

# Crypto assets and central bank digital currencies

potential implications  
for developing countries



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## EXECUTIVE SUMMARY

This Policy Review provides an accessible, yet academically informed, discussion of main implications of crypto assets for the monetary, financial and payments systems in developing countries. It asks four main questions: (i) what are the trends and drivers of crypto adoption, and which developing countries have been concerned the most; (ii) what do the economics of crypto assets imply for the ease of payments, financial inclusion, privacy, illicit financial flows, and currency substitution, as well as the architecture of the international monetary system (IMS); (iii) how can regulation shape the evolution of crypto adoption and what solutions can central bank digital currencies (CBDCs) and fast retail payment systems provide; and (iv) are the monetary, financial and payments systems in developing countries ripe for embracing crypto assets?

Crypto adoption has been strong in developing countries, probably because their financial systems tend to be narrower and less regulated, their macroeconomic stability lower, and their population younger and therefore more digitally savvy. The Policy Review recognizes that crypto assets promise to solve long-standing problems of financial markets in fostering financial inclusion and providing efficient, secure, and affordable monetary transfers, while preserving cash-like privacy. Examining the economics of crypto assets, it, however, shows that most of these promises are elusive. Cryptocurrencies have no intrinsic value which, combined with their sizable volatility, makes them unsuitable as a unit of account, means of payment and store of value. Beliefs in their capacity to increase financial inclusion, reduce costs of remittances, and ease access to investment finance and export credit may, nonetheless, draw developing countries towards crypto adoption. However, any substitution of national sovereign currencies by crypto assets can jeopardize financial stability and the effectiveness of monetary policy, reduce the effectiveness of capital controls, pose risks to countries' monetary sovereignty and, through the pseudonymous character of crypto assets, facilitate illicit financial flows. Some of these challenges can be addressed by regulation, aimed at ringfencing existing financial systems, protecting retail users, and bringing crypto exchanges under Know-your-customer (KYC) and Anti-Money Laundering/Combating the Financing of Terrorism (AML/CFT) requirements. Others, such as improving financial inclusion and monetary stability, as well as ensuring secure and transparent access to public money could eventually be addressed by CBDCs. However, given the many technical and policy challenges associated with CBDCs, developing countries may consider the potential of fast retail payment systems and improved auxiliary digital infrastructure to provide more rapidly available financial solutions.

## LIST OF ABBREVIATIONS

|                |  |
|----------------|--|
| <b>AML/CFT</b> | Anti-Money Laundering/Combating the Financing of Terrorism   |
| <b>BCBS</b>    | Basel Committee on Banking Supervision   |
| <b>BIS</b>     | Bank for International Settlements   |
| <b>BOJ</b>     | Bank of Jamaica  |
| <b>CBB</b>     | Central Bank of Brazil   |
| <b>CBDC</b>    | Central Bank Digital Currency  |
| <b>CEMAC</b>   | Communauté Économique et Monétaire de l'Afrique Centrale (Central African Economic and Monetary Community) |
| <b>CFTC</b>    | Commodities Futures Trading Commission   |
| <b>CPMI</b>    | Committee on Payments and Market Infrastructures   |
| <b>DLT</b>     | Distributed ledger technology  |
| <b>ESMA</b>    | European Securities and Markets Authority  |
| <b>FATF</b>    | Financial Action Task Force  |
| <b>FRPS</b>    | Fast Retail Payment Systems  |
| <b>FSB</b>     | Financial Stability Board  |
| <b>IFFs</b>    | Illicit Financial Flows  |
| <b>IMF</b>     | International Monetary Fund  |
| <b>IMS</b>     | International Monetary System  |
| <b>GFC</b>     | Global Financial Crisis  |
| <b>KYC</b>     | Know-your-customer   |
| <b>MiCA</b>    | Markets in Crypto Assets   |
| <b>NPCI</b>    | National Payments Cooperation of India   |
| <b>PBOC</b>    | People's Bank of China   |
| <b>P2E</b>     | Play to Earn   |
| <b>P2P</b>     | Peer to Peer   |
| <b>RBI</b>     | Reserve Bank of India  |
| <b>SDGs</b>    | Sustainable Development Goals  |
| <b>SEC</b>     | Securities and Exchange Commission   |
| <b>SMEs</b>    | Small- and Medium-Sized Enterprises  |
| <b>SSA</b>     | Sub-Saharan Africa   |
| <b>UEMOA</b>   | Union Economique et Monétaire Ouest Africaine (West African Economic and Monetary Union)                   |
| <b>UPI</b>     | United Payments Interface  |

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## 1. Introduction

Monetary and financial systems have become exposed to privately issued digital representations of value with monetary characteristics that rely on encryption, such as distributed ledger technology (DLT), and are generally known as crypto assets.<sup>1</sup> The rapidly expanding crypto asset sphere comes mainly in two forms: cryptocurrencies (e.g., Bitcoin) and stablecoins (e.g., USD Tether).<sup>2</sup>

Advocates of crypto assets promise an emancipation from State control and financial institutions, combined with solving the long-standing problems of monetary and financial systems in ensuring efficient, secure, and affordable monetary transfers, and fostering financial inclusion, while preserving cash-like privacy. The use of crypto assets has been driven by low trust in State regulation and banks following the Global Financial Crisis of 2008 (GFC), the development of digital technology (such as cloud computing and blockchain), and an expansion of digital payment systems and related infrastructure (e.g., pre-paid cards, e-wallets, or web-based services). Expected rapid high returns on crypto asset holdings and increased online shopping and contactless payment during the Covid-19 pandemic further pushed their use.

Although ultimately not realized (e.g., Pistor, 2021; Prasad, 2021: 168–175), the announcement in June 2019 by Facebook (now Meta) and its partners to launch a payments system based on a global stablecoin (Libra, then Diem) provoked steeply increased interest by central banks in considering Central Bank Digital Currencies (CBDCs). CBDCs (e.g., Sand Dollar, e-Naira) are digital forms of sovereign currencies, which can help to improve financial inclusion, address risks posed by crypto assets, and help safeguard consumer protection, financial stability, and monetary sovereignty (e.g., Powell, 2020; BIS 2022a).

The collapse of various crypto assets in May 2022 and crypto exchanges in November 2022<sup>3</sup> triggered a sizeable reduction in crypto asset valuation. These events shared characteristics of the GFC, such as speculative bubbles based on supposedly high-yielding low-risk assets, and sizable losses by retail investors (Cornelli et al., 2023). However, financial turmoil remained of a much smaller scale, probably because of the still relatively small size of the crypto world and limited interoperability between individual crypto assets. At the same time, it dampened beliefs in the promises of crypto ecosystems and bolstered the view that crypto assets are inherently unviable because they lack sovereign backing and stringent regulation.

Nevertheless, it is widely expected that these events do not imply an end to crypto and that at least some of its underlying technologies will persist and evolve.<sup>4</sup> Technology that makes financial intermediation faster, cheaper and more efficient, public blockchains that reduce the need for intermediaries, and self-executing contracts that add functionality to traditional financial services may eventually provide effective solutions to the long-standing problems of monetary and financial systems. Given that exploiting the benefits of these

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<sup>1</sup> Encryption is a form of record keeping that can certify transactions without an intermediary.

<sup>2</sup> With crypto assets being the most general term and cryptocurrencies the most widely used form of crypto assets, these two terms are often used interchangeably. Technically speaking, crypto assets may be subdivided into (i) non-fungible tokens (NFT), which are mostly used by artists to monetize and control their work, or in play-to-earn games, and can be resold on NFT-marketplaces, and (ii) private digital currencies. The latter can be divided into cryptocurrencies, i.e., private digital currencies that have no backing and whose value fluctuates relative to a monetary unit of account depending on supply and demand, and stablecoins, i.e., private digital currencies whose value is pegged to a fiat currency (such as the dollar) or backed by collateral.

<sup>3</sup> For a chronology of events as of mid-November 2022, see <https://www.cnn.com/2022/11/11/crypto-peaked-in-nov-2021-investors-lost-more-than-2-trillion-since.html>. For an account of the collapse of FTX, see Joshua Oliver “‘Sam? Are you there?!’ The bizarre and brutal final hours of FTX”, *Financial Times*, 8 February 2023, <https://www.ft.com/content/6e912f25-f1b7-4b19-b370-007fbc867246>.

<sup>4</sup> See, e.g., Kenneth Rogoff “Will crypto survive”, *Project Syndicate*, 25 November 2022, <https://www.project-syndicate.org/commentary/crypto-regulation-after-ftx-debacle-by-kenneth-rogoff-2022-11>; “Is this the end of crypto?”, *The Economist*, 17 November 2022, <https://www.economist.com/leaders/2022/11/17/is-this-the-end-of-crypto>. Hyun Song Shin, “The great crypto crisis is upon us”, *Financial Times*, 16 December 2022, <https://www.ft.com/content/76234c49-cb11-4c2a-9a80-49da4f0ad7dd>. See also Prasad, 2021.

technologies may imply a convergence between the architecture of the crypto world and that of traditional finance, it is important to consider how crypto affects traditional monetary and financial systems.

Crypto assets affect monetary and financial systems mainly in three ways (Prasad, 2021; Shin, 2021; Ahnert et al., 2022). The increased accessibility, speed and ease of digital payments can provide new solutions to financial inclusion and cost of financial services, although without also providing an alternative monetary anchor. The centrality of data in the digital economy poses new challenges concerning privacy and competition, with network effects reinforcing impacts on monetary sovereignty and architecture. Each of these three issues – ease of payments and monetary anchor, privacy, and competition and monetary sovereignty – has a domestic and an international dimension.

Existing research on domestic implications (IMF, 2021; Prasad, 2021; UNCTAD, 2022a) highlights the benefits from digital payments, including potentially enhanced financial inclusion and more efficient payment systems. It also points to potential risks concerning privacy (as reflected in challenges for consumer protection) and competition issues (as expressed in cryptoization). Cryptoization involves the replacement of domestic central bank money by crypto assets, which can adversely affect financial stability, the effectiveness of monetary policy and bank-based financial intermediation, as well as government revenues from seigniorage. Related policy recommendations generally emphasize regulation. But they also point to the potential issuance of a CBDC, for central banks both to provide a public low-cost alternative to crypto assets and to continue ensuring monetary and financial stability (e.g., Brunnermeier et al., 2019; BIS, 2020, 2022a; UNCTAD, 2022a).

Existing work on the international dimension emphasizes faster, cheaper and more secure cross-border payments. This can provide benefits, such as for remittances. But it can also pose risks by magnifying cross-border transmission of economic shocks and altering capital flow dynamics with adverse implications for the effectiveness of domestic monetary policy and capital controls or, related to privacy issues, by facilitating illicit financial flows (IFFs), including money laundering and terrorist financing (e.g., IMF, 2020; Feyen et al., 2021; UNCTAD, 2022b). Competition issues concern increased risks of currency substitution, i.e., increased accessibility of cryptocurrencies, stablecoins or foreign CBDCs for domestic use could cause the replacement of a country's sovereign currency (e.g., Adrian and Mancini-Griffoli, 2021), as well as implications for the role of the dollar in the international monetary system (IMS) (e.g., Brunnermeier et al., 2019).

The bulk of this existing work features general discussions of the macro-financial implications of crypto assets. It pays only occasional attention to specific implications for developing countries, pointing to existing digital divides that may complicate the adoption of digital money and payments in developing countries (e.g., Feyen et al., 2021; UNCTAD, 2022a, b). However, a broader focus on these implications appears important because (i) the intensity of crypto adoption has been most pronounced in developing countries (Chainalysis, 2021); (ii) their monetary and financial systems lag in many respects in terms of accessibility, affordability, and trust, and therefore may be particularly exposed to impacts from crypto assets; (iii) they often have unstable currencies and high inflation which encourages currency substitution, including through crypto assets; and (iv) remittances are particularly important for developing countries, while cross-border payments are the “forgotten corner of the world's financial plumbing” (CPMI, 2022: 1) for which crypto assets, arguably, promise a solution.

This Policy Review aims at supporting developing country policymakers in their thinking about crypto assets. Its main contribution is to provide an accessible, yet academically informed, discussion of the main implications of crypto assets for developing countries. It asks four main questions: (i) what are the trends and drivers of crypto adoption, and which developing countries have been concerned the most; (ii) what do the economics of crypto assets imply for the ease of payments, financial inclusion, privacy, illicit financial flows, and currency substitution, as well as the architecture of the IMS; (iii) how can regulation shape the evolution of crypto adoption and what solutions can CBDCs and fast retail payment systems (FRPS) provide; and (iv) are the monetary, financial and payments systems in developing countries ripe for embracing crypto assets?



Most closely related to this Policy Review are Feyen et al. (2021) and Alfonso et al. (2022). Feyen et al. (2021) explores impacts on developing economies with a focus on stablecoins. However, these authors pay only scant attention to currency substitution and the eroding effectiveness of capital controls, which arguably are among the main risks of crypto assets for developing countries. Alfonso et al. (2022) focus on the motivation of central banks in Latin America and the Caribbean to consider issuing a CBDC. Their discussion of potential implications emphasizes domestic aspects, leaving cross-border issues aside. The paper also relates to discussions of more specific issues, such as dollarization (e.g., Brooks, 2021; Christiano et al., 2021; Levy-Yeyati, 2021) or capital controls (Alnasaa et al., 2022; He et al., 2022; Popescu, 2022). Contrary to these studies, this paper emphasizes the digital dimension of dollarization and capital controls and related impacts on developing countries.

The main finding is that crypto adoption has been especially rapid in developing countries, and that these countries face important trade-offs. They encounter big challenges trying to balance potential benefits from the use of crypto assets regarding increased financial inclusion, reduced costs of remittances, and easier access to investment finance and export credit on the one hand, and risks to (i) financial stability, (ii) the effectiveness of monetary policy and capital controls; (iii) monetary sovereignty, with associated increased exposure to currency substitution; and (iv) further vulnerability to IFFs, on the other. Regulation can address some of these challenges, and CBDCs could eventually provide effective solutions for others. However, given the many technical and policy challenges associated with CBDCs, developing countries may consider improving the attractiveness of more traditional digital payment solutions, including FRPS and auxiliary digital infrastructure, to provide more rapidly available monetary and financial solutions.

The Policy Review proceeds as follows. Section 2 examines statistical evidence on trends in crypto adoption. Sections 3 discusses the economics of crypto assets and examines related implications for the ease of payments, privacy, the effectiveness of capital controls, and currency substitution as examples of where crypto assets may have larger quantitative and potentially qualitatively different impacts on developing than on developed countries. Section 4 examines regulatory issues. Section 5 discusses the motivations of central banks to consider CBDCs. Section 6 concludes and presents policy recommendations. The Appendix provides an econometric examination of the drivers of crypto adoption and discusses developing-country examples of FRPS and CBDCs.

