



THE CAPCO INSTITUTE  
**JOURNAL**  
OF FINANCIAL TRANSFORMATION

**CRYPTO**

Central bank digital currencies  
and payments: A review of domestic  
and international implications  
LILAS DEMMOU | QUENTIN SAGOT

**CLOUD**

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## JOURNAL OF FINANCIAL TRANSFORMATION

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**DEAR READER,**

Welcome to edition 55 of the Capco Institute Journal of Financial Transformation. Our central theme is cloud computing, which has transformed from an efficiency initiative for our clients, to an indispensable growth driver for financial services.

The pandemic has changed consumer expectations, with consumers now demanding 24/7 access to their financial resources from anywhere, as well as hyper-personalized products that reflect their lifestyle choices.

In this edition of the Journal, we explore the power of cloud and its potential applications through the lens of a joint Capco and Wipro global study, and take a deeper look at the financial services data collected in Wipro FullStride Cloud Services' 2021 Global Survey. The survey was focused on perceptions of cloud and its importance to business strategy from over 1,300 C-level executives and key decision-makers across 11 industries.

The study indicates that cloud is becoming ever more intelligent, hyperconnected, and pervasive, and enables companies to offer their end users the personalized, user-centric experience that they have come to expect. It's clear that only the financial services firms that can successfully leverage cloud, will thrive.

In addition, this edition of the Journal examines important topics around digital assets and decentralized finance, including central bank digital currencies, and bitcoin's impact on the environment, and cybersecurity and resilience.

As ever, you can expect the highest calibre of research and practical guidance from our distinguished contributors, and I trust that this will prove useful in informing your own thinking and decision-making.

Thank you to all our contributors and thank you for reading. I look forward to sharing future editions of the Journal with you.

A handwritten signature in black ink, appearing to read 'Lance Levy', with a stylized, flowing script.

**Lance Levy, Capco CEO**



# CENTRAL BANK DIGITAL CURRENCIES AND PAYMENTS: A REVIEW OF DOMESTIC AND INTERNATIONAL IMPLICATIONS

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## ABSTRACT

Recent technological developments linked to secure messaging and traceability present an opportunity to address certain challenges in international and domestic payment systems. From an international perspective, foreign exchange markets remain costly and relatively less efficient than domestic payment systems. From a domestic perspective, the decline in the relative importance of cash in most economies reflects changes in consumers' preferences, which questions the future of money and payment infrastructure. Against that background, private initiatives falling outside of current regulation, such as stablecoins and other virtual assets, are associated with several risks and opportunities and have fueled the debate on the merit for central banks to issue new form of digital public currency. This article reviews these different propositions and examines their implications for the international and domestic payment systems.

## 1. INTRODUCTION

The development of financial market infrastructure is inherently linked to technological innovation and has evolved in the second part of the 20th century in response to an increasing integration of actors across borders at an ever-lower cost. Electronic money gained momentum from the 1970s allowing vast amounts of money to be transferred first between financial institutions and then to a larger set of actors. Those developments have played a key role in supporting trade and economic activity. Yet, in the face of recent technological advances, the existing settlement system is still considered slow and costly and the demand for new kinds of medium of exchange, notably for digital currencies or tokens, has increased, reflecting the emergence of new needs. The growing digitalization of retail trade has fueled this demand

even further. While recent private and public initiatives aim at responding to those new needs, new challenges emerge for policymakers.

This paper takes stock of these developments and puts forward some economic implications on payment markets. First, ten years on from the worldwide emergence of a new type of privately-owned and decentralized digital financial asset, of which bitcoin was the first and currently the most well-known example, their potential economic impact is hugely debated. In November 2021, the total market capitalization of cryptocurrencies amounted to U.S.\$2,973 billion, from U.S.\$140 billion in March 2020, when COVID-19 hit. Yet, this market remains largely volatile, and costs of production inherently limit their use as a medium of exchange and reserve of value [FSB (2018a)]. Crypto assets' characteristics

<sup>1</sup> The authors would like to thank for helpful comments, valuable discussions, and insightful suggestions Laurence Boone, Luiz De Mello, Alain de Serres, Dennis Dlugosch, Guido Franco, Filippo Gori, Giuseppe Nicoletti (all from the OECD Economics Department), Caroline Malcom, Robert Patalano, Sebastien Schich, Ania Thiemann (all from the OECD Directorate for Financial and Enterprise Affairs), and Benoit Coeuré (from the Bank of International Settlements).

indeed make them a weak substitute to fiat currencies, while the underlying technology of these assets may not be flexible enough to ensure an adjustment of money supply to economic conditions.

However, further innovations in the crypto-economic world present the potential to change this global picture, in particular the development of stablecoins, i.e., crypto assets featuring a stabilization mechanism allowing them to anchor their price to a basket of stable fiat currencies or assets. While rather small in terms of market capitalization (circa U.S.\$180 billion),<sup>2</sup> scaling projects, notably Facebook's Diem, have the potential to disrupt the current monetary system based on national fiat currencies and pose several economic risks. Firstly, regulatory settings on crypto assets and stablecoins, established as speculation instruments, may not abide by payment service providers (PSP) standards and thus may not guarantee users similar operational security and system resilience. In particular, private actors present higher credit risk (or probability of default) than central agents [Sveriges Riksbank (2018)] and even if solvent, private entities face an inherent liquidity risk associated with their business cycles. Competition issues add to the problem, as tech giants could leverage their dominant positions on international commerce by concentrating the operations of the marketplace on their own platforms, from advertising, to payments, and potentially lending [OECD (2020a)]. Such concentration could also challenge the stability of the payment system as the more concentrated a payment market, the greater the risk of contagion in the system. These risks have fueled the public debate on the necessity to regulate private currencies<sup>3</sup> (an issue not discussed in the present paper, but which notably affected the launch of Facebook's Diem initiative, shut down by regulators) and on the opportunities for central banks to issue new forms of digital public currencies (CBDCs).<sup>4</sup> In 2019, 80 percent of world central banks, surveyed by the BIS, had declared pursuing work in the area of CBDCs, though only a few engaged in the active development of pilots [Rice et al. (2020)]. Against this background, this article takes an exploratory perspective to examine the potential impacts of different CBDC designs on three areas: i) cross-border and domestic payment systems,

ii) the role of the banking system; and iii) the efficiency of monetary policy toolkits. Country-specific experiences are also reported given that the motivations for expanding CBDCs may vary across countries, as do pilots' implementation level.

