Instant and atomic settlement would enable an exchange of principal with the instant ability to reuse funds receive. The elimination of open positions would obviate risk mitigation measures including netting.

The representative foreign exchange transaction would be a PvP of CBDC versus CBDC akin to transaction 4 in Figure 4. The exchange of principal in foreign exchange implies that no pre-funding in trading would be necessary. As funds are exchanged instantly, instant borrowing can be arranged to enable unfunded trading upon availability of sufficient collateral. As funds are also received instantly, they reduce any position to the foreign exchange risk only and can be reused immediately. Large-scale transactions would be possible as no open positions will be incurred.

Foreign exchange swaps trading

The instant and atomic settlement reduces a swap from four to *de facto* two transactions. The spot transactions would settle instantly and the forward transaction upon maturity would similarly settle instantly. The representative foreign exchange transactions would be a combination of two PvPs of CBDC versus CBDC akin to transactions 4 and 10 in Figure 4.

Collateral

The adoption of CBDC may widen the scope of reserves to serve as collateral. Reserves can be used to settle large value transactions and be lent to other financial institutions. The issuance of reserves by central banks normally by accepting as collateral or buying high quality securities or foreign exchange from market participants implies that large amounts of high quality securities are no longer available to serve in lending, hedging and other collateral-intensive transactions. The portability of CBDC would allow using CBDC directly as collateral. The representative transactions would be 1, 3 and 6 as an exchange of reserves for CBDC in Figure 4.

CBDC as foreign exchange reserves

CBDC could be held in lieu of securities as part of central banks' foreign exchange reserves. It would enable central banks to directly hold currency rather than securities that would be available for immediate intervention in the foreign exchange market and would not affect securities markets directly when performing a foreign exchange market intervention. The representative transaction to acquire CBDC of another central bank would be 11b as an exchange of CBDC for a security in Figure 4.

Federal Reserve dollar liquidity swap lines

The adoption of CBDC would allow dollar liquidity from the Federal Reserve dollar liquidity swap lines to reach non-resident commercial banks in need directly. The Federal Reserve would exchange CBDC only with a foreign central bank but the foreign central bank could allow the CBDC to be passed to its resident banks against eligible collateral. The portability of CBDC would allow banks to hold foreign currency central bank money that can be used to meet foreign currency obligations. The representative transactions to acquire a domestic currency CBDC by a non-resident bank would be 14 and 15 in Figure 4.

SNB foreign exchange market interventions

The SNB's foreign exchange market interventions have been the largest proportional to the size of the economy. It has been the principal operating measure of the SNB mostly through permanent franc sales financed by sight deposits.[13] The foreign exchange interventions have led to a considerable increase in the SNB's balance sheet amid an accumulation of foreign exchange reserves. The SNB's balance sheet increased from 274 billion francs (23 percent of GDP) in January 2011 to 860 billion francs (120 percent of GDP) in October 2019. During the same period, sight deposits increased from 25 billion francs to 533 billion francs as foreign exchange reserves rose from 210 billion francs to 800 billion francs.

The use of CBDC in foreign exchange market interventions would enable the SNB to hold a claim on another central bank rather than on a commercial bank and reduce its risk exposure tied to its foreign exchange market interventions. The acquisition of a foreign currency CBDC would also offer the possibility of some diversification in its foreign exchange portfolio and reduce the direct impact of its holdings on securities markets. The large amount of reserves outstanding if exchanged for CBDC could also serve more widely in lending and collateral-related transactions. The representative transaction to acquire a foreign currency CBDC would be 10b as an exchange of CBDC for reserves in Figure 4.

International settlement of securities

The use of CBDC in cross-border and off-shore transactions would enable settling securities in central bank money in cross-border and off-shore transactions and offer new scope for central banks to accommodate demand for liquidity outside the domestic market. The possibility to settle in the domestic CBDC in cross-border and off-shore transactions would afford the same conditions for settling domestic currency-denominated securities in the domestic market to foreign markets. The additional functionality of a CBDC could enhance the propensity to hold central bank money in particular by off-shore entities which may necessitate additional provisions to attenuate demand for CBDC. The programmability of CBDC would allow to restrict use by designated entity and/or trading venues. The representative transactions for international settlement in domestic CBDC would be 5 and 8 in Figure 4.

The distribution of CBDC offshore would occur through the domestic banking system. Domestic banks would acquire CBDC and "sell" CBDC to off-shore entities against high quality assets, normally government securities. The harmonisation of domestic and international settlement conditions should facilitate financial market integration and improve price discovery across markets. It would make dealing in domestic currency-denominated securities more attractive and bring local settlement conditions to international investors.

[13] Sight deposits can also change, for example, due to flight-to-safety by banks, and therefore only represent an imperfect proxy measure for foreign exchange interventions; see Auer (2015).

6. Conclusion

The paper aims to offer a preliminary discussion on how the adoption of CBDC could transform the foreign exchange market through the safety of central bank money and versatility of tokens. The foreign exchange market would likely be amongst the greatest beneficiaries of CBDC. The possibility to settle in instant and atomic transactions could significantly reduce settlement risk, allow convergence of trading and settlement cycles and facilitate access to central bank money. The direct exchange of central bank money could afford a more equitable distribution of central bank money supporting competition and international financial market integration. The adoption of CBDC is seen to complement rather than replace existing foreign exchange market arrangements.

The DLT-enabled networks would provide needed functionalities and security to control access, trading and settlement. The strict separation of network operators and wallet holders would enable a two-tiered approach in foreign exchange trading that provides seamless transactions between resident and non-resident entities while preserving operational autonomy with resident entities. It would preserve existing regulatory and supervisory oversight while extending reach.

The transformation of the foreign exchange market with a decline in settlement with PvP and larger portion of end-customers as direct market participants may require a new approach to mitigate risk and afford needed protection to market participants. While most market participants would benefit from instant settlement, a differentiated approach would be possible to accommodate inter-dealer specific requirements through a variable settlement window approach to ensure needed continuity in foreign exchange trading.

The decision to adopt CBDC rests with central banks alone. Central banks could act proactively to diversify trading and settlement opportunities for the foreign exchange market. Naturally, a feasible approach would need to involve at least two central banks. A consortium approach would allow setting needed standards to ensure inter-operability of CBDC across networks and market participants can be achieved.

CBDC could bring needed efficiency gains to the international monetary system. It may convey greater confidence about access to domestic currency liquidity possibly supporting more stable allocations to domestic currency-denominated assets. The wider distribution of central bank money could improve international liquidity and become a determinant for the relative attractiveness of currencies benefiting in particular smaller currencies. CBDC may help address several long-held grievances in international monetary relations by facilitating the international use of central bank money. While in most countries most economic agents act internationally, central bank money has remained local.

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