## 2. Trends and drivers of crypto adoption

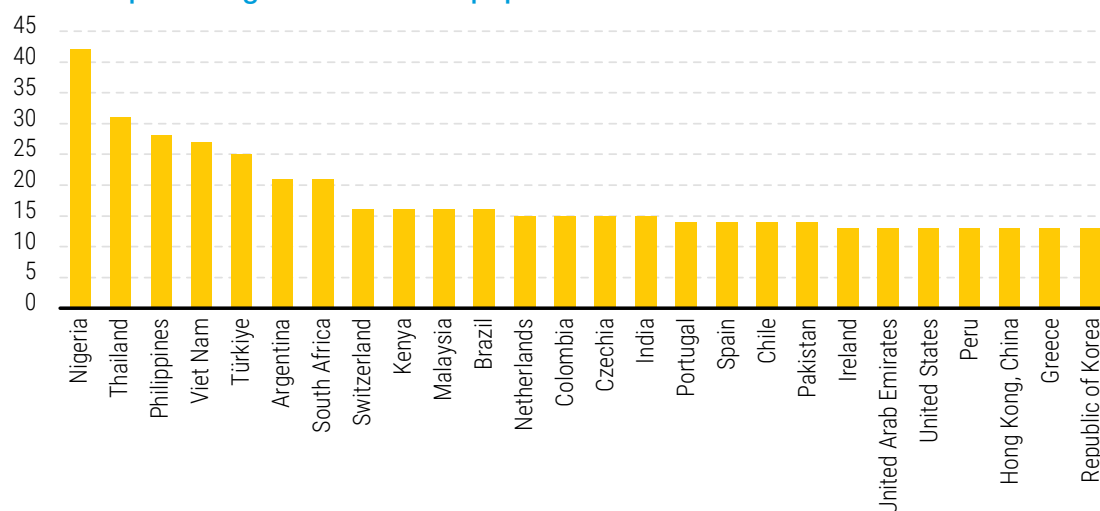
### *(i) Trends in crypto adoption: some statistical evidence*

Crypto adoption has grown rapidly. Between 2020 and 2021, it increased more than five-fold to reach a total transaction volume exceeding \$15 trillion (Chainalysis, 2021). As already mentioned, 2022 was marked by a sizable loss in the valuation of cryptocurrencies and stablecoins and by the bankruptcy of crypto exchanges, but these events are unlikely to imply an end to crypto.

Given pseudonymity as a main characteristic of crypto assets, there is no reliable way to measure crypto stocks or flows based on country residency. Nevertheless, available data suggest that countries in sub-Saharan Africa (SSA) and South-East Asia have been at the forefront of crypto adoption (figures 1–4). Survey data indicate that the share of the population that either held or used cryptocurrencies in 2021 was highest in Nigeria, Thailand, the Philippines, Viet Nam, Türkiye, Argentina, and South Africa (figure 1). Inferring the residency of on-chain crypto asset flows based on blockchain analysis suggests that crypto adoption was largest in Viet Nam, India, Pakistan, Ukraine, Kenya, Nigeria, and Venezuela (figure 2). Countries in SSA figure prominently in these country-specific statistics. The large size of crypto adoption in SSA is also reflected in data by geographic region on the value of crypto assets received to the extent

that these data are measured as a share of GDP (figure 3).<sup>5</sup> While the shares of North America, Northern, Central and Western Europe, and East Asia are the largest of all regions if measured in absolute terms, these values are among the lowest as a share of GDP.

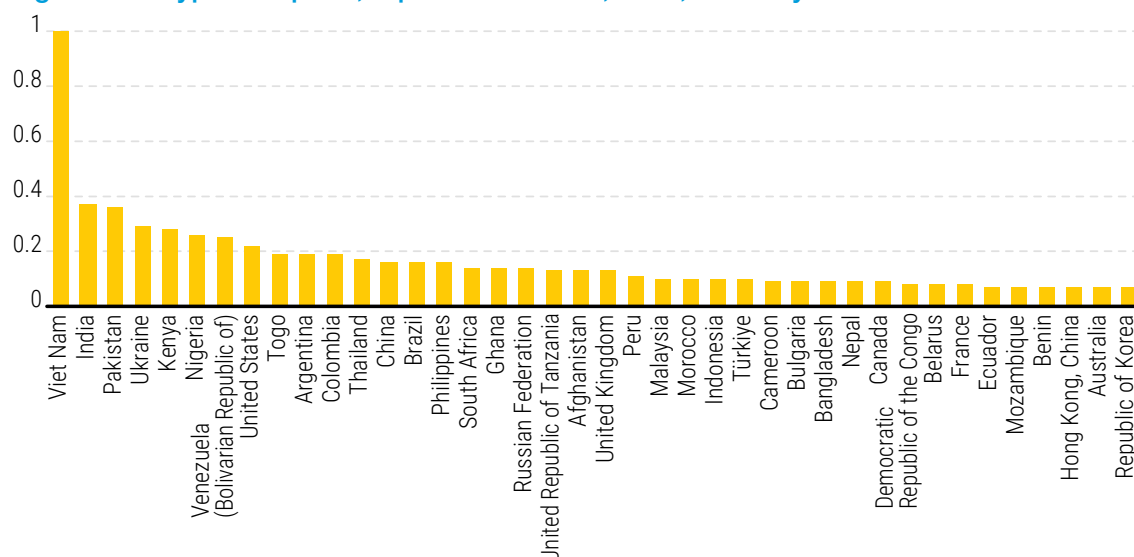
**Figure 1 Ownership or use of cryptocurrencies, top twenty economies, 2021, percentage shares in total population**



Source: Statista (<https://www.statista.com/statistics/1202468/global-cryptocurrency-ownership/>), accessed 4 December 2022.

Note: Numbers based on survey data covering 56 countries with 1'000–4'000 respondents per country replying to the question "Which of these financial products and investments do you currently use/own? (multi-pick)". The figures shown here reflect respondents who selected the option "Cryptocurrency (e.g., Bitcoin)".

**Figure 2 Crypto adoption, top 40 economies, 2021, Chainalysis Index Score**

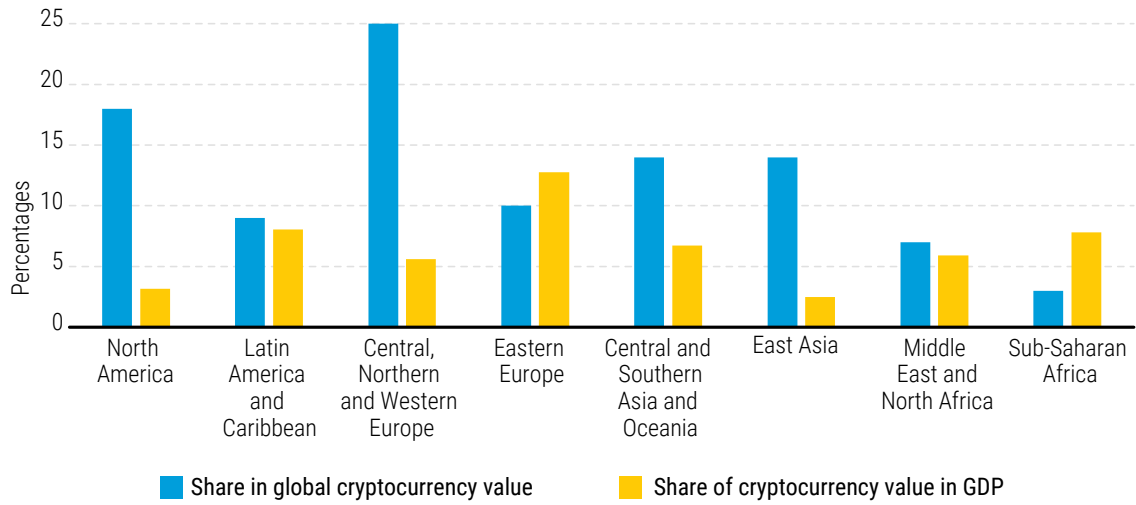


Source: Chainalysis (2021).

Note: The index numbers are the geometric means of countries' ranking on three measures: on-chain cryptocurrency value received, weighted by purchasing power parity (PPP) per capita; on-chain retail value received, weighted by PPP per capita; peer-to-peer exchange trade volume, weighted by PPP per capita and number of internet users.

<sup>5</sup> Apart from issues of data availability, the accuracy of the data underlying figures 2 and 3 may be reduced by two factors. First, the use of technologies that mask online transfers, or by such transfers reflecting exchanges between wallets of online providers rather than increased use by retail users. Second, so-called "crypto wash trading", i.e., inflated volume reporting by unregulated crypto exchanges that try to improve their ranking, thereby attracting more users (Cong et al., 2022).

**Figure 3** Crypto asset value received, share in world total, June 2020 – June 2021, and share of crypto asset value in GDP, 2020, by geographic region, percentages

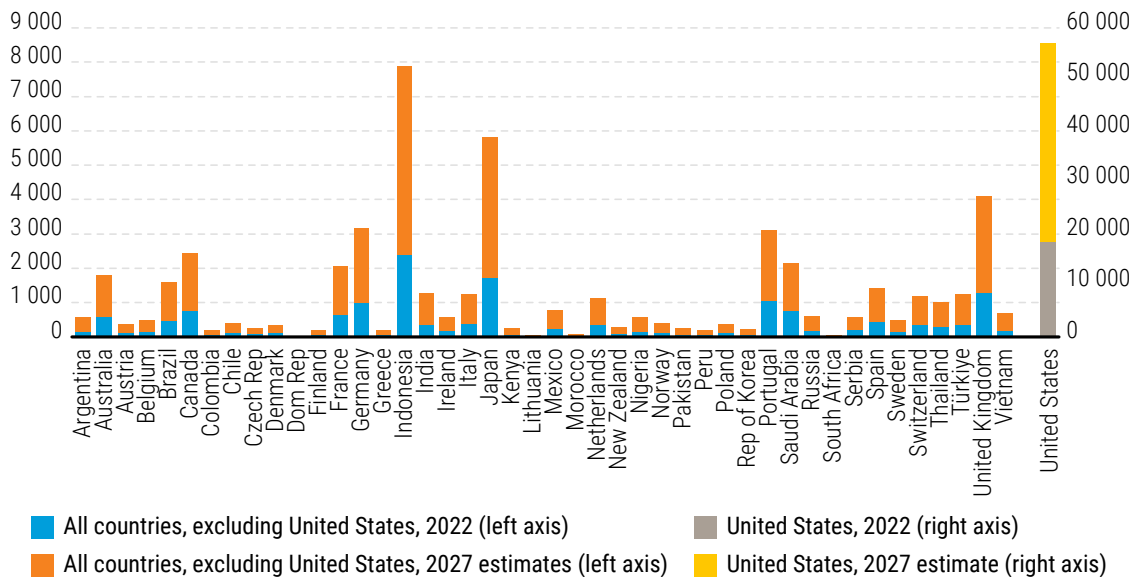


Source: UNCTAD calculations based on Chainalysis (2021) and UNCTADstat database.

Note: Composition of geographic groups as in Chainalysis (2021). Shares in GDP are estimates.

Estimates for the period 2022–2027 (figure 4) suggest particularly large absolute increases in crypto currency turnover in some advanced economies (such as the United States, Japan, the United Kingdom, and Germany) and India, and large relative increases in Pakistan, Nigeria, Argentina, and Viet Nam.

**Figure 4** Crypto currency turnover, 2022 and 2027 estimates, selected economies, \$ million



Source: Statista (<https://www.statista.com/outlook/dmo/fintech/digital-assets/cryptocurrencies/worldwide#revenue>), accessed 4 December 2022.

## **(ii) Potential drivers of crypto adoption**

The rise in crypto adoption relates to various factors. According to Chainalysis (2021), the high scores in their data on crypto adoption of countries in Central and Southern Asia and Oceania mainly reflect non-fungible tokens and their use in play-to-earn (P2E) games (the two largest ones being operated in Viet Nam and Australia, and the scale of P2E-penetration being particularly large in India, the Philippines, and Viet Nam, as well as in the United Arab Emirates).<sup>6</sup> This country group (especially India, Australia, and Viet Nam) is also a hub for innovation in blockchain-based entertainment.

It is difficult to quantify some potential drivers of crypto adoption, such as an appetite for speculative investment, frustration with the lack of innovation in traditional financial intermediation, and the value attached to the perceived anonymity of transactions.<sup>7</sup> Nevertheless, an econometric exercise (Appendix 1) indicates that the ease of using crypto assets, a younger demographic structure, and volatile macroeconomic conditions – currency depreciation, exchange rate volatility, and inflation – are general drivers of crypto adoption.

Remittances could be another driver of crypto adoption. High hopes have sometimes been put in the use of crypto assets, and blockchain technology more generally, to boost remittances, even though any such potential is subject to risks of enhanced IFFs and data misuse (e.g., Rühmann et al., 2020). Using crypto assets for remittances would reduce both the cost and time of transmittances, mainly because of a reduced number of intermediaries. The size of remittances and their cost can give some indication of the potential gains and beneficiaries.

According to data from the World Bank (2022), the global average cost of sending money exceeds 6 per cent of the amount remitted, with SSA being the most expensive region of destination, with an average cost close to 8 per cent, and South Asia the lowest cost receiving region, with an average cost of about 4 percent. With remittances sent to low- and middle-income countries in 2021 amounting to about \$605 billion<sup>8</sup>, this represents an annual transaction cost of roughly \$30 billion for these countries. It also implies a sizable gap with target 10c of the Sustainable Development Goals (SDGs): “By 2030, reduce to less than 3 per cent the transaction costs of migrant remittances and eliminate remittance corridors with costs higher than 5 per cent.” Indeed, while the G20 called on the national financial services sectors to lower remittances transfer costs to below 5 per cent in 2015, progress has been slow (CPMI et al., 2021).

An examination of the size of remittances and their cost might indicate which developing countries would benefit most from a reduction in the cost of remittances. South Asia received the most remittances as a share of GDP during 2016–2020, probably driven by the large remittances flows to Nepal which is the only country from this region among the top 20 recipient countries (table 1). Many of the other top recipient countries are small countries, including small island developing states. Small countries also are among the countries for which the cost of receiving remittances was highest during 2016–2021 (table 2). Taken together, this evidence suggests that improving payment systems related to remittances and achieving SDG target 10c would benefit developing countries from all geographic regions and that many small countries would be among the main beneficiaries.

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<sup>6</sup> For further data on the geographic and demographic characteristics of P2E-players see, e.g., <https://www.finder.com/nft-games-statistics>.