## 2. THE OPPORTUNITY OF CBDCs TO ADDRESS INTERNATIONAL PAYMENT SYSTEM CHALLENGES

### 2.1 Brief overview of international payments: a costly and slow payment system that may act as a barrier to trade and growth

An efficient cross-border payment infrastructure, enabling fast and affordable payments, is paramount to support international trade. Indeed, transaction costs appear as an important cost component in international trade for goods and services, amounting to roughly a fifth of total costs [Rubínová and Sebtí (2021)] (Figure 1). The recent worldwide surge in e-commerce, fostering business-to-person sales as well as the significant increase in the volume of remittances, exacerbate further the need for cost-efficient cross-border transactions. Against that background, the current cross-border payment system is deemed to be slow, costly, and opaque, when compared to domestic payment systems.

**First, the international payment infrastructure is largely dominated by a few large players constituting the so-called correspondent banking system:** payment service providers (PSP) and international banks having a presence in several countries – or correspondents – settle international claims on their own accounts across borders. Correspondents totalize roughly 90 percent of cross-border payment volumes, the remaining 10 percent being covered by the marginal presence of money transfer operators (MTOs – e.g., Western Union). Further, the FSB indicates that 45 percent of surveyed banks rely on two or fewer correspondents for more than 75 percent of the value of their wire transfer. This concentration around correspondent banks is even higher for small and medium banks. Such market power can have potential negative impacts on costs and efficiency, especially for smaller banks more vulnerable to abuses from dominant positions [FSB (2018b)].

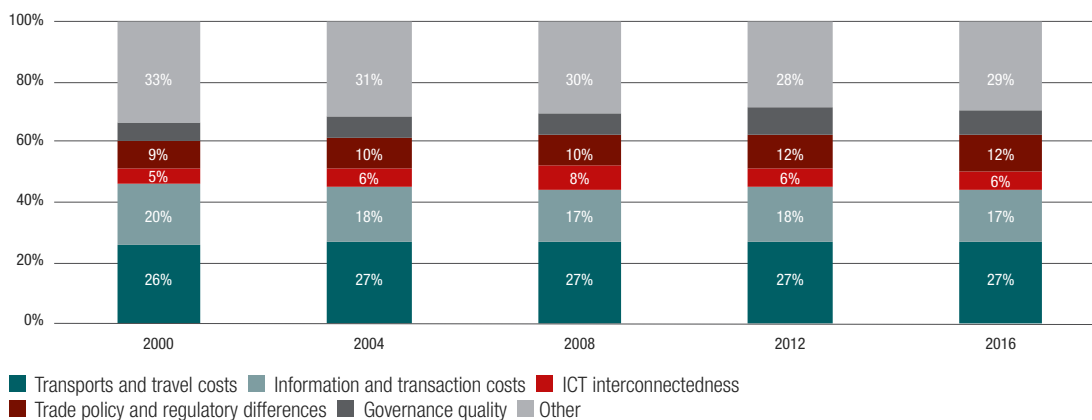
<sup>2</sup> Figures extracted from the website: <https://coinmarketcap.com/view/stablecoin>.

<sup>3</sup> To this date, after the initial development of virtual assets outside of established regulatory framework, the G7 and the G20 have called upon a coordinated research and collective regulatory effort on these issues and their links with payments. The G7 has mandated the Financial Stability Board (FSB) to frame regulatory aspects of stablecoins. The G20 has mandated the BIS Committee on Payments and Market Infrastructure (CPMI) to investigate/identify policy options to address weaknesses in cross-border payments, considering CBDCs, among other options. The Financial Action Task Force focuses on regulating virtual asset service providers, in light of the standards of financial regulation regarding anti-money laundering and combatting the financing of terrorism (anti-money laundering/combating the financing of terrorism – AML/CFT).

<sup>4</sup> Note that digital central bank money already exists under the form of commercial bank reserves deposited at the central bank.



Figure 1: Breakdown of international trade costs



Source: Rubínová and Sebtí (2021)

**Second, international payments remain costly compared to domestic payments:** in particular, banks realize larger margins on international transactions, nearly 20 basis points (bp) against 2 bp for domestic transfers [McKinsey (2016)]. The impact is particularly large in “low and middle-income countries” (LMICs), where remittances have become the main source of external financing, surpassing FDI flows in 2018.<sup>5</sup> While the global goal for the cost of remittances has been established at 3 percent in the Sustainable Development Goals for 2030, the current global average stands at 7 percent.

**Third, developments over the past few years exacerbated the risk of exclusion for LMICs from global markets:** as reflected by the decline of correspondent relationships in many remote regions [Durner and Shetret (2015), Alwazir et al. (2017)]. A yearly analysis performed by the Committee on Payments and Market Infrastructures (CPMI) has shown that correspondent banking relationships have been in severe decline since 2012, as open correspondent corridors and active relationships have declined respectively by 10 percent and 20 percent from 2012 to 2018 (Figure 2) despite a relative surge in volume of cross border payments [Rice et al. (2020)]. Such reduction in service has been driven by several factors:

- The increase in the compliance burden has discouraged banks from managing less profitable correspondent relationships [BIS (2018)]. Specifically, the necessity to

engage and manage AML/CFT measures, including the costly “know your customer” (KYC) procedure, has put pressure on the back-offices of correspondent banks, reducing the overall profitability of the relevant business line [Breslow et al. (2017)].

- Correspondent banks have generally adopted a lower risk profile to adapt to new post-GFC (global financial crisis) regulation (for which greater capital is required for riskier activities), notably discouraging them from engaging in jurisdictions where comprehensive due diligence of correspondent banks (receiving the funds) could not be enforced [IMF (2017)].
- The degree of integration of information and communication technology fosters interconnections between international and local PSPs. Less integrated jurisdictions are, thus, suffering from reduced competitiveness, which often cause the reduction in active corridors [BIS (2020)].