<sup>7</sup> Evidence from Auer et al., 2022, indicates a positive relationship between the price of Bitcoin and downloads and active use of crypto apps, suggesting that speculative motives play a significant role in Bitcoin use.

<sup>8</sup> See <https://unstats.un.org/sdgs/report/2022/Goal-17/>.

**Table 1 Average remittances received as a share of GDP, by geographic region and top 20 countries, percentages, 2016–2020**

| Geographic region            | Percentages | Country         | Percentages | Country            | Percentages |
|------------------------------|-------------|-----------------|-------------|--------------------|-------------|
| World                        | 0.8         | Tonga           | 35.6        | Jamaica            | 17.6        |
| North America                | 0.0         | Kyrgyz Republic | 30.5        | Lebanon            | 16.2        |
| Europe and Central Asia      | 0.8         | Tajikistan      | 27.9        | West Bank and Gaza | 16.1        |
| Latin America and Caribbean  | 1.8         | Nepal           | 24.9        | Kosovo             | 16.1        |
| Middle East and North Africa | 2.0         | Lesotho         | 22.3        | Somalia            | 14.9        |
| Sub-Saharan Africa           | 2.6         | Bermuda         | 21.2        | The Gambia         | 14.2        |
| South Asia                   | 3.8         | El Salvador     | 20.9        | Comoros            | 14.2        |
| East Asia and Pacific        | 0.5         | Honduras        | 20.3        | Marshall Islands   | 13.7        |
|                              |             | Haiti           | 19.3        | Guatemala          | 12.9        |
|                              |             | Samoa           | 18.8        | Liberia            | 12.8        |

Source: UNCTAD calculations based on World Bank, World Development Indicators database.

Note: Geographic regions as defined by World Bank.

**Table 2 Median cost of receiving remittances from the United States as a share of amount sent, top 30 developing countries, percentages, 2016–2021**

|               | Transfer of \$200 | Transfer of \$500 |           | Transfer of \$200 | Transfer of \$500 |
|---------------|-------------------|-------------------|-----------|-------------------|-------------------|
| Cuba          | 10.0              | 10.1              | Colombia  | 5.6               | 4.0               |
| Cabo Verde    | 8.3               | 6.6               | Yemen     | 5.5               | 2.2               |
| Guyana        | 8.3               | 6.8               | Egypt     | 5.5               | 3.3               |
| Lebanon       | 7.5               | 6.2               | China     | 5.4               | 2.6               |
| Thailand      | 7.3               | 5.5               | Brazil    | 5.3               | 3.9               |
| South Africa  | 7.0               | 5.6               | Ethiopia  | 5.2               | 2.8               |
| Jamaica       | 6.7               | 4.8               | Eritrea   | 5.0               | 2.3               |
| Afghanistan   | 6.6               | 3.5               | Haiti     | 5.0               | 2.4               |
| Indonesia     | 6.5               | 4.5               | Liberia   | 5.0               | 2.0               |
| Kenya         | 6.5               | 4.7               | Nigeria   | 5.0               | 3.6               |
| Ghana         | 6.3               | 4.8               | Nepal     | 4.7               | 3.3               |
| Jordan        | 6.3               | 3.6               | Pakistan  | 4.5               | 3.1               |
| Somalia       | 6.0               | 6.0               | Mexico    | 4.4               | 2.9               |
| Costa Rica    | 5.7               | 4.2               | Vietnam   | 4.4               | 2.0               |
| Dominican Rep | 5.6               | 4.1               | Guatemala | 4.4               | 2.7               |

Source: UNCTAD calculations based on World Bank, Remittance Prices Worldwide database.

Note: Country ranking based on cost of transferring \$200.

However, as indicated by the econometric analysis in appendix 1, there is no evidence of a relationship between remittances and crypto adoption. One reason could be that reduced cost may well imply cheaper remittances, but this cost reduction might not translate into sustained higher remittance levels. Recent evidence indicates that the response of remittances to transaction costs is essentially short-term and dissipates within three months following the cost reduction (Kpodar and Imam, 2022). Remittances are less responsive to transaction costs, for example, where financial systems are developed, as well as with more competition in remittances markets and higher ICT-use, access, and affordability.

Another reason could be that the dependent variable, which is based on survey data, may not be representative or does not fully capture the use of crypto currencies for remittances. Using data from two large centralized P2P-exchanges with a global reach, Graf von Luckner et al. (2023) show that an important use case of Bitcoin is as a vehicle currency for cross-border transfers, including remittances.<sup>9</sup>

It should also be noted that specialized money transfer operators or interfaces that use smartphone applications can – similar to the promises of crypto assets – provide near instantaneous transfers at significantly reduced cost, and they can do this while respecting financial regulation that provides consumer protection. One such example is the collaboration between the central bank of Pakistan and AliPay for remittances from Malaysia to Pakistan.<sup>10</sup> Another example is the Unified Payment Interface (UPI), a real-time payment system developed by the National Payments Corporation of India (NPCI) and regulated by the Reserve Bank of India, which became interlinked with Singapore’s PayNow system in February 2023 to enable instant and low-cost fund transfers.<sup>11</sup> This and other FRPS are further discussed below.

### 3. The economics of crypto assets

Issuing crypto assets may be considered as an attempt to find new solutions to longstanding problems of monetary and financial systems – such as providing efficient, secure and affordable monetary transfers, fostering financial inclusion, and finding the right balance between ensuring privacy and preventing IFFs. Such solutions may affect developing countries by reshaping the architecture of monetary and payment systems, the nature of currency competition, and the set-up of the IMS. This section discusses the economics of crypto assets. The following sections focus on how developing countries may address related challenges through regulation, CBDCs, or FRPS.

#### *(i) Crypto assets and the architecture of monetary and payment systems*

The promise of crypto assets and blockchain technology is to improve existing monetary and financial systems by increasing financial inclusion and allowing for more efficient, secure, and affordable monetary transfers while preserving privacy (e.g., Prasad, 2021). To assess the potential impacts of an increased use of such assets in payments, it is useful to compare the monetary characteristics of crypto assets with those of cash and traditional digital money.

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<sup>9</sup> However, it should be noted that, from a practical point of view, a positive relationship between crypto adoption and remittances would imply that both the sender and the receiver of remittances are able to handle cryptocurrencies. Judging from the case of El Salvador discussed below, this might require educated and digitally savvy individuals at each end of the transaction, as well as the existence of digital infrastructure that can support transfers through cryptocurrencies. A prevalence of all these conditions combined may be difficult to find in many developing countries.

<sup>10</sup> <https://www.pri.gov.pk/pakistan-adopts-blockchain-technology-to-attract-remittances/>

<sup>11</sup> See, e.g., <https://www.forbes.com/advisor/in/personal-finance/what-is-upi-and-how-does-it-work/>; <https://bsfi.economicstimes.indiatimes.com/news/fintech/how-indias-upi-and-singapores-paynow-linkage-will-change-the-global-payments-landscape/98113959>. India also tries to discourage the use of crypto assets through taxation <https://economicstimes.indiatimes.com/wealth/tax/how-tds-on-crypto-virtual-digital-assets-will-work-from-july-1-2022/articleshow/92409625.cms>.

Cash in the form of banknotes and coins is issued by central banks, i.e., it is sovereign (or public) money. Cash settles payments instantly and in an inclusive way as its use requires no access to digital money. Cash payments protect users' privacy, data, and identity in financial matters by not involving a third party that verifies their identity. Cash denominated in domestic currency is legal tender and the central bank guarantees its stability as a unit of account.

In traditional two-layered monetary systems, digital money takes the form of bank deposits and central bank reserves. Bank deposits can always be converted to an equal quantity of cash, thanks to the combination of banking supervision and regulation, deposit insurance, and the central bank's function as lender of last resort (Ahnert et al., 2022). If a bank defaults on its obligations, deposit holders can claim the bank's illiquid assets (Brunnermeier et al., 2019).

However, using traditional digital money can be time-consuming and expensive. Bank transfers may take days, even within jurisdictions, and the use of credit cards remains expensive for merchants. One reason for this high cost may be market concentration among card networks whose payments architecture are available across the world.<sup>12</sup> Moreover, given that bank deposits are linked to bank accounts, privacy and inclusiveness are impaired because the identity of holders is identified and the unbanked have no access to banking services.

New market entrants have used these drawbacks to gain market shares. The key innovation of cryptocurrencies and stablecoins is their use of blockchain technology that in principle can provide decentralized, direct peer-to-peer (P2P) transactions without the need for intermediaries.<sup>13</sup> Decentralized blockchain-based validation promises secure payments, while also ensuring privacy. Moreover, eliminating banks as intermediaries promises faster and cheaper transfers and financial inclusion of the unbanked. Given that the share of the unbanked population tends to be higher in developing than in developed countries, financial inclusion is often cited as a key advantage of digital assets for developing countries (e.g., Prasad, 2021).

A reduced role of intermediation may also facilitate access to finance by firms. Especially small- and medium-sized enterprises (SMEs) often find it difficult to access finance and export credit from traditional financial service providers because of information asymmetries between lenders and SME borrowers. Traditional financial systems tend to have stringent loan underwriting and collateral requirements and, accordingly, require a vast infrastructure to maintain trust between lenders and borrowers, where the latter often lack collateral and have limited credit histories and insufficient or inaccurate data. This is expensive itself and frequently involves a surcharge levied by insiders. By contrast, blockchain technology could establish readily available track records and make transactions transparent and, in theory, trustworthy. Moreover, blockchain-based loans can be augmented by smart contracts, which are computer programmes that govern the transfer of digital assets and allow for greater customization and a bundling of services that address both financial and non-financial needs.<sup>14</sup> They may also self-execute transactions as written and help to avoid loans being diverted. An associated tokenization of loans could incentivise open-source contributions and thereby allow accessing a larger pool of lenders prepared to grant small loans.

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<sup>12</sup> This has sometimes been called "the Visa-Mastercard duopoly", see <https://www.economist.com/finance-and-economics/2022/08/17/can-the-visa-mastercard-duopoly-be-broken>. These networks do not extend to China, which has a state-owned credit card network, UnionPay, and rival private digital payments networks, Alipay and WeChat, whose ambitions to expand abroad now appear modest, given current geopolitical tensions.

<sup>13</sup> In reality, however, large parts of crypto asset transaction are intermediated by crypto exchanges (e.g., Bains et al., 2022; Weaver, 2022). Interoperability between different cryptocurrencies and/or between a cryptocurrency and non-crypto parts of the financial system also require intermediaries.

<sup>14</sup> One such use could be initial coin offerings as an alternative mechanism of underwriting private investment. However, this could distort the allocation and funds for productive investment (Kregel and Savona, 2020). However, it should be noted that smart contracts can also cause exclusion, such as by writing them according to social or economic distinction (Morgan, 2023), and that any inconsistency in the code can be used by hackers, whereby the irreversibility of blockchains causes an inability to recuperate resulting theft (Weaver, 2022).

However, the superiority of on-chain financial records over the soft information gained from face-to-face contacts in relationship banking is questionable, and they cannot make up for concerns with data quality and low SME-digitalization. The absence of a financial intermediary between the borrower and lender implies the disappearance of due diligence of commercial and investment activities, as well as of the regulation of borrowers (Kregel and Savona, 2020). Moreover, such records obviously have no information on start-ups that have never approached lenders. On-chain lending may also be highly concentrated and permit lenders to manipulate and engage in predatory lending practices. Its application to existing crypto assets also faces challenges due to the immense volatility of these assets. This can imply high credit risk and make borrowing expensive, such as by requiring collateral that exceeds the value of the loan. Moreover, linking loans to smart contracts runs the risk that even subtle programming errors can be used to siphon off funds.

Decentralized P2P crypto settings also encourage pseudonymous transactions and secrecy. Know-your-customer (KYC) and Anti-Money Laundering/Combating the Financing of Terrorism (AML/CFT) requirements, which apply to traditional digital payment methods and intermediation, may be more difficult to satisfy in crypto-asset transactions designed to imitate cash transactions. Crypto-asset transactions that do not reveal the identity of the sender or the receiver of funds are an ideal instrument for engaging in activities such as bribery, drug trading, tax evasion and money laundering. As such, crypto assets may act as a new form of tax havens, with significant adverse implications for countries' domestic resource mobilization, and therefore are very problematic from the point of view of financing for development (UNCTAD, 2022c).

Moreover, cryptocurrencies and stablecoins originate in the private sector and have zero intrinsic value. And unlike traditional digital money, they are neither a liability of any institutions nor backed by any authority. The value of these crypto assets relies on the belief that users can exchange them for other goods or services.<sup>15</sup> However, the value of cryptocurrencies has been very volatile, which makes them unattractive as a unit of account, means of payment and stable store of value. This means that they lack the essential attributes of money.

Stablecoins attempt to attain the trust of public money by pegging their value to the dollar or other sovereign fiat currencies, and by holding collateral meant to back outstanding liabilities. However, stablecoins remain largely unregulated, so that such transactions take place in a regulatory vacuum with no consumer protection. Moreover, raising collateral is expensive and unprofitable unless a stablecoin issuer holds collateral equal to only a fraction of the value of the coin it issues, which makes the backing highly fragile, or it holds interest-bearing assets and makes money on the interest earned. But the latter form of backing is highly vulnerable to a depreciation of these assets and can make the issuer unable to redeem its stablecoin at par. This can easily lead to runs on the stablecoin, against which the issuer is not protected because it does not benefit from the regulatory requirements and protections of cash and bank deposits, or from the central bank acting as lender of last resort (e.g., Prasad, 2021). Just like cryptocurrencies, this causes stablecoins to lack the essential attributes of money and make them objects of speculation.

In addition, fragmentation is an intrinsic problem of the decentralized crypto ecosystem with hundreds of different crypto assets running on incompatible blockchains. Monetary devices that run on decentralized blockchains risk being unable to realize the network effects that would allow rapid and cheap payments. Hence, decentralization comes at the cost of limited speed and scalability and makes cryptocurrencies unattractive as a means of payment for retail payment systems that require a very large number of transactions per second.<sup>16</sup> While increased usage can cause congestion and delay processing, sustaining the security of a system of decentralized consensus through self-interested validators that record

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<sup>15</sup> Public money also relies on trust. However, trust in public money is backed by government agencies and regulated financial institutions. Trust in crypto assets relies on decentralized unregulated private entities that confirm records, or on unregulated backing by collateral.

<sup>16</sup> Moreover, decentralized consensus mechanisms, especially those based on permissionless DLT and proof-of-work consensus, are inefficient in environmental terms, as they require large amounts of energy.



transactions on the blockchain implies that these validators must be motivated by monetary rewards high enough to make them prefer honest validation to potential gains from cheating. The way to reward validators is to limit the capacity of the blockchain and keep fees high. Hence, it is the underlying economic incentives, not technological constraints, that drive the fragmentation, congestion, and cost structure of the crypto universe (BIS, 2022b).<sup>17</sup>

Limited consumer protection has been another concern of crypto adoption. The United States Federal Trade Commission (FTC, 2022) indicates that, between January 2021 and March 2022, consumers reported losing over \$1 billion to fraud involving cryptocurrencies, with most of these losses occurring through bogus investment opportunities that falsely promise potential investors to earn sizable returns.<sup>18</sup> Chainalysis (2023) reports crypto-based illicit transaction volume to have risen for two consecutive years and reached an all-time high of \$20 billion in 2022, up from \$14 billion in 2021 and \$7.8 billion in 2020.

The potential of crypto assets to reduce the use of cash and the holdings of bank deposits also raises concerns regarding financial stability and the transmission of monetary policy. Reduced holdings of bank deposits would reduce bank intermediation and hence a source of low-cost and stable income for commercial banks. This could reduce the amount or increase the cost of loans that they provide to households and enterprises, which could reduce aggregate spending. It could also encourage commercial banks to tap alternative sources of income by investing in riskier assets, as well as households and enterprises to access loans from non-banks or equity and financial markets with the attendant increased risks compared to bank loans. The extent of substitution away from the existing banking system for deposits and payments towards crypto assets and the degree of economic and financial interconnection between the users of sovereign currency and the users of crypto assets also affect monetary policy transmission. If the substitution is large and the interconnection is weak, then the transmission mechanisms of monetary policy will become less effective (CPMI, 2015).

While the very characteristics of crypto assets narrowly constrain their usability as a unit of account, medium of exchange and store of value, their use as a vehicle currency in cross-border transactions may provide an economic value. Biais et al. (2023) argue that the fundamental value of cryptocurrencies like Bitcoin lies in their expected net transactional benefits. These net benefits result from the relationship between their pseudonymity-based capacity to be used as a vehicle in cross-border transfers where government controls hinder transfers through traditional financial institutions, relative to the costs of such transactions, with an important part of these costs concerning the sizable volatility and risk of collapse of cryptocurrency prices. The empirical analysis of Graf von Luckner et al. (2023) supports this argument, showing that the use of Bitcoin as a “crypto vehicle currencies” for cross-border transfers, such as remittances, is largest for developing countries with sizable capital controls.

The above has shown that the risks of currency substitution and IFFs may be particularly important for developing countries where macroeconomic stability are often lower, financial markets narrower and less regulated, and capital controls more prominent than in developed countries, as further discussed below.

Another characteristic of crypto assets is that their usability requires effective access to digital equipment and that their benefits will not be realized if the digital divide persists. To use crypto assets, citizens need to have the capacity to connect to and use the Internet, as well as be able to access in an affordable way communication technologies that transmit data. Evidence on mobile connectivity and the use of the Internet suggests the continued existence of a large digital divide (table 3).

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<sup>17</sup> The recent so-called “merge” of the Ethereum blockchain, i.e., the move from a decentralized “proof-of-work” consensus mechanism to a permissioned “proof-of-stake” mechanism where only specific network nodes can update the ledger was intended to improve the scalability and reduce the environmental footprint. While this promises significant efficiency gains and energy savings, it goes against the de-centralization principle that lies at the core of crypto assets and may give rise to market concentration and jeopardize the privacy principle.

<sup>18</sup> Similar developments have been reported for the United Kingdom <https://www.ft.com/content/c7d2eeae-9a66-4dc4-a10e-11dcd2807600>.

**Table 3 Digital connectivity penetration rate, selected indicators, 2022, per 100 inhabitants**

|              | <b>Mobile-cellular telephone subscriptions</b> | <b>Population covered by a mobile-cellular network</b> | <b>Individuals using the Internet</b> |
|--------------|--|--|---------------------------------------|
| Africa       | 86.3   | 91.5   | 39.7                                  |
| Americas     | 108.5  | 96.0   | 83.2                                  |
| Arab States  | 95.5   | 96.4   | 70.3                                  |
| Asia-Pacific | 110.6  | 98.8   | 64.3                                  |
| CIS          | 147.4  | 99.0   | 83.7                                  |
| Europe       | 120.9  | 99.8   | 89.5                                  |

Source: ITU, Measuring digital development: Facts and Figures 2022, <https://www.itu.int/en/ITU-D/Statistics/Pages/facts/default.aspx>.

### **(ii) Crypto assets and currency substitution**

The creation of privately issued crypto assets and their verification processes through blockchain may be seen as a solution to the technical and operational detail involved in the proposal of Hayek (1976). Hayek (1976) suggested denationalizing money and replacing existing two-tiered monetary systems by a system of competing private currencies that abolishes central banks' monopoly on the issuance of legal tender, which he saw as the source of recurring bouts of inflation and deflation. He believed that currency competition would force the issuers of money to keep their currencies stable in terms of their purchasing power and that private monies would eventually drive national public monies out of business. The related loss of national monetary sovereignty – the loss of supremacy of the national currency for fulfilling the three functions of money (unit of account, means of payment, store of value) – is generally referred to as currency substitution.

However, the incomplete fulfilment of monetary characteristics of crypto assets and limits to scaling the use of cryptocurrencies are likely to prevent their evolution beyond niche status towards full-scale competitors of fiat currencies (BIS, 2022b). Empirical evidence suggests that competition between cryptocurrencies and stablecoins has not resulted in the dominance of any single privately issued crypto asset (Bofinger and Mayer, 2022). This suggests low network effects and little potential of existing crypto assets to drive fiat currencies out of business.

Nevertheless, any erosion of market shares of publicly issued money due to competition from crypto assets reduces the effectiveness of monetary policy by limiting the part of monetary aggregates on which central bank policy has a direct impact. It may also have adverse fiscal effects, in the form of declining seigniorage. Seigniorage as a source of state revenue refers to the difference between the face value of money and the cost to produce and distribute it. While the distribution of cash can be very costly, particularly in vast but sparsely populated territories, printing money can be a fiscal policy instrument, for example to finance unexpected large expenditure related to emergencies, such as during the Covid-19 pandemic. However, the importance of seigniorage as state revenue strongly varies across countries, depending on the elasticity of the demand for domestic sovereign money relative to nominal GDP, the ratio of base money to broader money holdings, and the perceived cost of holding domestic sovereign money relative to alternatives.

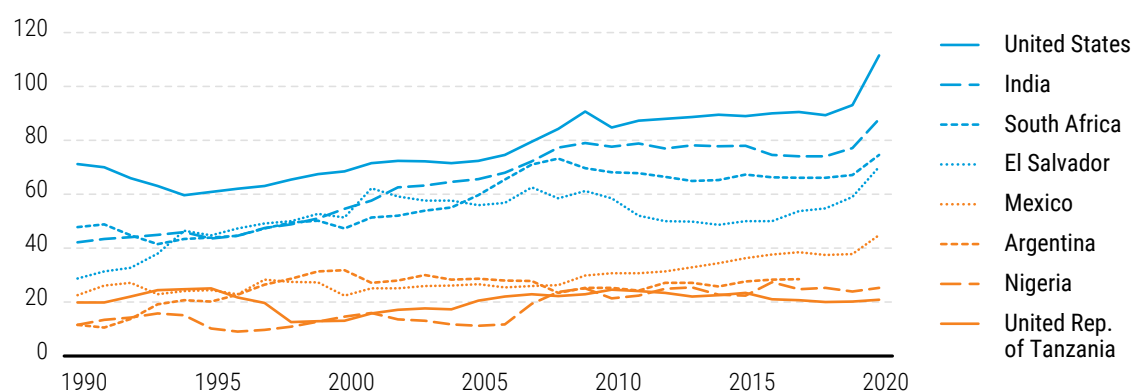
Edwards (2021) reports that, during the period 1970–1991, seigniorage at times exceeded 20 per cent of public sector revenues in countries like Argentina, Bolivia, Brazil, and Peru. The basis for this assessment of seigniorage is the share of base money in nominal GDP.<sup>19</sup> This share will tend to be lower in countries

<sup>19</sup> Base money consists of bank reserves and money in circulation. Broad money is wider and includes financial assets that can easily converted into cash. The calculation here uses broad money because comprehensive data on base money is not available.

with a history of macroeconomic and financial instability, high inflation, and recurrent currency crises, i.e., features that tend to drive crypto adoption (appendix 1). If this share declines, for example due to the use of foreign fiat currencies or crypto assets, then the amount of collected seigniorage will decline.

To illustrate the potential loss of seigniorage revenue, figure 5 shows the evolution of the share of broad money in nominal GDP for the United States and three developing countries for which this share has been relatively high (El Salvador, India, and South Africa), as well as four developing countries with frequent macroeconomic instability, for which this share has been relatively low (Argentina, Mexico, Nigeria, and the United Republic of Tanzania). Assuming currency substitution in El Salvador, India, and South Africa to cause a decline of this share to the levels of Argentina, Mexico, Nigeria, and the United Republic of Tanzania, while not affecting GDP, the first group of countries would lose more than half of their basis for seigniorage revenues. This is likely to be a sizable amount. At the same time, Nigeria could increase seigniorage revenues if the eNaira were to substitute for the use of foreign currencies or crypto assets. To put this illustration into perspective, it is useful to recall that central banks, particularly those in developed countries, nearly doubled base money as a share of GDP during 2007–2011. This has allowed total cumulative seigniorage revenues collected in advanced economies during 2008–2011 to reach 8 per cent of GDP, more than five times pre-2008 levels (IMF, 2012).

**Figure 5 Broad money as a share of GDP, selected countries, 1990–2020, percentages**



Source: World Bank, World Development Indicators database.

From an international perspective, currency substitution is often referred to as dollarization independently of whether currency substitution involves switching to the dollar or another international currency. While dollarization has been a long-standing feature in many developing countries (Levy-Yeyati, 2021), crypto assets quantitatively reinforce the incentives behind currency substitution. One reason for a change in the ratio of domestic fiat currency and crypto assets that are demanded by residents relates to the store-of-value function, i.e., crypto assets could increase the elasticity of demand for currency substitution relative to a change in the cost of holding domestic money. This elasticity relates to the switching costs of using crypto assets as a store of value, whereas the cost of holding domestic money is determined by expected inflation, as well as the financial infrastructure, legal frameworks and regulations that govern access to domestic deposits. If crypto assets reduce transaction costs due to the abolition of intermediaries and if they preserve their value, for example through full dollar backing, crypto assets could strongly increase the sensitivity of demand for domestic money to a change in expected inflation of the domestic economy.

A second reason why crypto assets can reinforce currency substitution is that they tend to make capital controls less effective. Such measures typically require that financial intermediaries verify the nature of transactions and the identities of the transacting parties. Crypto assets complicate such verification because they can be held without identification of the residency of the asset holder and be traded pseudonymously or on a P2P-basis without any intermediary. Even when these assets are traded and held through intermediaries, such as crypto exchanges and wallets, those intermediaries or service providers may not be regulated or obligated to comply with foreign-exchange regulations and capital controls. Moreover, regulation may be inconsistent or have gaps because there is no common and consistent taxonomy of crypto assets, and because cross-border provision of crypto services makes supervision and enforcement by national authorities difficult (He et al., 2022). This loss in the effectiveness of capital controls could drive more developing countries towards de-facto open capital accounts and flexible exchange-rate systems with an attendant greater exposure to spillovers from global financial markets. Even if existing measures remain effective, they may require strengthening to the extent that crypto assets reduce the cost of cross-border transfers and cause an increase in gross foreign capital positions. This is because larger gross foreign capital positions imply greater valuation effects. Moreover, an increase in foreign asset positions based on crypto assets that provide no yield may increase the resource transfer from developing to developed countries, with ensuing adverse effects on developing countries' current-account balances and balance-of-payments positions (Mayer, 2021).

While the causes of dollarization are likely to differ across countries, it may be useful to examine where dollarization is already high to gauge which countries may be exposed most to currency substitution through crypto assets in terms of the store-of-value function of money. Dollarization related to the store-of-value function of money may be measured by the share of foreign-currency in total deposits (IMF, 2020). Empirical evidence on this deposit dollarization for the period 2000–2017 (table 4) suggests that a wide range of countries from all geographic regions have faced the risk of dollarization, but that countries in Central Asia, South-Eastern Europe, and SSA may be exposed the most.

A third reason why crypto assets tend to quantitatively reinforce the incentives behind currency substitution relates to network effects in the medium-of-exchange function. The greater ease and lower cost that crypto assets promise for cross-border payments imply a decline in the advantage that existing network effects confer to incumbent currencies. And while network effects may be limited for cryptocurrencies, sizable network effects could occur for global stablecoins issued by large technology companies or platforms. The fact that these platforms offer services on social networking and e-commerce platforms of global scale would facilitate a rapid scaling-up of the use of such a stablecoin with ensuing sizable network effects. Hayek (1976) did not consider the possibility that the processes of currency competition could be different between the functions of means of payment and store of value. However, such global stablecoins can unbundle the traditional functions of money and, instead, specialize as a means of payment and bundle this monetary function with other economic functions, such as data gathering or social networking, or smart contracts. The attractiveness of crypto assets for currency substitution in the payment system would stem from their tailored offerings of products and services or credit provision based on payment

data (Brunnermeier et al., 2019). This attractiveness could be enhanced by the fact that such platforms are not typically bound by exchange-rate regulations and capital controls.

It is true that Libra (Diem), which might have translated these unbundling and re-bundling processes into practice, has not come to life.<sup>20</sup> Nevertheless, policymakers in developing countries may find it worthwhile thinking about potential responses to such processes because countries lagging in digital money adoption, with weak macroeconomic fundamentals and sizable exchange-rate volatility could be drawn much faster into dollarization and international financial flow volatility than in the past. The above discussion indicates that small, open economies with a large informal sector, a narrow financial system and macroeconomic instability are vulnerable to both traditional and digital forms of currency substitution, whereas those with an inefficient electronic payment system and strong presence of tech platforms are particularly exposed to the latter.