**Finally, the lack of interoperability between domestic payment systems makes cross-border payments slow and expensive compared to domestic payments:** if not regulated under a harmonized payment area, such as the Single Euro Payment Area (SEPA), international payments rely on specific bilateral relationships, which are less efficient as they raise legal, regulatory, and technical issues [ITU (2016)]. The lack of interoperability is even more salient for “low and middle-income countries” (LMICs), which report

<sup>5</sup> Remittances flows in LMIC are evaluated at U.S.\$462 bln, excluding China compared to U.S.\$344 bln for FDI. Remittances are on track to become the largest source of external financing in developing countries [WBG (2019)].

interoperability of their automated teller machines (ATMs) and points of sale (POSS) between countries at roughly 50 percent, compared to 86 percent for high-income countries [WBG (2012)].

## 2.2 Recent public and private sectors initiatives have improved the current cross-border payment system

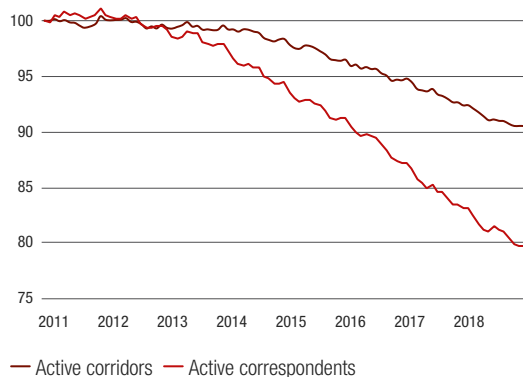
Recent innovations in exchange of information and digital repositories present the potential to raise the global efficiency of international payments by reducing the cost of cross-border transactions while increasing their speed of execution. A number of private and public initiatives have in particular emerged.

**Firstly, correspondents are undertaking collective initiatives to lower the transaction costs of international trade:** the pooling of customer regulatory information has been integrated into bank processes and should result in lower compliance costs (e.g., KYC depositories). Additionally, a sector-wide harmonization is being conducted by commercial banks and PSPs to establish global standards for payment messaging (ISO 20022 or SWIFT Global Payment Initiative), facilitating cross-border messaging while ensuring payment transparency.

**Secondly, fintech is gaining momentum especially in Europe:** where non-banks payment systems have experienced a rise of +529 percent in investments from 2013 investment levels [Bruno et al. (2019)]. They specifically tackle the retail segment by offering less costly and more rapid transaction services. This growth is mainly driven by two factors: the global expansion of online commerce and relative lower compliance costs, spurring from a more lenient regulatory regime, as most do not register as banks. Even if a complete substitution is not yet to be considered, this competitive pressure does, however, force prices down and foster operational innovation in the market.

**Thirdly, central banks shoulder the responsibility for harmonization of cross-border payment infrastructures by improving the interoperability of national payments infrastructures:** since 1999, the U.S. has been able to open its domestic system to cross-border payments by extending automated clearing house (ACH) services to foreign banks. These initiatives are, however, not widespread, notably

**Figure 2: Cumulative decline in correspondent banking**



Source: New correspondent banking data – the decline continues [BIS (2018)]

Note: In the context of international money transfers, bilateral relationships exist between countries, in the form of active corridors, generally operated by SWIFT or between banks, forming active correspondents.

because they feature lower margins for participating banks, making them less attractive overall. As an example, since it joined in 2003, Mexico has processed U.S.\$2.6 billion worth of cross-border transactions [BIS (2018)]. Central banks are also increasingly researching “distributed ledger technology” (DLT)-interoperability to link real-time gross settlement (RTGS) systems across the globe (see Box 1).

**Finally, international standard-setting agencies are actively researching common measures to address the above-mentioned frictions:** noted advances under the G20 mandate of the FSB to address the continuing decline of active corridors have focused on harmonizing regulations in national jurisdictions. Empirical research has recently shed light on the causes of de-risking, providing evidence that the loss of a corridor was related to Financial Action Task Force (FATF) country high-risk profiles, as well as their level of technological integration [Rice et al. (2020)].

## 2.3 Stablecoins could potentially increase efficiency of cross border payments, but their wide adoption would come with several risks

Created in 2014, stablecoins are crypto assets aimed at operating payments on distributed ledger technologies, allowing for peer-to-peer transactions. They are designed to address the most salient setback of crypto assets, namely their price volatility that prevents them from being used as a stable medium of exchange and unit of account, two fundamental

**BOX 1. PUBLIC INITIATIVE OF DLT-BASED INTERNATIONAL SETTLEMENT SYSTEM**

The Bank of Japan and the ECB's project ["Project Stella" – ECB, BoJ, (2019)] aims to leverage interoperability of "distributed ledger technology" (DLT) in different currencies. Such a system would rely on pre-funded deposit accounts, conditional payments, and guaranty lines. Just as for domestic payments, a central ledger would be operated based on these pre-funded accounts and exchanges would be performed, as well as recorded, irrevocably on the ledger. However, the project does not elaborate on the creation of a dedicated token.

The Monetary Authority of Singapore (MAS), jointly with the Bank of Canada and the Bank of England, has developed several models to establish a framework to use DLT in cross-border payments ["Project Ubin" – BoC, BoE, MAS (2018), Shabsigh et al. (2020)]. These models focus on the interoperability of decentralized ledgers to allow CBDCs to be used for cross-border payments:

- In the first model, central banks would issue CBDCs against their local currency on specific accounts opened by private entities – probably correspondent banks. The latter would hold accounts in multiple central banks to satisfy consumer demand in a varied range of currencies. This approach would provide a good technical solution to reduce both operating costs and settlement time as transactions would be performed within a single decentralized ledger. However, it would not significantly reduce the transaction costs associated with the system of correspondent banks, which is mainly driven by the regulatory reserves required when dealing with high-risk countries (as per Basel regulation).
- A second model explores potential agreements between central banks to operate CBDC accounts accessible to any participating banks. Practically, a ledger would exist for each currency in the monetary agreement and banks could directly access a foreign currency, without relying on any system but the DLT network, thus speeding up the process and potentially reducing fees to be paid to multiple actors. The foreign exchange rate would be determined by fractional reserve of the participating central bank's currency.
- Finally, the last model envisages the creation of a universal international currency, similar to the model of the stablecoin (reviving the idea of Keynes' bancor), against which all currencies would be quoted. Central banks and banks alike would open accounts on the DLT-operated networks and would trade the currency in line with their clients' needs. Exchange rates would be determined by fractional reserves.

characteristics of currencies. To do so, the price of the coin is anchored to a pool of assets. Stablecoins may use different mechanisms to stabilize prices: backing their value on assets or on algorithms controlling the supply of new stablecoins to preserve the value of existing coins [FSB (2020)].