**Table 4 Evolution of deposit dollarization, selected countries, 2000–2017, percentages**

|                 | 2000 | 2010 | 2017 |                 | 2000 | 2010 | 2017 |
|-----------------|------|------|------|-----------------|------|------|------|
| Cambodia        | 93.2 | 96.8 | 94.1 | Lao PDR         | 84.9 | 53.6 | 53.7 |
| Dem. Rep. Congo | 50.0 | 84.9 | 89.4 | Maldives        | 45.1 | 52.4 | 53.6 |
| Nicaragua       | 70.3 | 73.4 | 78.6 | Albania         | 25.0 | 47.7 | 53.4 |
| Serbia          | 62.7 | 78.6 | 72.2 | Djibouti        | 58.4 | 46.8 | 53.4 |
| Anguilla        | n.a. | 76.3 | 72.0 | Kazakhstan      | 50.3 | 42.8 | 52.0 |
| Suriname        | 46.4 | 53.1 | 71.4 | Uzbekistan      | n.a. | n.a. | 47.8 |
| Belarus         | 70.1 | 52.7 | 69.3 | Kyrgyz Republic | 57.9 | 52.1 | 47.5 |
| Uruguay         | 81.6 | 68.6 | 69.0 | Paraguay        | 63.2 | 42.6 | 47.3 |
| Georgia         | 78.9 | 65.7 | 67.9 | Ukraine         | 38.4 | 42.6 | 46.0 |
| Haiti           | 39.1 | 56.4 | 66.2 | Peru            | 78.5 | 49.2 | 44.4 |
| Lebanon         | 62.3 | 58.8 | 63.7 | Jamaica         | 23.0 | 36.5 | 42.2 |
| Mauritius       | 10.2 | 64.1 | 60.3 | Moldova         | 48.8 | 45.6 | 41.5 |
| Croatia         | 70.7 | 71.5 | 60.1 | Türkiye         | 45.1 | 28.3 | 41.5 |
| Tajikistan      | 67.8 | 60.6 | 57.1 | Seychelles      | n.a. | 25.1 | 41.4 |
| Armenia         | 81.2 | 64.0 | 55.7 | North Macedonia | 34.9 | 53.2 | 40.9 |

Source: UNCTAD elaboration, based on Christiano et al., 2022, database, available at <https://sites.google.com/view/hus-nucdalgit/datacodes/dollarization-data>.

Note: Countries ordered by exposure in 2017.

<sup>20</sup> Prasad (2021: 168–175) explains that the introduction of Libra (Diem) met stiff resistance from governments and central banks around the world for two reasons. First, Libra (Diem) was to move gradually from a centralized permissioned to a de-centralized permissionless blockchain, which could have made it a conduit for money laundering and tax-related IFFs, while making Facebook (Meta) no longer responsible for validation. Second, while Libra (Diem) was to be fully backed by assets, the enormous international network of Facebook (Meta) created a risk that its value would eventually be delinked from these assets and allow Facebook (Meta) to create money as an unregulated entity. This would have had adverse implications for monetary policy and cross-border flows. Moreover, the enormous reach and financial clout of Facebook (Meta) could have led citizens in some developing countries to consider Libra (Diem) more trustworthy and stable in value than their country's fiat currency. See also, e.g., Pistor (2021) and C Duffy, "Facebook's dream of creating its own global cryptocurrency officially comes to an end", CNN Business, 1 February 2022, <https://edition.cnn.com/2022/02/01/tech/facebook-diem-association-dissolving/index.html>.

These unbundling and re-bundling processes may also affect the IMS. Digital platforms tend to develop closed ecosystems where users are locked in through economic incentives and technical standards (UNCTAD 2018, 2019). As a result, the bundling of payments with data services in such ecosystems encourages network effects in terms of the means-of-payment function of money but discourages interoperability between payments services. Such ecosystems, which have been called “digital currency areas” (Brunnermeier et al., 2019), are held together by digital interconnectedness. They may occur within countries.<sup>21</sup> But they may also transcend national borders and link a currency not to a specific macroeconomic regime but to the use of a particular digital network that may relate to tight trade and payments arrangements or strong geopolitical forces.

Digital currency areas could be further supported by creating alternatives to the SWIFT payment messaging system, such as China’s Cross-Border Interbank Payment System (CIPS), or by developing a cross-border payment system that uses a CBDC and does not rely on SWIFT, such as mBridge, a BIS pilot project that brings together the People’s Bank of China, the Hong Kong Monetary Authority, the Bank of Thailand, and the Central Bank of the United Arab Emirates.<sup>22</sup> However, countries could leverage such payment systems also to reinforce payment links among themselves, while excluding others, which could fragment global liquidity and trade links.

## 4. Regulating crypto assets

Regulation is one way of influencing the evolution and use of crypto assets. However, many crypto-asset activities and markets are not compliant with applicable regulations or have remained unregulated (FSB, 2022). One reason may be the technological novelties of crypto assets. Many activities escape existing regulation because decentralization and the limited transparency of the crypto universe creates significant data gaps. Definitional issues, such as difficulties in establishing whether a stablecoin issuer is a narrow bank or a money market mutual fund, or whether Ether is a commodity or a security, also hamper effective regulation.

Another reason regards the very characteristics of crypto assets. Their inherently borderless nature and absence of an identifiable operator imply that risks are faced directly by end users, rather than by regulated financial institutions as in traditional financial systems. Moreover, the variety of involved actors and the frequent combination of services may require the disaggregation of certain functions and activities with the resulting parts attributable to a multitude of regulators – regulating banks, commodities, securities, payments, etc. – with sometimes fundamentally different frameworks and objectives (Narain and Moretti, 2022).

National authorities also face the dilemma that the borderless nature of crypto assets demands an internationally coordinated, consistent, and comprehensive regulatory framework as a benchmark. The current limited availability of such a benchmark complicates the establishment of national regulation that would both avoid regulatory fragmentation and reflect national specificities in the use cases of crypto assets and characteristics of national financial markets.

However, some international standards are being developed. The Financial Stability Board (FSB, 2022) aims at providing effective guardrails around crypto assets and markets to address potential sources of financial instability and minimize spillover risk. It proposes a framework for effective regulation and supervision of crypto-asset activities and markets that follows the principle of “same activity, same risk, same regulation”. Accordingly, crypto assets and intermediaries which perform an equivalent economic function to one performed by instruments and intermediaries of the traditional financial sector should be subject to equivalent regulation, regardless of how a particular crypto asset is characterized (e.g., as a payment, security, or other instrument). The framework also aims at regulating specific stakeholders,

<sup>21</sup> It may be argued that Ant Financial/Alipay and Tencent/WeChat Pay come close to meeting this definition in China.

<sup>22</sup> For further detail, see BIS, Project mBridge: Connecting economies through CBDC, [https://www.bis.org/about/bisih/topics/cbdc/mcbdc\\_bridge.htm](https://www.bis.org/about/bisih/topics/cbdc/mcbdc_bridge.htm).

where regulation should provide for adequate transparency, accountability, market integrity, investor and consumer protection, and AML/CFT compliance across the crypto-asset ecosystem. FSB foresees finalizing the proposed recommendations by mid-2023 (FSB, 2022).

Current AML/CFT regulations essentially rely on identity and KYC checks at the intersection between the fiat and the crypto world. Countries may also apply a risk-based approach to identify, assess and understand the money laundering and terrorist financing risks that they are exposed to.<sup>23</sup> Countries can then implement AML/CFT measures that mitigate these risks. To guide such implementation the Financial Action Task Force (FATF), which counts a wide range of developing countries among its members, introduced the first binding AML/CFT global standards on crypto assets in 2019. However, an assessment in June 2022 revealed that most countries, including developed countries, have yet to implement these measures. For example, of 98 surveyed countries, just 11 were enforcing and supervising the FATF's 'travel rule' that ensures crypto asset firms monitor who their customers are, and who they are doing business with. According to FATF (2022), this points to an urgent need to accelerate implementation and enforcement to mitigate criminal and terrorist misuse of crypto assets.

Other recent recommendations from international standard setting bodies also aim at minimizing spillover risk but emphasize regulating specific stakeholders. Regarding the prudential treatment of banks' exposure to crypto assets, the Basel Committee on Banking Supervision (BCBS, 2022) divides crypto assets into two broad groups to determine minimum risk-based capital requirements for credit and market risk. A first group is seen as meeting a set of classification conditions subject to the existing Basel capital framework, while another group (including unbacked crypto assets and stablecoins with ineffective stabilisation mechanisms) should be subject to higher capital requirements.<sup>24</sup>

Given that developed countries often set the trend in financial regulation, it is useful to examine crypto regulation in the European Union (EU) and the United States. The EU framework for Markets in Crypto Assets (MiCA)<sup>25</sup> is intended to implement recommendations of FSB (2022). MiCA emphasises consumer protection by regulating specific stakeholders. For example, it requires crypto asset service providers to give detailed information about their project and have a license from one member country to do business across the EU. It also mandates stablecoin issuers to hold sufficient liquid reserves to prevent crashes like that of Terra/Luna, and puts ceilings on stablecoin issuance and trading. Moreover, it imports rules from existing equity market regulations on market manipulation and investor protection including AML/CFT rules that require crypto transfers to include data on the payer and the payee. The framework is set to apply as of 2024 and bring crypto assets and exchanges under the supervision of the European Securities and Markets Authority (ESMA) and the European Banking Authority – except those that are already regulated by existing EU financial services regulations, which will remain under the existing framework.

Crypto regulation in the United States may have been delayed because of a fragmented regulatory scheme, as reflected in questions on the extent to which entities headquartered elsewhere can be regulated by US regulators, whether crypto regulation falls in the jurisdictions of the Securities and Exchange Commission (SEC), the Commodities Futures Trading Commission (CFTC) or banking regulators, as well as concerns that regulating crypto could be seen as giving these assets undeserved credibility despite their niche role and market turmoil in crypto so far unable to cause broader financial instability. However, following the issuance of Executive Order 14067 "Ensuring Responsible Development of Digital Assets" in March 2022, the Government issued a "Comprehensive Framework for Responsible Development of Digital

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<sup>23</sup> Such risk exposure may be gleaned from "red flag indicators", as provided by FATF (<https://www.fatf-gafi.org/media/fatf/documents/recommendations/Virtual-Assets-Red-Flag-Indicators.pdf>).

<sup>24</sup> For discussion of recommendations issued by other international standard-setting bodies, see the annex in FSB, 2022.

<sup>25</sup> See <https://data.consilium.europa.eu/doc/document/ST-13198-2022-INIT/en/pdf>.

Assets” in September 2022.<sup>26</sup> It presents ways to make traditional digital transactions easier and eliminate the perceived need for cryptocurrencies (such as by adopting instant payment systems and creating a dollar CBDC) and crack down on fraud (such as by amending the Bank Secrecy Law and laws against unlicensed money transmitting to apply explicitly to digital asset service providers, and by mandating the Treasury to complete a financial risk assessment on decentralized finance).<sup>27</sup>

In addition to issuing public warnings about the risks involved in crypto assets, developing country regulators trying to avoid regulatory arbitrage and a race to the bottom may strive for the effective implementation of global standards such as those recommended by FSB (2022), BCBS (2022), and FATF (2022). Three areas would appear to be particularly important. First, ringfencing the traditional financial system from spillovers from crypto. This could be done by delineating the exposure and engagement towards crypto assets of regulated financial institutions; setting limits on exposure to different types of crypto assets and stipulating specific capital and liquidity requirements for financial institutions that engage in crypto activity; and imposing transparency on stablecoin issues and crypto exchanges, including to prevent misuse of customer funds.

Such an application of existing regulation to crypto assets may rely on two reasons. One is that episodes of loss of confidence in stablecoins and crypto exchanges — as reflected by the collapse of Terra/Luna in May 2022 or the implosion of FTX in November 2022 - have so far had limited impacts outside the crypto-asset ecosystem, which may reflect the still low interconnection with the traditional financial system.<sup>28</sup> While this situation could change rapidly, establishing separate structures for crypto regulation could create a faulty feeling of legal certainty in the crypto ecosystem. This could increase interconnections by encouraging banks to engage in crypto dealing, with ensuing vulnerability to adverse valuation changes, and financial activity to migrate from traditional systems to the crypto universe. It could also reduce the volatility of cryptocurrency prices and the risk of their collapse, thereby increasing the net transactional benefits of using cryptocurrencies as “crypto vehicle currencies”. As discussed above, this may be a major concern particularly for developing countries.

The other reason is that letting the crypto ecosystem live its promises that it can provide a viable financial system through the very absence of government regulation will probably cause multiple collapses such as those in 2022, thus showing the faultiness of these promises. By contrast, departures from these promises to gain efficiency and credibility are undermining the foundational promises of cryptocurrencies. Such departures are reflected by evidence that Bitcoin is inherently inefficient and its blockchain not inter-operable with other cryptocurrencies, so that it can handle only a small fraction of the transactions needed by an economy (BIS, 2022b), or by the change in the validation process of the Ethereum blockchain that may increase efficiency, but also implies centralization and reduced room for anonymity, contrary to its foundational promise (Biancotti, 2022). Moreover, the dynamics around the implosion of FTX highlighted that much of crypto activity takes place on highly centralised exchanges, and it revealed how the crypto ecosystem is managed by a small number of individuals from issuers of cryptocurrencies, stablecoin companies, and crypto exchanges.

Second, regulators may address specific stakeholders to protect retail users of crypto assets. This could be done by mandating issuers of crypto financial instruments to provide detailed information on their product, and set strict requirements on stablecoin backing, as well as capital adequacy rules for financial institutions holding crypto assets. Regarding fraud and theft, by contrast, it may be argued that existing criminal laws can be applied. Moreover, speculators should be let bear their risks and not be bailed out for bets on assets with no intrinsic value.

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<sup>26</sup> See <https://www.whitehouse.gov/briefing-room/statements-releases/2022/09/16/fact-sheet-white-house-releases-first-ever-comprehensive-framework-for-responsible-development-of-digital-assets/>.

<sup>27</sup> Decentralized finance is an emerging technology that promotes P2P transactions, including those involving crypto assets.

<sup>28</sup> See note 4 above.



Third, and especially important for developing countries, regulators might need to adapt foreign-exchange regulations and capital controls to address risks of currency substitution, as discussed above. One such possibility would be the eventual adoption of a CBDC combined with a smart contract that would be programmed such as to avoid using the CBDC for the kind of cross-border transfers that traditional capital controls are intended to prohibit.

One case of navigating these various regulatory issues may be represented by El Salvador and the Central African Republic that have left crypto assets basically unregulated and encouraged their use with a view to swapping sovereign currencies for cryptocurrencies.<sup>29</sup> In September 2021, El Salvador made Bitcoin legal tender, along with the dollar that continued to serve as a reference currency for accounting purposes.<sup>30</sup> The government required all economic agents to accept Bitcoin as a medium of exchange for all transactions. It provided major adoption incentives by launching the Chivo Wallet app, which allowed users to trade bitcoin and dollars without transaction fee, giving a \$30 Bitcoin bonus to citizens who downloaded the app, and providing a discount on fuel purchased with the app. The government also guaranteed the automatic conversion from Bitcoin to dollars through a trust fund of \$150mn, financed from the government budget. Its hope was that Bitcoin use would promote financial inclusion, attract tourists trying to spend their Bitcoins, and reduce the cost of remittances to El Salvador (IMF, 2022).

However, the uptake of Bitcoin, whose valuation declined by about 60 per cent within one year after the experiment started, appears to have been low. Survey data (Alvarez et al., 2022) indicate that most downloads of the app took place immediately after its launch, with the objective to receive the bonus (equivalent to 0.7 per cent of annual per capita income), and less than half of them continued using the app. It also indicates that app users were predominantly owners of a cell phone with Internet access, banked, educated, young, and male. Citizens who knew about, but did not use the app, indicated that they preferred cash and did not trust the app or Bitcoin.<sup>31</sup> The Central Bank of El Salvador reports that only 1.7 per cent of remittances were received via digital wallets in August 2022.<sup>32</sup> At the same time, it appears that by mid-November 2022, the country had lost about two-thirds of the \$105 million spent on purchasing Bitcoin,<sup>33</sup> its fiscal deficit strongly increased, and negotiations became difficult with the IMF that urged the country to abandon Bitcoin as legal tender (IMF, 2022).

In April 2022, the Central African Republic made Bitcoin legal tender, alongside the CFA-franc. It allowed using Bitcoin for all electronic transactions and all monetary obligations denominated in the CFA-franc, with a view to improving the conditions of citizens and putting the country on the map of the world's boldest and most visionary countries.<sup>34</sup> In July 2022, the country launched the Sango project with a view to making the Sango Coin (to be mined in Dubai) the first sovereign national digital currency, with an initial 210 million Sango Coins put up for sale at \$0.10 each to raise \$21 million. To help its adoption, the government intends to provide residency or citizenship in exchange for purchasing pre-defined amounts of Sango Coins that must be deposited with the government for a specific amount of time before being freely disposable.<sup>35</sup>

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<sup>29</sup> Proposals to use a digital currency as a legal payment method have been advanced in other developing countries, including Argentina, Brazil, Panama, and Paraguay (Alvarez et al., 2022).

<sup>30</sup> The dollar became legal tender since 2011 and the local currency, the colón, no longer circulates.

<sup>31</sup> Regarding Bitcoin use by businesses, the Chamber of Commerce and Industry of El Salvador indicated in March 2022 that only 14 per cent of businesses were transacting in Bitcoin and less than 4 per cent felt that Bitcoin use had increased their sales (<https://camarasal.com/empresarios-proyectan-invertir-en-el-salvador-pese-a-los-retos-que-enfrenta-el-pais/>).

<sup>32</sup> See <https://www.bcr.gob.sv/2022/09/20/las-remesas-familiares-acumularon-us5065-6-millones-al-mes-de-agosto-de-2022/>.

<sup>33</sup> See "El Salvador's bitcoin experiment is not paying off", *The Economist*, 17 November 2022, <https://www.economist.com/the-americas/2022/11/17/el-salvadors-bitcoin-experiment-is-not-paying-off>.

<sup>34</sup> <https://www.reuters.com/article/centrafrique-economie-bitcoin-idFRKCN2MJ1SY-OFRIN>

<sup>35</sup> See <http://www.sango.org>.

These moves may be controversial in economic terms not only because the volatility of Bitcoin can undermine monetary and financial stability. In addition, only a small percentage of the population has access to electricity or the Internet. Frequent electricity outages present operational risks where significant downtime periods can prevent the use of services and result in losses of customer funds or congestion and high transaction costs.<sup>36</sup> Moreover, the country is a member of the Central African Economic and Monetary Community (CEMAC), whose arrangements give the Bank of Central African States the exclusive right to issue money in the monetary union.<sup>37</sup> A mechanism that allows converting CFA-francs into cryptocurrency would also allow any CFA-franc holder in CEMAC to move currency out of the region in an uncontrolled manner.

However, Bitcoin adoption may well be motivated more by political considerations, such as to maintain political stability through a private security entity that may be unable to accept payment in CFA-franc, or to loosen ties with France. The CFA-franc may well provide macroeconomic stability and low inflation. However, perceptions that these benefits mainly accrue to local elites and that the CFA-franc link leads to overly constrained monetary policy and associated fiscal rules that were causing exchange-rate overvaluation and holding back economic development of CFA-franc countries have led countries of the West African Economic and Monetary Union (UEMOA) to loosen ties with the French Treasury, with similar steps so far not adopted by CEMAC.<sup>38</sup>

The extreme opposite to welcoming crypto assets in El Salvador and CAR is the outright ban that China has instituted in September 2021. The Chinese government declared all private crypto-related transactions illegal, citing concerns about speculative investments, extreme price volatility, gambling fraud, and money laundering (Biancotti, 2022).<sup>39</sup> In a similar vein, the Indian Government sought to introduce a revised Cryptocurrency and Regulation of Official Digital Currency Bill in 2021, which seeks to prohibit all private cryptocurrencies in India. Bangladesh, Nepal, and a range of countries in the Middle East and North Africa have also banned cryptocurrencies (Biancotti, 2022), whereas Iran passed a law in September 2022 that allows business imports to be paid for in cryptocurrencies, even as speculative investments remain illegal. Regarding countries in SSA, six (Cameroon, Ethiopia, Lesotho, Sierra Leone, Republic of Congo, and United Republic of Tanzania) have banned crypto, while two-thirds have implemented some restrictions.<sup>40</sup> For example, Nigeria prohibited the private creation and dealing in cryptocurrencies and barred them from becoming legal tender, and it launched its own digital currency (the eNaira) in 2021.<sup>41</sup> In Latin America and the Caribbean, Argentina, Bolivia, Dominican Republic and Ecuador have fully or partly banned crypto assets (Appendino et al., 2023).

To summarize, regulation can address many public-policy concerns about crypto assets. However, it cannot address challenges regarding the availability of public money and its convertibility promise when

<sup>36</sup> See David Pilling, “Central African Republic’s adoption of bitcoin is mostly about geopolitics”, *Financial Times*, 26 May 2022, <https://www.ft.com/content/8b68b0cd-230c-4e9b-aa66-84bdb98c9e0>.

<sup>37</sup> See Article 21 of the Convention governing the Central African Monetary Union, available at [https://www.cemac.int/sites/default/files/inline-files/Convention\\_umac.pdf](https://www.cemac.int/sites/default/files/inline-files/Convention_umac.pdf).

<sup>38</sup> See “La France acte officiellement la fin du franc CFA en Afrique de l’Ouest”, *Le Monde*, 21 May 2020, [https://www.lemonde.fr/afrique/article/2020/05/21/la-france-acte-officiellement-la-fin-du-franc-cfa-en-afrique-de-l-ouest\\_6040339\\_3212.html](https://www.lemonde.fr/afrique/article/2020/05/21/la-france-acte-officiellement-la-fin-du-franc-cfa-en-afrique-de-l-ouest_6040339_3212.html).

<sup>39</sup> See also, e.g., “China Makes Cryptocurrency Transactions Illegal: An Explainer”, China Briefing, 21 October 2021, <https://www.china-briefing.com/news/china-makes-cryptocurrency-transactions-illegal-an-explainer/#:~:text=On%20the%20September%2024%2C%202021,provide%20services%20to%20Chinese%20citizens>.

<sup>40</sup> For the state of crypto regulation in a range of countries, see the Official Monetary and Financial Institutions Forum (OMFIF) Digital Asset Regulatory Tracker (<https://www.omfif.org/digitalassetstracker/>), as well as the 2022-Thomson Reuters report “Cryptocurrency regulations by country” <https://www.thomsonreuters.com/en-us/posts/wp-content/uploads/sites/20/2022/04/Cryptos-Report-Compendium-2022.pdf>. For sub-Saharan Africa, see Fuje et al., 2022.

<sup>41</sup> See <https://www.cbn.gov.ng/Out/2021/FPRD/eNairaCircularAndGuidelines%20FINAL.pdf>.

cash is no longer used. National regulation also faces difficulties in addressing monetary sovereignty concerns where financial instability increases the exposure to currency substitution or where a few global firms dominate domestic digital retail payments. Moreover, regulation is unlikely to improve payments efficiency and financial inclusion. Hence, policymakers may consider providing citizens and firms with a public money alternative to crypto assets. Such an alternative could be a CBDC, as discussed next.

## 5. Central Bank Digital Currencies

The declining use of cash and the growing role of crypto assets have led central banks to contemplate CBDCs. A CBDC is a publicly issued digital money denominated in the national unit of account. It is issued and regulated by a country's national authority or central bank. As such, it offers, in digital form, the unique advantages of central bank money: monetary anchor, settlement finality, liquidity and integrity. There are two main types: a retail CBDC is issued to the general public, such as individuals and businesses, and exhibits characteristics of cash (but in digital form), while a wholesale CBDC is issued primarily for interbank transactions and available only to selected financial institutions (similar to bank reserves). However, compared to bank reserves, a wholesale CBDC may be accessible to a wider range of counterparties and be interoperable with other payment systems (both domestic and foreign). CBDCs may be programmable in the form of smart contracts. Most developing country central banks are investigating both retail and wholesale CBDCs (Kosse and Mattei, 2022).

Central banks may have five main reasons to issue CBDCs (e.g., Ahnert et al., 2022). First, CBDCs are backed by the full faith of the issuing country's central bank. Hence, they maintain the monetary anchor of current financial systems, as well as the trust, safety, liquidity, and settlement finality of traditional central bank money. By issuing CBDCs, central banks can complement cash as public money, ensure the continued availability of a risk-free medium of exchange, and maintain payments efficiency, even in a world in which consumers and firms increasingly turn to electronic payments.

Second, regarding cross-border use, CBDCs would not require the multi-layered correspondent banking relationships that characterize current remittances transfers, as CBDCs are direct liabilities of central banks and – being the least risky and most liquid settlement assets – could significantly ease settlements. By reducing the number of intermediaries, wholesale CBDCs would allow cross-border payments to become faster, cheaper, more transparent, and easier accessible. Targeted CBDC-design could facilitate interoperability, as well as help to use CBDCs for finetuning and calibrating capital controls (BIS, 2022a).

Third, the issuance of CBDCs would help central banks to ensure monetary sovereignty and their function as lender of last resort that safeguards financial stability because they can print unlimited amounts of the domestic currency to support financial institutions in distress. By contrast, using cryptocurrencies and stablecoins and quoting prices in a different unit of account can give rise to financial stability risks because, for example, distress liquidity support is no longer effective if liabilities are denominated in another unit than that of public money. By offering a digital version of sovereign money, central banks would safeguard monetary sovereignty even in situations of widely used global stablecoins or the issuance of private digital money by digital platforms with a global reach. By exploiting their customer base, global digital platforms may quickly become dominant issuers of private digital money. They could bundle payments with their digital services, such as online marketplaces, messaging apps and financial services (for example lending and insurance) (Brunnenmeier et al., 2019). A CBDC could ensure that public money remains used in practice, and thus help ensuring monetary sovereignty.

Fourth, while all digital transactions leave a trail, a CBDC could help to preserve privacy at an intermediate degree between cash, which fully preserves privacy, and crypto assets. Issuers of crypto assets, and especially global platforms, typically collect personal data when people use their digital money to make payments. CBDCs could of course lead to an undue concentration of information on payments with government authorities. However, preventing data misuse is largely a regulatory problem and, depending on their design, CBDCs could allow users to retain more control over their data, such as by letting them determine for themselves when, how, and to what extent they want to share personal data with third

parties in exchange for more personalized services. As such, CBDCs could help to set privacy standards for digital payments.

Moreover, as a public low-cost alternative to crypto assets issued by global platforms, where network effects tend to create highly concentrated payments markets, CBDCs could be used to counter oligopolistic market structures in digital money. However, appropriate regulation of privately issued digital money would at least partly address market concentration and allow the design of CBDCs to concentrate on other matters (Assenmacher and Bindseil, 2021).

Fifth and of particular importance for developing countries could be the use of CBDCs as a single platform for payments to and from the Government. This could facilitate tax collection, for example, by making it more cumbersome to use cash for reasons of tax evasion. It could also enable the Government to reach every citizen everywhere and at any time. The provision of targeted transfers could concern regular payments but play a particularly important role in immediate relief payments to households and businesses in case of emergencies. Such CBDC-transfers could be programmed with an expiry date and made conditional on being spent on certain goods and services. Such payments could be disbursed more rapidly than through checks or tax refunds. On the other hand, data privacy and rapid disbursement could also be achieved through FRPS, provided that all government payment beneficiaries have access to transaction account facilities.

Some observers also see CBDCs as providing new and more efficient monetary policy instruments. According to this argument, central banks could control either the quantity or price of CBDCs in a countercyclical fashion (Barrdear and Kumhof, 2016) or more easily overcome the zero-lower bound of monetary policy by loosening constraints on applying negative interest rates to stimulate aggregate demand (Ahnert et al., 2022). However, allowing these features to occur would require abandoning cash, which central banks are not envisaging (Bindseil, 2020). It should also be noted that in developing countries monetary policy transmission may suffer from vulnerabilities in the financial system and the presence of a large informal sector more than from an ineffectiveness of existing monetary policy instruments.

These potential advantages face six main concerns. First, just like an increased use of crypto assets, user decisions to hold CBDCs instead of bank deposits could cause bank disintermediation. This could increase banks' funding costs and reduce their profit margins which, in turn, could force them to raise interest rates to retain customers, which could jeopardize their money-creation function via credit provision (Cecchetti and Schoenholtz, 2021). It may also encourage banks to take on riskier assets on their balance sheets, such as by extending riskier loans or investing in speculative assets. Such greater risk exposure could facilitate bank runs.

To counter these effects, a CBDC could be designed as a system of tiered remuneration, with CBDC holdings beyond some threshold being discouraged by a sufficiently unattractive remuneration, which in cases of banking crises could be made even less attractive to prevent bank runs (Bindseil, 2020). On the other hand, the mere possibility of negative interest rates could reduce the acceptability of CBDCs. Instead, tiering could work with several thresholds of holdings and increasing levels of penalty, which would be independent of the economic, monetary, and financial situation. Central banks could also deposit money at banks to compensate their loss in client deposits (Brunnermeier and Landau, 2022).

Second, to the extent that countries would adopt a retail CBDC, they may risk largely giving up the existing two-layered monetary system, based on the co-existence of central bank and commercial bank money. It could also imply for the central bank to assume sizable additional logistical tasks. This may be challenging for many developing countries that may lack the required human and financial resources. It might also duplicate solutions that have been, or can be, developed by the private sector, introducing inefficiencies. Taking direct responsibility for a larger payment system would also risk problems in terms of disservices and malfunctions to be attributed to the central bank, which could cause reputational damage and hamper achieving the institution's primary objectives. Moreover, introducing a CBDC might require a revised legal framework.