Though their adoption as a new means of payment has been so far limited, their characteristics give them the potential for a more widespread use. Stablecoins could potentially represent an alternative means of payment for international settlement, bypassing the current correspondent banking system. Practically, one buyer would be able to purchase goods and pay in stablecoins, which could in turn be exchanged for an equivalent amount of fiat currency reflecting the price of the currency relative to the basket of currencies of the stablecoin. This process may increase the efficiency of cross-border payments by reducing transaction costs.

The use of a global medium of exchange is not a new phenomenon and has been undertaken by several national currencies. However, the specificity of crypto assets lies in the fact that they can be used at the same time as a means of payment, competing with national currencies [Benigno et al. (2019)]. Such a configuration would impose drastic changes on the existing financial system if largely used, the consequences of which remain to be formally assessed by regulators, in particular with respect to exchange rate, monetary, and competition policies.

**2.3.1 EXCHANGE RATE POLICIES – A POTENTIALLY LESS EFFICIENT MARKET CLEARING**

With a crypto asset used in parallel with national currencies, the fiat FX market would potentially clear less efficiently due to the lag induced by the currency being exchanged for stablecoins instead of another fiat currency. Market



clearing would be subordinated to the stabilization mechanism of the stablecoin based on an algorithm. The efficiency of the latter remains to be proven effective under minimal market depth and low liquidity in asset reserve markets. Central banks may hence face difficulties in implementing their exchange rate policy.

Another concern relates to the capacity of a private actor to maintain the desired level of the peg, as claimed [Bullmann et al. (2019)]. Similarly, to maintain fiat currency pegs, stablecoins need to balance their collateral (foreign exchange reserves) on a continuous basis, to stabilize the coin value. Stablecoins algorithms have not yet proven capable of maintaining the peg value. Without the insurance that the pegs could be maintained by liquidity injections, stablecoins would require a lender of last resort to secure trust in the coin value, as is the case for any fiat currency [Schich (2019)]. Yet, such facility comes at the cost of heavier regulation and dependency on a central agent, which intrinsically opposes the initial motive for the development of stablecoins.

### **2.3.2 MONETARY POLICY: A DILUTION OF THE MONETARY POLICY CHANNEL**

A widespread adoption of stablecoins would immunize the economy from central bank intervention. In particular, high-inflation currencies could see their citizens shifting towards

the stablecoin to pay domestically, thus creating a type of dollarization of their economies. The reduction in banks' deposits, turned into stablecoins, would, therefore, render monetary policy, based on the two-tier system, less efficient in accommodating exogenous shocks through the interest rate channel [(Edwards and Igal Magendzo (2003)]. In addition, economies featuring a partial integration of stablecoins in their payment systems would also suffer from any appreciation of the external currencies, causing output to contract on accounts of higher stablecoin-denominated costs. Experience from dollarized economies has shown that an appreciation of the U.S. dollar may cause up to 1.5 percent reduction in emerging markets outputs [BoE (2017)].

In the current international monetary system, a trilemma prevents the simultaneous pursuit of three policy goals: financial integration, fixed exchange rate, and independence of monetary policy (conceptualized in the Mundell-Fleming framework). In the event of an economic downturn, central banks tend to conduct expansionary monetary policies to pull down the interbank interest rate and foster investments. Under the current system, the decline in the relative interest rate would trigger capital outflows to more generous jurisdictions, bringing down the exchange rate, boosting imports, and fostering additional growth (through the exchange rate channel).

The adoption of stablecoins would constrain monetary policy, leading to a potential dilemma, a situation where countries are forced to adopt synchronous monetary policy, even in the event of free capital flows and flexible exchange rate [Benigno et al. (2019)]. This comes from the fact that stablecoins, by acting as a global currency and at the same time as a means of payment, may be used as a substitute at the local level. The risk of portfolio shift between different currencies through the global money would increase and imply that currencies would compete indirectly with the global alternative. Exchange rates would then have to remain constant to avoid a flight towards the global money. Furthermore, if exchange rates remain constant, interest rate parity, which is required when capital movements are free, implies that nominal interest rates should be equalized, and hence monetary policy in the trading countries should be synchronized. Such a synchronization has been adopted in certain regions, with some benefits (e.g., eurozone), yet if stablecoins were to be prevalent at the global scale, countries may find themselves forced to such synchronization. In practice, the international role the U.S. dollar already plays prevents some jurisdictions from conducting an independent monetary policy.

### 2.3.3 COMPETITION POLICIES: THE RISK OF DOMINANT MARKET POSITION ABUSES<sup>6</sup>

The entry of tech giants in the payment services market may reduce its contestability. These firms gain dominant position in international commerce by concentrating the operations of the marketplace on their own platforms, from advertising, to payments, and potentially lending. Indeed, tech firms' business models are based on Data analytics, Network externalities, and interwoven Activities (DNA), which allow them to benefit from network effects. Simply put, adding additional users

to the network increases the value to each user, notably through accessibility to a wider variety of individuals. These positive returns to scale usually create large barriers to entry and introduce a "winner takes all" risk. Furthermore, tech firms collect and manage users' data with more efficiency than banking actors, due to the inherent benefits for users to transmit data to the platform. Lastly, a decline in the use of cash might further reduce the market contestability of payments; in the event of no alternative public option, consumers could be subject to an oligopolistic behavior from payment infrastructure providers. Against this background, a first challenge relates to the protection of consumers' data, while a second critical issue relates to the need for new regulatory measures to reduce the risks of potential anti-competitive practices from dominant tech giants.