Third, to the extent that a CBDC can be held by non-residents, increased ease and efficiency of cross-border payments could create new international arbitrage conditions between domestic and foreign interest rates and the exchange rate. It could undermine national control of monetary policy and facilitate circumvention of capital controls with ensuing increased capital-flow and exchange-rate volatility. As a result, economies with high inflation and volatile exchange rates might experience an increase in currency substitution (Levy-Yeyati, 2022).

To curb currency substitution, CBDCs could be designed by issuing central banks such as to preclude or limit their use outside the issuing country. CBDC-issuing central banks could also allow foreign countries to introduce such limits on their own territory, or wallets in recipient countries could be designed to allow local authorities to implement certain exchange restrictions or capital controls. In addition, the programmability of CBDCs could potentially be used to allow only small-value transfers, such as those usually used for remittances.

On the other hand, designing CBDCs such that their use is restricted to citizens of prescribed economies could cause fragmentation of the international monetary and financial system. Like digital currency areas based on stablecoins issued by global tech platforms, digital currency areas could also occur around CBDCs from issuers of international currencies – the United States, the euro area<sup>42</sup> and, potentially, China – to the extent that those CBDCs would be available to non-residents. A decline in the cost of cross-border payments related to issuing such a CBDC may enhance its role as a global means of payment, boosted by its safety, liquidity, efficiency, and scalability.

These processes could enhance existing network effects and make the dollar become even more dominant. On the other hand, a digital Euro or the e-CNY could scale up faster if they offer significant advantages in terms of costs, trust, and ease of use. This could be achieved by combining such CBDCs with currency swap lines, so that foreign-exchange dealers could intermediate currency flows between local payments systems without referencing the dollar. First-mover advantages may also play a role. An edge on setting the standards and creating the infrastructure for CBDCs would not only lead in international principles for digital asset transactions but could, more generally, influence global norms and rules around the Internet, data transfer and security, and the overall digital economy. An important role in this regard could be played by mBridge, which allows participating central banks to issue their respective CBDC, as well as participating commercial banks to receive a CBDC in return for reserves and to transact directly with each other regardless of jurisdiction. The project's use case is particularly strong for international trade settlement and could accelerate an increase in the share of trade denominated in renminbi. This could eventually spur broader internationalization of the renminbi, and an associated decline in the international status of the dollar, even without China moving towards full capital-account convertibility (Eichengreen et al., 2022).

In addition to altering the structure of the international monetary and financial system, cross-border use of CBDCs, or their unlimited availability to non-residents, could also generate stronger international financial spillovers, thus increasing exchange-rate volatility and affecting capital flow dynamics. This is because a CBDC that can be held by non-residents and that combines characteristics such as scalability, liquidity, safety, and (potentially) remuneration creates new international arbitrage conditions that link together interest rates, the exchange rate, and the remuneration of the CBDC (Ferrari et al., 2022). The magnitude of these effects crucially depends on CBDC design, especially the restrictions on transactions by non-residents and the remuneration rate on the CBDC. These aspects underline the importance of close collaboration on standards, underlying technologies and regulation between central banks that issue a CBDC and other central banks and relevant authorities to realize the potential benefits of CBDC while guarding against the risks of currency substitution and international financial instability.

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<sup>42</sup> The Federal Reserve has not decided whether to pursue or implement a CBDC (<https://www.federalreserve.gov/central-bank-digital-currency.htm>, accessed on 20 December 2022). The Governing Council of the ECB has launched an investigation phase on the possible issuance of a digital euro, due to end in September 2023 (<https://www.ecb.europa.eu/paym/intro/news/html/ecb.mipnews221216.en.html>).

Fourth, cybersecurity and privacy risks loom large in concerns whether CBDCs should be developed at all. A larger extent of digital transactions that depend on computer software widens the vulnerability to cyberattacks. However, up-to-date assessments of cybersecurity risks will help supervision and oversight, and internationally harmonized reporting of cyberattacks will promote rapid responses and recovery of stolen assets. Concerning privacy, a CBDC may not preserve the same level of privacy as cash, given that any transaction leaves some digital trace. Underlying ledger technology could cause a centralized government-administered accumulation of sensitive payment and user data that users might wish to keep private and secure, such as purchases of medicine or travel itineraries. Using ledger technologies also makes it more difficult to reverse fraudulent or erroneous transactions, including automated transactions related to programming errors in smart contracts (Weaver, 2022). However, choosing specific design principles for a CBDC can alleviate these risks. For example, transaction verification by the ledger could be disaggregated, with each component collecting only the information needed for functionality (Fanti and Kostianen, 2022). Individual components could be validated by different third parties that comply with AML/CFT rules and stringent auditing and breach disclosure requirements. In addition, cash-like privacy could be granted up to certain transaction threshold to ensure that users enjoy privacy for retail payments, while allowing regulatory authorities to meet other important goals, such as combatting illicit financial activities, for larger amounts.

Fifth, CBDCs face the risk of low adoption. This would jeopardize the reputation of the central bank with potential adverse impacts also on its functions in the traditional monetary and financial system. To avert this risk, the design of CBDCs must ensure to satisfy unmet needs by users and acceptance by merchants within the country-specific characteristics of established financial and payments systems, while at the same time finding the right balance between privacy and prevention of IFFs. Doing so will depend on country-specific economic structures, forms of economic activity, and payment landscapes. It will also depend on users' capacity to access digital services; the safety, security, and privacy features of the CBDC; the degree of transaction cost reduction and use of existing, accessible technology and infrastructure; and the achievement of network effects (e.g., by facilitating P2P use that would make merchants to accept the CBDC). User adoption of a CBDC will also depend on its interoperability, i.e., the ease with which funds can flow between the CBDC and other payment systems, both domestically and cross-border. Existing degrees of financial inclusion will also determine CBDC-adoption, where public commercial banks and their incentives to reach the unbanked might raise financial inclusion and obviate the usefulness of a CBDC for this purpose. One way of driving adoption would be employing CBDC for government payments, such as pension, benefits, and taxes.

Defining the appropriate design requires extensive testing to determine what technology can do and what policy and ensuing regulation must do. Given the time and effort that monetary authorities in the major developed countries dedicate to testing and finding appropriate solutions to the many trade-offs in terms of performance, privacy, and security indicate the immense challenge faced by monetary authorities in developing countries, where often large informal sectors and frequent macroeconomic instability pose additional challenges.

Finally, some observers believe that CBDCs are a solution in search of a problem and that any problem with private digital money and payments could be addressed through regulation (e.g., Cecchetti and Schoenholtz, 2021). They doubt that CBDCs could provide cheaper, faster, more reliable, and more accessible retail payment system than private solutions because any rents that commercial banks earn from their market power in payment services provides a profit opportunity for nonbanks to enter the market and pressure banks to reduce their markup (Waller, 2021). Hence, no CBDCs would be needed.

Similar arguments may refer to countries that have operational FRPS. These are digital payment schemes that allow for the processing of transactions in real time and can provide faster, cheaper, and more accessible transfers without the anonymity of crypto assets that complicates tracing payments and facilitates IFFs. They employ simpler technologies and payment systems that might address the needs of consumers and businesses at least as well as crypto assets and their functionalities are in many respects similar to those of CBDCs. Appendix 2 discusses examples of FRPS in developing countries.

The advantages of fast retail payment solutions over traditional payment systems are no or little restrictions on operating hours, and the reduction in transaction times and therefore cost, as receivers have payments available for immediate reuse and thus require smaller cash balances. However, using FRPS may require a bank account, therefore falling short in terms of financial inclusion compared to a retail CBDC, which extends financial inclusion also to the unbanked. Retail CBDCs have the additional advantages of ensuring access to public money for all and of potentially being programmable, thereby facilitating targeted government transfers. For example, a retail CBDC could foster financial inclusion to the extent that holdings could be loaded on digital wallets of and transferred from mobile phones or smartcards, so that even the unbanked could use the CBDC (e.g., Eichengreen et al., 2022). Yet, a CBDC will do little if financial exclusion relates to the lack of ancillary services, such as not having the equipment required for internet-enabled payments. Indeed, India's experience suggests that feature phones with limited processing and storage capacity and unable to access the Internet might support FRPS more easily than a CBDC.<sup>43</sup>

Several challenges remain regarding the interoperability of FRPS though, compared to interoperability between CBDCs, their potential solutions appear more advanced. One such solution is bilateral interoperability, such as established in April 2021 between Singapore and Thailand and in February 2023 between Singapore and India. Regional payment connectivity between Indonesia, Malaysia, the Philippines, Singapore, and Thailand is envisaged to be achieved by 2025 (MAS, 2022).

Multilateral platforms of FRPS could very effectively alleviate the frictions of cross-border payments and help achieve the SDGs target regarding remittances. However, they involve complicated legal and operational issues, such as whether to apply a common single rulebook or to make existing national rulebooks interoperable, or whether to employ a single currency, multicurrency, or cross-currency platform (BIS, 2023a). The BIS Project Nexus provided, in March 2023, a technical proof-of-concept for the multilateral interlinking of the fast payment systems of the Euro Area, Malaysia, and Singapore, only using mobile phone numbers. This outcome allows for an exploration of the practical applications of a distributed multilateral network (BIS, 2023b). The project aims at establishing a unified solution that coordinates payments-based foreign-exchange conversion, message translation, and compliance, with a view to streamlining the entire cross-border payment process (BIS, 2021). Participation in such multilateral, or even just bilateral, payment connectivity, nevertheless, requires a fully functioning FRPS at the national level.

Regulatory authorities and central banks can foster the implementation of FRPS in various ways (Khiaonrong and Humphrey, 2022). As catalysts, they can design national strategies towards modernizing national payment systems. As regulators, they may directly provide instant payment services for new payment applications, with a view to shortening settlement periods and reducing payment risk. As operators, their involvement may take various intensities and can involve owning and operating the services themselves, regulating the service providers, or simply providing real-time settlement. To ensure smooth transactions, central banks will also need to implement arrangements that enable users to bridge emergency liquidity shortages. As illustrated in Appendix 2, the successful deployment of FRPS suggests that it is crucial for the government to provide a digital identify and for the central bank to act as a provider and operator of a payment platform that also allows it to define and enforce rules, including on costs, use of data, and other technical standards. Moreover, to allow for rapid scaling up and network effects, it is critical to mandate the participation of large banks, payment providers and financial institutions.

Public FRPS have significant advantages over privately run FRPS and mobile money schemes.<sup>44</sup> The latter may be subject to tendencies towards market concentration and the risk that dominant firms reduce the

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<sup>43</sup> See Reserve Bank of India, "Reserve Bank of India launches (a) UPI for Feature Phones (UPI123pay) and (b) 24x7 Helpline for Digital Payments (DigiSaathi)", Press Release, 8 March, [https://www.rbi.org.in/Scripts/BS\\_PressReleaseDisplay.aspx?prid=53385](https://www.rbi.org.in/Scripts/BS_PressReleaseDisplay.aspx?prid=53385).

<sup>44</sup> A recent survey on mobile money (Suri et al., 2023: 24) concludes that mobile money has been very successful in some countries but that its use overall has remained bounded to very specific P2P-transactions, including "those that take place over long distances and those that are in places where holding cash is risky." This implies that mobile money has so far not fulfilled its promise as a genuine payment system.

number of start-ups, and economic dynamism in the process, and abuse their market power. Abuse of dominant positions could be contained by taxing profits or imposing price ceilings. However, to restore market dynamism authorities will necessarily need to resort to antitrust and regulatory policy. Yet, the question is whether developing countries have the financial and staff resources to effectively enforce such measures, particularly in light of lobbying by dominant firms. While still difficult, it may nonetheless be more easily feasible to establish publicly run FRPS that are interoperable with the existing financial system to increase competition.

With many of these considerations in mind, central banks around the world started seriously examining the issuance of a CBDC when Facebook (now Meta) and its partners announced plans to launch a global stablecoin (Libra, then Diem) in June 2019. These plans unravelled in January 2022, as already mentioned. Nevertheless, as of December 2022, 114 countries representing more than 95 per cent of global output were exploring a CBDC, while eleven countries (the Bahamas, Jamaica, Nigeria, and the eight members of the Eastern Caribbean Central Bank (Anguilla, Antigua and Barbuda, Commonwealth of Dominica, Grenada, Montserrat, Saint Christopher, Saint Kitts and Nevis, Saint Lucia, and Saint Vincent and the Grenadines)) have already launched a CBDC. These eleven countries are small, and they have yet to solve technical interoperability challenges and overcome the complex cross-jurisdictional regulatory hurdles for their CBDCs to scale up and move beyond niche status. On the other hand, the number of countries that are in an advanced phase of exploration reaches new highs, with 18 of the G20 countries in the development or even pilot stage (such as India, Republic of Korea, Russian Federation, Saudi Arabia, South Africa) and China set to launch the e-CNY in 2023.<sup>45</sup> The United States is actively examining the requirements and feasibility of launching a Fed-issued digital dollar, and the European Central Bank started a two-year investigation phase in July 2021.<sup>46</sup> Appendix 3 discusses experiences with different approaches to CBDCs in selected developing countries.

A recent survey (Kosse and Mattei, 2022) indicates that 80 per cent of central banks are considering CBDCs and 50 per cent have moved beyond conceptual research to experimenting and running pilots. It also shows that work on retail CBDCs is at a more advanced stage than work on wholesale CBDCs and provides further detail on the potential benefits and risks that central banks expect from CBDCs. The common thread of these replies is the recognition that a digital form of public money should exist. Beyond that, the survey reveals wide diversion (figure 6). While payments safety, domestic payments efficiency, and financial stability are motivations shared across developed and developing countries, central banks in developing countries also see CBDCs as an important instrument to promote financial inclusion, with CBDC-issuance in developed countries also motivated to make up for dwindling cash use.

Perhaps surprisingly, promoting cross-border payments efficiency appears to be less of a motivation for developing countries, even though such efficiency improvement could significantly reduce the cost of remittances. One reason may be the formidable challenges related to technological aspects and multilateral collaboration of design principles. With the involvement of several jurisdictions, major risks regarding financial stability, regulatory standards and interoperability with existing payment systems, which were discussed above for domestic uses of CBDC, become invariably more complex, with further risks regarding currency substitution, capital flow volatility and macroeconomic spillovers added.