## 3. THE OPPORTUNITY OF CBDCs TO ADDRESS LOCAL PAYMENT SYSTEMS CHALLENGES

### 3.1 Brief overview of domestic wholesale payment infrastructure system – efficient but liquidity requirements remain high

While largely recognized as efficient, wholesale payments have been associated until recently with a trade-off between settlement risk reduction and up-front liquidity requirement for banks. National payment infrastructures are multi-layered and involve a multiplicity of actors in a two-tier model. Exchanging goods and services against cash or deposit claims electronically is made possible by a network of participants, operating transfers on a daily basis. Commercial banks operate large-value payments (LVP), as they deal with larger corporate and financial clients. These payments could generate settlement risk,<sup>7</sup> i.e., the risk that a counterparty

**Table 1:** RTGS systems opening hours

OPERATING HOURS (LOCAL TIME)	AUSTRALIA	COLUMBIA	EUROZONE	NORWAY	U.K.	U.S.
Opening time	07:30	07:30	07:00	06:40	06:00	21:00 (ET) the previous calendar day
Close for customer transfers	16:30	20:00	17:00	No standard cut-off times	16:00	18:00 (ET)
Final close	18:30	20:00	18:15	16:30	16:30	18:30 (ET)

Source: Allsopp et al. (2008)

<sup>6</sup> A wider analysis of the regulatory challenges and policy options on the topic have been explored by the OECD and its Delegates within the Competition Committee in June 2019 and the Committee on Financial Markets, which summarizes its conclusions in a recent paper [OECD (2020)].



does not receive its payment, while having disbursed the related securities. As wholesale payments became larger, coping with this settlement risk became paramount.

The move from deferred net settlement (DNS)<sup>8</sup> systems to RTGS wholesale systems in the 1990s and the progressive adoption of fast payment systems for retail infrastructure since the 2000s [BIS (2016)] have reduced substantially the settlement risk associated with payments. RTGS systems are dedicated platforms operated by central agents, allowing the immediate execution of wholesale payments in central bank money. Such systems, like the European TARGET2 or the U.S. Fedwire Funds Service, execute real-time settlements in central bank money. Settlement risk is then reduced as reserve pre-funding ensure the availability of funds, while dealing in central bank money protects the transaction from the default of the operator, given central banks are virtually immune from default in their own currency. By 2016, roughly 80 percent of the world central banks had implemented some form of RTGS.

Yet, the large adoption of RTGS systems, and the associated lower credit risk, has come at the cost of higher liquidity needs for commercial banks [Banque de France (2019)]. Indeed, RTGS systems require individual accounts to present the available funds to settle the transaction. If the funds are insufficient, the transfer is not performed or the payer needs to drawdown a credit line, often collateralized.

Furthermore, the system is only operational during central banks' opening hours, as outlined in Table 1 for six RTGS systems, which reintroduces settlement risk in the system. The collateralization of intra-day liquidity provided by central banks indeed causes mispricing as central counterparties shift their liquidity drawdown towards the end of the day, to save costs [Pfister (2018)]. To cope with this development, some central banks actively research full availability in their RTGS systems. For instance, the European Central Bank (ECB) TIPS operates pre-funded accounts, which can perform settlements on a 24/7 basis, but those accounts are funded only during the opening hours of the ECB and do not feature netting mechanisms.<sup>9</sup>



<sup>7</sup> BIS Glossary: settlement risk pertains to “the risk that settlement in a funds or securities transfer system will not take place as expected.”

<sup>8</sup> DNS aggregated daily transactions to net opposing positions and reduce liquidity intensiveness of wholesales payments yet building up credit risk as open positions increased.

<sup>9</sup> Netting is the process of offsetting the value of opposing positions or payments due to be exchanged between several parties. It generates credit and liquidity risks during the time the position remains open.



### 3.2 New technologies have the potential to increase further the efficiency of wholesale payment, though the overall gains appear limited

Wholesale central bank digital currencies (CBDCs) would represent a design increment to central bank money, which could present opportunities to reduce further intermediary costs and liquidity needs associated with the current RTGS systems.<sup>10</sup> This type of CBDC would exclusively aim at facilitating the exchange between the central bank and its designated central counterparties (systemically important commercial banks having access to the central bank's balance sheet through reserve deposits), within the interbank market. The main evolution from the existing system would be the migration from a gross system with partial availability to a netting system, featuring complete availability. Enhancement to the current system could include a reduction in settlement risk, liquidity needs [Garrat (2016)], and intermediary costs [Bech et al. (2017)], as well as ensuring complete availability of the payment system.

However, the DLT efficiency remains to be proven efficient and scalable. The execution speed of current DLT-systems would not support large-value payments (LVPs), notably due to lags in the validation process. Furthermore, no project large enough has been realized to test for the significance of cost-effectiveness of DLT, despite some interesting proofs-of-concept (see Box 2).

### 3.3 A universal CBDC could answer the decline in the demand for physical cash, yet with some profound economic implications

#### 3.3.1 DEMAND FOR MEANS OF PAYMENT AND STORE OF VALUE PROVES INCREASINGLY DIGITAL

The decline of physical cash as a means of payment to the benefit of electronic money is noticeable in several developed countries. From 2006 to 2016, the share of transactions paid by cash declined: depending on the computational method, the yearly average reduction ranges from 1.3 percent to 2.2 percent across 11 countries and is forecasted to decline

#### BOX 2. THE CANADIAN CADCOIN PROOF-OF-CONCEPT AND POLICY RESEARCH

In 2016, the Bank of Canada (BoC), jointly with Canada Payments and the R3 Consortium, developed a pilot for its own CBDC: the CADcoin.<sup>11</sup> Their goal was to achieve operational efficiency through the creation of a wholesale currency, notably aimed at reducing back-office costs for users and the liquidity needs associated with RTGS systems. Indeed, the Canadian RTGS system mobilizes an increasing amount of liquidity, with roughly a tenth of the Canadian GDP (U.S.\$175 billion) exchanged daily in central bank money.

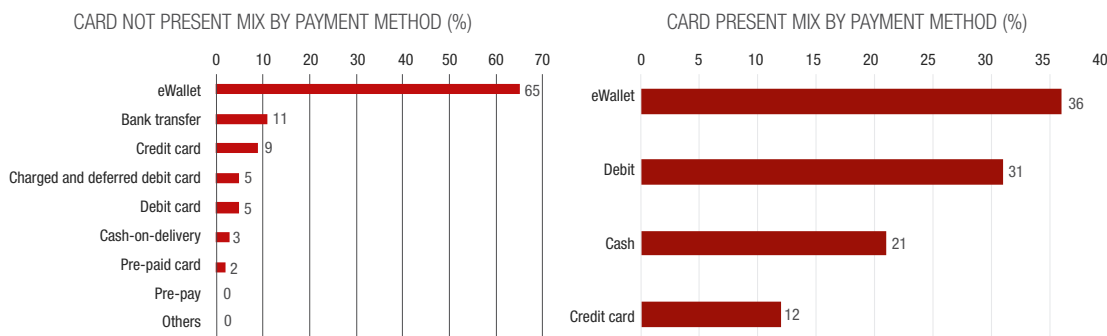
The CADcoin is a DLT-operated central bank money based on digital depository receipts (DDR) that act as a pre-funded central bank zero-interest bond sent to the receiving counterparty. Transactions are netted and settled throughout the day until a "cashing-out" phase, which updates banks' positions in the central bank accounts. In essence, the BoC allows central counterparties to credit a segregated account on its books, in exchange for DDR to be spent during the day. Furthermore, because the money is deposited at the central bank, in its own currency, the credit risk would remain virtually nil. Liquidity needs are then reduced as DDR allow for an instantaneous netting of commercial banks' transactions, supporting higher volumes of transactions.

Overall, the project demonstrated successfully how DDR could be used to reflect existing securities markets on a digital ledger, featuring the issuance of securities from different actors and the existence of central bank issued cash to transact with. However, the BoC recognizes that the project's scope was not sufficiently large to detect any significant cost-saving opportunities related to the use of DLT.<sup>12</sup>

<sup>10</sup> Although not within the scope of this article, the authors recognize similar appetite for DLT existing in other capital markets, such as equity payments, to facilitate the settlement cycle or delivery versus payment [BIS (2020)].

<sup>11</sup> Several sources relay presentations and analysis of the project, notably Bank of Canada (2017), Chapman et al. (2017), and Bank of Canada (2018).

<sup>12</sup> Additionally, a legal framework is needed. In 2018, roughly 75 percent of central banks did not know or did not have the capacity to issue a new legal tender for a wholesale CBDC [Barontini and Holden (2019)].

**Figure 3: Retail payment method mix in China (2017 figures)**

Source: Worldpay (2018)

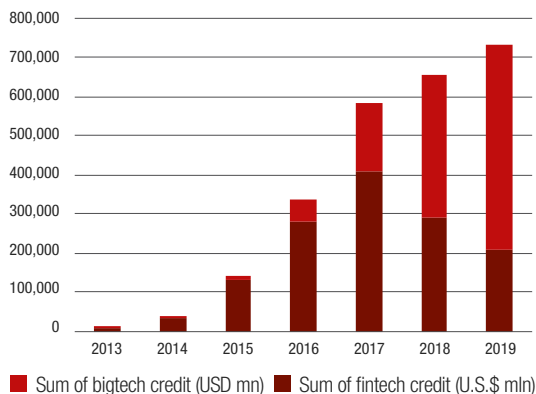
further at an annual average rate of 1.4 percent by 2026 [Khiaonarong and Humphrey (2019)]. Compositional changes in the population drive this trend, as younger adults use digital currencies (cards and mobile phones) for payments more often than physical ones.<sup>13</sup> Yet, cross-country differences in the use of cash remain large; the Germans pay for almost 70 percent of total transactions in cash, card, and e-money, compared to 10 percent for the Norwegians [Khiaonarong and Humphrey (2019)]. The general decline in the use of cash is associated with several opportunities and risks (Box 3).

### 3.3.2 AN INCREASING ROLE OF DIGITAL CASH PROVIDERS, ESPECIALLY IN EMERGING ECONOMIES

Accompanying the rise of online commerce, new payment systems have emerged and became widespread in some economies. These systems, more prevalent in developed economies, operate as overlay systems that relay the existing payment infrastructure (e.g., Paypal, Apple Pay). Alternatively, some platforms have developed a settlement system in-house, which features proprietary wallets [e.g., M-Pesa, AliPay, WeChat Pay – BIS (2019)]. While the former remains limited in use (Apple Pay in the U.S. only penetrates circa 7 percent of the population), presumably due to the established credit card infrastructure, the latter has experienced staggering growth in the past years. AliPay and Wechat Pay, respectively, account for 500 million (36 percent of the Chinese population) and 900 million users (65 percent), together realizing 94 percent of mobile payments in China. These new systems are now prevalent payments in China, with 36 percent of “card present” payments (based on the credit card infrastructure) and a staggering 65 percent of “card not-present” payments (Figure 3). Nonetheless, the People’s Bank

of China has been active in the development of a pilot CBDC, launching public digital wallets in four major cities to try to attract a share of the Chinese mobile payments.

These platforms generally operate as money market funds (MMFs), wherein they store and invest currency deposited in productive asset (generally repos or treasury bonds). Thus, they provide users with a store of value, alternative to banks’ deposits. In China, these tech firms have grown to represent a significant part of traditional short-term funding, to such an extent that the Chinese government developed a dedicated clearing house to manage and secure these flows. A few of them actively engage in lending, however, this activity remains small relative to the global credit to private actors (less than 1 percent of total credit – see Figure 4 – [IMF (2019)].<sup>14</sup>

**Figure 4: Global credit from tech firms (2013-2017)**

Source: IMF (2019)

Note: 2019 fintech lending volume figures are estimated on AU, CN, EU, GB, NZ and US. 2 Data for 2019. 3 Domestic credit provided by the financial sector. Data for 2018.

<sup>13</sup> Here results for India could be counterintuitive as both birth and death rates stand high. According to “Beyond Cash” [USAID (2016)], these results might be due to the lack of penetration of digital infrastructure – “only 21% of these who earn digitally can save money in a bank account” – and the resulting low acceptance of digital means of payment by merchants.

<sup>14</sup> Big tech and the changing structure of payment services [BIS (2019)].

**BOX 3. THE POTENTIAL RISKS AND OPPORTUNITIES ASSOCIATED WITH THE DECLINE OF CASH USE**

Central banks bear the responsibility for maintaining the cash infrastructure of their given currency, which involves costs related to printing, designing, delivering, and replacing notes, among others. They earn, in turn, interest payments on the total of banknotes issued. Stronger efficiency gains related to the maintenance of a physical infrastructure are potentially associated with the digitalization of money. It is also associated with several potential gains related to a better traceability of payment, reducing the possibilities for tax evasion (in particular for VAT schemes) and other illicit financial flows.

One direct consequence of the decline in the use of cash is to lower seigniorage income (interest paid by banks in exchange for accessing central bank money) that can be quite substantial depending on the structure of the money demand. For instance, it ranged between U.S.\$1-2 billion since the year 2000 at the Bank of Canada [Engert and Fung (2017)].

Furthermore, the decline of cash and a potential substitution towards crypto assets may be ultimately associated with financial risks. In the theoretical case of a cashless society, e-money and deposits would not be convertible into cash. The different forms of money would behave as financial assets, with their value against each other being continuously reassessed. The different forms of money would become an imperfect substitute and financial fragility could increase as the risk of runs from some forms of currencies emerges [Landau and Genais (2018)].

Finally, an effective decline in cash use would ultimately reduce the privacy of consumers' spending. As such, if effects of privacy on spending patterns remains debated [Acquisiti et al. (2017)], governments shall carefully define the means permitting the protection of consumer data.

Those risks related to the decline of cash are additional arguments feeding the debate about the opportunities to issue a CBDC in order to preserve demand for central bank liability and related seigniorage income.

**3.3.3 A GENERALIZED ACCESS CBDC IS LIKELY TO DISRUPT THE FINANCIAL MARKETS, YET WITH POTENTIAL CONSIDERABLE BENEFITS IN THE CONDUCT OF MONETARY POLICY****3.3.3.1 Risks for financial stability in the deposit market and for economic growth**

The provision of a risk-free option in the deposit markets is likely to increase the risk of bank runs from private actors unless protective dispositions are taken to counterbalance these effects. The threat of bank runs exists due to a lack of trust from consumers in a bank (or a group of banks) relative to their central liability (i.e., cash). By extending access to a risk-free bank liability (central bank money) through a CBDC, central banks would increase this threat. Different options would exist to dampen this risk, notably by designing restrictions or disincentives to portfolio shifts. First, promoting a financial safety net should preserve trust in the system in the event of a crisis. Among others, remaining lenders of last resort to immunize the economy from systemic risk losses, as well as protecting consumer accounts through deposit guaranty schemes, would be crucial for central banks. Second, central banks could also impose portfolio ceilings and dynamic transfer fees in order to curb portfolio movements, which could take the form of a volume fee, on the number of transactions, or a value fee, on the amount transferred [Mancini-Griffoli et al. (2018)]<sup>15</sup>.

The introduction of a public digital currency and the new deposit role of central banks would reduce financial market intermediation and potentially lower the profitability of the banking sector. The possibility for consumers to satisfy their demand for deposit via a risk-free asset is likely to reduce banks' main funding through deposits. In the current system, banks carry out transformations of short-term liquid deposits to long-term illiquid investments for individuals or firms. In addition, banks also have the capacity to create money, through seigniorage-financed lending<sup>16</sup> (even though this funding capacity is strictly regulated by central banks' reserve requirements, as a percentage of deposit held). With the creation of a public digital deposit, the central bank would reduce the amount of deposits available to banks and thus further deprive the banking sector of its primary funding mechanisms. Banks may then turn to commercial paper or equity for additional funding, yet these are likely to be more

<sup>15</sup> It should be noted that regulators should question the fairness of such a fee with regards to income inequality, not to disadvantage less endowed households.

<sup>16</sup> Commercial banks can create money through accounting by granting a loan and subsequently providing the funds in deposit accounts. Hence, the banks' balance sheet remains balanced and money, under the form of a deposit, can be expensed in the real economy. It is called seigniorage as in this case the banks' liabilities (deposit accounts) is used as currency.

costly and less stable, since the banks would retain the most junior share if a credit event occurs.

Introducing an interest-bearing CBDC may further deepen financial market disintermediation unless the supply of lending has the capacity to adapt. If an interest-bearing CBDC is introduced, the rate duly set by the central bank would constitute a floor to the market rate due to the risk-free characteristic of the central agent. This would influence the other actors in the deposit market; to remain competitive banks would need to increase their deposit rates vis-à-vis this risk-free option. This situation would shift up the supply curve faced by individual banks, as competition increases, and

would bring about a subsequent reduction in banks' margins, especially if the price hike cannot be fully passed on to the lending rates [Chiu et al. (2019)]. Yet, if banks hold sufficient market power, it would be possible for them to pass on more of the additional costs to their lending rates, thus protecting their profit margins, and increasing their activities, by attracting more deposits [Mancini-Griffoli et al. (2018)]. However, as higher funding costs cascade into higher loan rates, potential adverse impact on economic growth may arise.

Depending on its design (see Box 4), account CBDC has hence the potential to weaken the overall prominence of commercial banks in the financial sector, to the benefit of

#### **BOX 4: POSSIBLE DESIGNS FOR A CBDC<sup>17</sup>**

**The generalization of the access of a digital central bank liability to the wider population could rely on three distinct designs:**

**The first option would be to reduce the disruption to the current system by preserving the two-tier system, the banking business model and the existing form of cash:** commercial banks could offer segregated accounts to consumers. Exchanges would then mimic current bank transfers and be operated by the existing organizational structures. Differences with the current system would lie in the legal arrangements pertaining to the rights of banks over this new form of money and the willingness of regulators to amend the current system. In this scenario, central banks offer an alternative public store of value, under the form of a protected account. Cash could, therefore, be preserved.

**The second option would be to allow the public to hold accounts directly at the central bank, with potentially stronger effect to lower operating costs and settlement risks while still preserving cash:** under this scenario, the central bank would provide a platform for exchange, immunizing the payment system from private actors' credit risk. Any payment performed on the platform would be irrevocable and guaranteed by the central bank. The need for intermediaries would then be reduced, as central banks would undertake a new role as payment system providers for individuals and non-financial firms. It would also need to manage individual deposit accounts in place of retail banks. In this case, overall operating costs could be reduced, as a unique central actor would perform all national transfers and thus would benefit from economies of scale. Importantly, central banks do not currently hold the adequate organizational setup to achieve these new functions, which constitute an important barrier for the adoption of this scenario. Cash could be preserved under this scenario, yet it would become less useful as most transactions could be performed under virtually frictionless platforms.

**A token CBDC represents the furthest iteration to the current system, as it leverages DLT technology to substitute the existing payment infrastructure and the nature of cash:** under this scenario, cash could be phased out completely and be replaced by a CBDC. Similar to wholesale CBDCs, all participants in the payment market (in this case, everyone) would hold a wallet from which exchanges would be performed. Each node would also participate in updating the version of the distributed ledger according to defined consensus mechanism. All tokens would then be created either by a transfer of cash or through the validation of this consensus mechanism. This scenario would thus preserve the peer-to-peer characteristic of cash, as DLT systems are based on the authentication and the validation of transactions by the decentralized network and do not require a central database gathering all information.

<sup>17</sup> The authors have selected only some of the design scenarios of a generalized CBDC. A more complete analysis can be found in Engert and Fung (2017).



central banks with two potential risks for economic growth, a reduction of the allocative efficiency of credit and a potentially negative impact on lending [Greenwood and Jovanovic (1990), Cetorelli and Gambera (1990)]. In order to reduce this risk of disintermediation, central banks could substitute retail deposits and lend directly to banks the money transferred to CBDC [Mancini-Griffoli et al. (2018)]. By disentangling the deposit and lending activities of banks, central banks would then secure the role of private actors to allocate credit while still reaping the benefits of a general-purpose CBDC. However, in such a scenario, central banks still need to devise a framework establishing rules of financing for banks, notably aimed at preserving central bank independence, which is crucial to guaranty the credibility of monetary policy [(Bordo and Siklos (2014)].

### 3.3.3.2 New tools for monetary policy and new risks for central banks

By controlling the rate of return on an interest-bearing CBDC, central banks could gain total control over the market rate, ultimately strengthening the monetary policy transmission channel. The difficulties met by central bankers to ensure the transmission of monetary policy to the real economy during the last (double dip) financial crisis has highlighted a

weakness of our two-tier monetary order. Indeed, as the credit freeze occurred in Europe in 2010-2011, banks impeded the transmission mechanism of monetary policy through the interest rate channel and thus prevented the economy from adapting to the severe downturn. Those difficulties would be arguably stronger in a system where the share of privately operated money is larger. By contrast, an interest-bearing CBDC could bypass central counterparties and communicate rates to the market directly, thus allowing a complete transmission of monetary policy. Because central banks are the safest counterparty in their own currency, any rate they offer is virtually risk-free and thus constitutes the market floor. The rate would then be offered to all, and not limited to a single tier of central counterparties. In essence, CBDC holders would have an incentive to spend or to hoard depending on their expectations on the CBDC rate, thus smoothing potential output gaps.

An interest-bearing token CBDC could more specifically prevent economies from entering a “liquidity trap”, by alleviating the “zero-lower bound” (ZLB), which was hit by several advanced economies following the global financial crisis (GFC). This barrier to negative interest rates actually exists due to the presence of a zero-interest asset in the economy: cash.

Indeed, if the central bank can set negative rates, investors always have the option of holding cash, as a safe asset earning no interest. This possible “flight-to-safety” thus makes any increase in liquidity inefficient. The possibility of a flight-to-safety disappears if an interest-bearing CBDC supplants cash; central banks would gain immediate impact when applying a negative rate to boost currency circulation. Consequently, only an interest-bearing CBDC, with no remaining cash in the economy, would strengthen the efficiency of monetary policy. In contrast, implementing a non-interest-bearing CBDC (the closest to cash) would only have the effect of raising the lower bound from negative rates to zero [Sveriges Riksbank (2018)]. The current ZLB stands below zero (e.g., -0.4 for the eurozone) due to the relative burden of holding cash (e.g., cost of moving physical cash, insurance costs). In a digitized environment, there is no such physical slack. A negative policy rate would then always push investors towards holding CBDCs instead of central bank deposits, effectively raising the ZLB to zero.

Finally, an account-based,<sup>18</sup> interest-bearing, generalized CBDC would also provide a platform for Friedman’s famous “helicopter money” [Engert and Fung (2017), Bordo and Levin (2017)]. As popularized by Bernanke (2002), this unorthodox monetary tool aims to combat risks of deflation in a low rate environment by increasing consumer demand, and thus welfare. This fiscal policy measure provides consumers with additional income, financed by newly printed money rather than by the monetization of existing assets, as traditionally undertaken in central bank operations. This emergency income handed over to consumers and businesses would be financed on the central bank balance sheets, rather than by national treasuries, through write-offs on the asset side or using the

subsidies of other monetary operations [Galí (2020)]. If, on the liability side, helicopter money is distributed under the form of a CBDC, central banks could then benefit from an additional option to overcome the ZLB and further strengthen monetary policy. Some argue, however, that this solution may prove less efficient than the current targeted monetization of government debt, with the latter remaining sovereign in the allocation of fiscal support [(Blanchard and Pisani-Ferry (2020))].

#### 4. CONCLUSION

Global trends in international and domestic payments are driven by buoyant innovations that challenge established systems, both in the private and the public sphere. The digitalization of payment messaging and security has helped bring down some of the existing entry barriers, resulting in acknowledged portfolio shifts towards new virtual assets. We argue that these developments came about partly to cope with existing limitation in payments but also questioned policymakers on the collective actions needed and potential options to address such limitations. The international payment system features the most advanced proof-of-concept and focuses primarily on fostering the integration of emerging economies in global trade. On the domestic front, recent crises have shed light on opportunities to improve the conduct of monetary policy. Overall, central bank digital currencies remain a relatively new field in the economic and financial literature and many questions, notably on financial stability and privacy, remain. In this, it is likely that the numerous projects undertaken in central banks, intergovernmental organization, and academia will provide valuable insights in the years to come.

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<sup>18</sup> Even though helicopter money could be programmable on a DLT, it may appear difficult to forecast its characteristic with any degree of precision, hence calling for a centralized provision of the CBDC to achieve this specific goal.



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