Current cross-border payments rely on the correspondent banking network to address the lack of interoperability between national payment systems. Resulting high costs and difficulties in ease of access

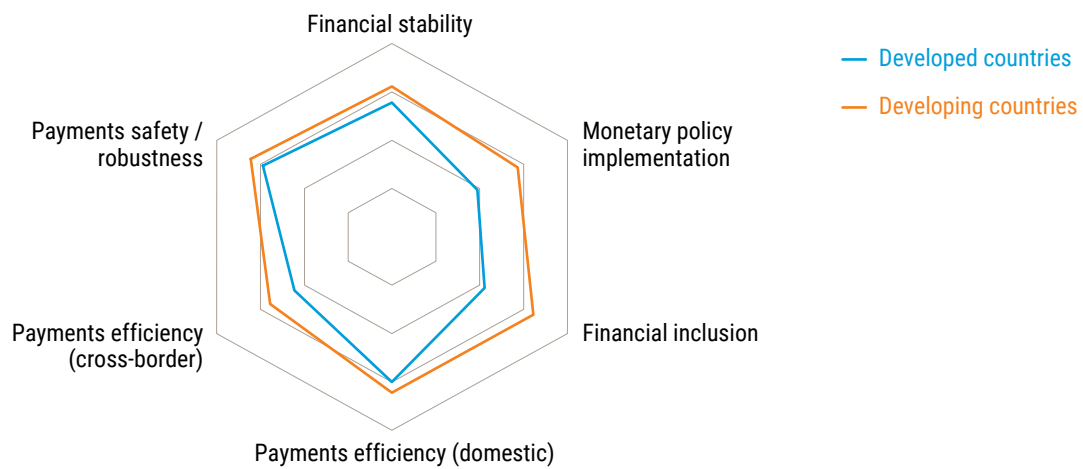
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<sup>45</sup> All numbers in this paragraph are from Atlantic Council; see <https://www.atlanticcouncil.org/cbdctracker/>, accessed 19 January 2023. Among non-G20 developing countries, CBDCs are also at pilot stage in Ghana, Iran Islamic Republic, Kazakhstan, Malaysia, Singapore, Thailand, United Arab Emirates.

<sup>46</sup> On 9 March 2022, President Biden signed an executive order (<https://www.whitehouse.gov/briefing-room/statements-releases/2022/03/09/fact-sheet-president-biden-to-sign-executive-order-on-ensuring-responsible-innovation-in-digital-assets/>) that directs the US Government to assess the technological infrastructure and capacity needs for a potential US CBDC and encourages the Federal Reserve to continue its research, development, and assessment efforts for a US CBDC. For the ECB, see Press Release 14 July 2021



**Figure 6 Motivations for issuing a retail CBDC, by order of average importance, 2021**



Source: UNCTAD elaboration based on Kosse and Mattei, 2022.

Note: Scores calculated as an average of the options: (1) = not so important, (2) = somewhat important, (3) = important, (4) = very important.

have partly been tackled by money transfer operators, as well as P2P transactions based on crypto assets. Smooth cross-border interoperability of CBDCs would be superior to any of these solutions, as it would provide easy access at any time to less complex, low-cost, secure and regulated transactions based on public money. This could be done either by making a retail CBDC of a given jurisdiction available to anyone outside this jurisdiction, or by the establishment of access and settlement arrangements among different retail and/or wholesale CBDCs, based on tight collaboration among central banks. The latter could relate either to enhanced compatibility of technical and regulatory standards with overlapping participation; interlinking through shared technical interfaces or by use of a (centralized or decentralized) common clearing mechanism (e.g., Project Jasper-Ubin); or a multi-CBDC (mCBDC) arrangement with a single set of rules, a single technical system, and a single set of participants (e.g., Project Dunbar or mBridge) (BIS, 2022c).

Much in this area remains work in progress. Completed (e.g., Jasper-Ubin and Dunbar) and ongoing (mBridge) projects have relied on wholesale CBDCs with multiple CBDCs transferred either individually or against another CBDC. Their lessons include that mCBDCs are technically feasible and could offer faster, cheaper, and more transparent cross-border payments, but that many questions related to access policy and legal and regulatory frameworks (including how to incorporate exchange-rate regulations and capital controls in cross-border use of CBDCs) remain unanswered, and that basic operational economics (e.g., related to scalability and how DLT platforms interact with existing systems) may call into question the viability of mCBDC platforms (World Bank, 2021; BIS, 2022d).

To sum this discussion of the advantages and challenges of CBDCs, one way forward for developing countries may be developing a public FRPS even though – compared to a retail CBDC – FRPS do not extend financial inclusion to the unbanked, do not ensure access to public money for all, and so far are not programmable. Regarding cross-border transactions, FRPS may have an advantage over CBDCs at least in the short run, as solutions to interoperability challenges for FRPS appear more advanced than for CBDCs. This approach may be augmented by the introduction of a CBDC once the country-specific use cases are fully understood, payment and financial system infrastructure has been sufficiently advanced to ensure interoperability of traditional public money and the CBDC and does not negatively affect monetary policy and financial stability, and once the necessary legal and regulatory changes have been undertaken and regulatory authorities sufficiently endowed to allow enforcing these changes.

## 6. Conclusions and suggested policy recommendations

Traditional monetary and financial systems face long-standing problems in providing efficient, secure, and affordable monetary transfers, fostering financial inclusion, and finding the right balance between ensuring privacy and preventing criminal or illicit activities. The promise of crypto assets has been to address these problems by improving efficiency and inclusion through decentralized, peer-to-peer transactions and by providing security, transparency, and privacy with decentralized DLT.

The adoption of crypto assets is difficult to measure. Nevertheless, available evidence suggests that it has been strongest in developing countries (particularly India, Kenya, Nigeria, Pakistan, Thailand, and Viet Nam) and that general drivers of crypto adoption include appetite for speculative investment, the ease of using crypto assets, a younger demographic structure, and volatile macroeconomic conditions – currency depreciation, exchange rate volatility, and inflation. An increased use of crypto assets for cross-border payments and a related decrease in the cost of such transfers could provide significant benefits for countries that are large receivers of remittances, such as developing countries in South Asia and SSA, as well as a wide range of small economies across the world. Crypto assets could also ease the access to affordable investment finance and export credit.

Despite rapid adoption of crypto assets, their relative importance and links with established monetary and financial systems have remained low, such as reflected by the closely circumscribed impacts of the collapse of some cryptocurrencies, stablecoins, and crypto exchanges in 2022. The reason for the continued niche-kind character of the existing private crypto ecosystem may be that crypto assets are, in fact, unable to address the shortcomings of existing monetary and financial systems, for at least three reasons: (i) cryptocurrencies face a scalability problem because trying to obtain trust through decentralized DLT comes at the cost of redundant computations and storage, which makes them unsuitable for large volumes of small-value retail transactions; (ii) crypto assets have no intrinsic value which, combined with their sizable volatility, makes them unsuitable as a medium of exchange and store of value; and (iii) their pseudonymity makes them unsuitable to solve the trade-off between preserving privacy and preventing fraud and illicit financial activity.

While the purported benefits of crypto assets have yet to materialize, any such potential benefit comes along with many challenges and risks. A substitution of national sovereign currencies by crypto assets can jeopardize financial stability and the effectiveness of monetary policy, as well as pose risks to countries' monetary sovereignty. The latter may be particularly problematic for developing countries, not only because of the loss of fiscal revenues from seigniorage, but especially because they are more exposed to the risk of currency substitution, as macroeconomic stability tends to be lower and financial markets narrower and less regulated than in developed countries.

Regulation can help address some of these risks, even though the pseudonymity of crypto transactions create data gaps and their decentralization principle allows avoiding regulated intermediaries. Regulation should foster consumer protection, stem the tendency that boundaries between the crypto world and the traditional financial system are increasingly becoming blurred, and, especially important for developing countries, implement global AML/CFT standards, adapt foreign-exchange regulations and capital controls to address risks of currency substitution. However, regulation cannot improve payments efficiency or financial inclusion, address concerns about the availability of public money when cash is no longer used, or deal with monetary sovereignty challenges where financial instability increases the risk of currency substitution or where a few global firms dominate domestic retail payments.

Confronting this situation, central banks worldwide have been considering CBDCs, not as just another electronic medium of exchange but to ensure monetary sovereignty and the function of central banks as lenders of last resort that safeguards financial stability. CBDCs have a spectrum of “cash-like” and “deposit-like” features, and they provide time-invariant direct access, offline capacity, safety and integrity, and programmability. Particularly important for developing countries could be the use of CBDCs for payments to and from the Government. Such payments may regard taxes, but especially immediate relief payments to households and businesses in case of emergencies.

CBDCs have several advantages over crypto assets. They are issued and backed by a central bank, scalable and compatible with existing two-tier financial systems, as well as regulated, so that associated transactions are secure and maintain consumer protection. However, different setups for CBDCs could be necessary to address different priorities, and the impact of a CBDC for citizens and financial stability highly depends on country-specific characteristics, such as the use of cash compared to other means of payment, competition in the banking sector, and values and beliefs on privacy. Moreover, solutions that improve the interoperability of CBDCs and reduce the cost of remittances are yet to be found.

The challenges as to how to regulate the crypto ecosystem and how to design CBDCs are probably more serious for developing countries because of the structural characteristics of their financial systems and their lower institutional capacity. The policy actions that developing countries may consider include:

- Adopting regulation which protects the traditional financial system against spillovers from crypto assets;
- Improving the attractiveness of more traditional digital payment solutions, including FRPS and auxiliary digital infrastructure, to provide more rapidly available solutions to the long-standing problems of monetary and financial systems;
- When appropriate for the stage of their payment and financial infrastructure development and of their deployment of legal and regulatory changes designed to ensure financial stability and the effectiveness of monetary policy, developing countries could also explore CBDCs, especially for more efficient cross-border payments, reduced risks of currency substitution, and continued access to public money;
- Developing countries may also wish to work through international fora to ensure that global regulatory standards for AML/CFT be developed while taking into account the specific challenges and needs of developing countries, as well as that potential CBDCs of major developed countries take account of potential adverse impacts on developing countries' financial systems and their monetary sovereignty.

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## Appendix 1: Drivers of crypto adoption – an econometric exercise

This appendix presents a regression analysis of the drivers of crypto adoption across countries. Similarly to He et al. (2022) and Alnasaa et al., (2022), the analysis aims to estimate the effect of various demographic, macroeconomic, and institutional variables, as well as factors related to the digital divide and financial inclusion that are not considered by these two studies. The regression equation takes the following form:

$$ADOPT_{i,t} = a_1 DEM_{i,t} + a_2 DD_{i,t} + a_3 INC_{i,t} + B_1 INT_{i,t} + B_2 RE_{i,t} + B_3 Z_{i,t} + \mu_t + \epsilon_{i,t}$$

where *ADOPT* is a proxy for crypto adoption, *DEM* is a demographic variable, *DD* and *INC* are proxies for the digital divide and financial inclusion, *INT* is a vector of institutional variables, *RE* is a vector of variables concerning remittances, *Z* is a vector of macroeconomic variables, and  $\mu_t$  represents year fixed effects.

The dependent variable, i.e., crypto adoption, is measured by the share of respondents to a survey who indicated that they either owned or used cryptocurrencies (Statista, 2022).<sup>47</sup> The explanatory variables are as follows: (i) *DEM* represents the share of the population older than 65 years; (ii) *DD* represents the digital divide, approximated by the preparedness of the population to use digital money and measured by mobile-cellular subscriptions per 100 inhabitants (ITU, 2022); (iii) *INC* represents financial inclusion, measured by the number of banks by 100'000 adults; (iv) institutions, *INT*, are proxied by *CORRUPT*, which represents the control of corruption index from the World Bank Worldwide Governance Indicators database, and *Chinn-Ito*, which reflects the *Chinn-Ito* financial openness index (Chinn and Ito, 2006); (v) remittances, *RE*, and proxied by *REM*, which reflects personal remittances received (in percent of GDP) and *COST*, which reflects the cost of remittances, measured by the annual median total cost as a percentage of transacting \$200 from the United States; and (vii) a vector *Z* of macroeconomic variables, including inflation, exchange rate movements (appreciation or depreciation) and exchange rate volatility. The exchange rate (in log) is quoted in dollars per unit of local currency (an increase denotes an appreciation of the local currency). Exchange rate volatility is measured as the annualized standard deviation of monthly exchange rate log returns.

The analysis covers 30 developed and 26 developing countries, i.e., all countries for which data for the dependent variable are available. The main regressions are estimated for the period 2019–2021 with Panel Least Squares with period fixed effects and cross-section clustered error terms. They yield eight notable results (table A1):

One, the coefficient on the demographic variable is strongly significant in all regressions on the entire sample (columns (1)–(7)), suggesting a positive association between crypto adoption and a younger population. A younger population may be more digitally savvy and therefore more likely to use digital currencies such as crypto assets.

Two, the coefficient on the variable reflecting the digital divide is also strongly significant in all regressions, suggesting that crypto adoption is higher the more widespread are mobile telephone subscriptions. By contrast, a variable expressing the availability of broadband internet access (not reported) is not significant, suggesting that crypto assets can be used even without sophisticated digital infrastructure.

Three, the coefficient on the variable reflecting financial inclusion is also not significant suggesting that crypto adoption is not limited to the unbanked population.

<sup>47</sup> These data for the dependent variable are also used by Alnasaa et al., 2022, who also note that it is not possible to confirm that the respondents are representative of the whole population, while explaining the methodological drawbacks of alternative datasets. Alnasaa et al., 2022, run OLS regressions with robust standard errors on the dependent variable  $\log(1+adopt)$ . They find highly significant negative effects of capital controls and corruption, but do not control for variables reflecting demographics, the digital divide, and exchange-rate movements or variability.

Four, the coefficients on macroeconomic variables – currency depreciation, exchange-rate volatility, and inflation – are highly significant in all regressions, suggesting that unstable macroeconomic conditions favour crypto adoption.

Five, countries with perceived weaker control of corruption (i.e., perceived greater corruption) tend to have more crypto adoption, suggesting that crypto use may be a channel to transfer corruption proceeds.

Six, the reception of remittances or their cost do not seem to be a significant reason for crypto adoption. However, data coverage for remittances is smaller than for the other variables.<sup>48</sup> Moreover, empirical evidence suggests that the response of remittances to lower transaction costs is a short-term phenomenon (Kpodar and Imam, 2022), so that annual data may be unable to capture any statistically significant relationship between remittances and crypto adoption. It should also be noted that few people are paid in cryptocurrency or can use it for day-to-day purchases. Hence, both senders and beneficiaries of remittances in cryptocurrency must exchange it for local currency, adding foreign-exchange risk to the transaction cost.

Seven, none of the coefficients on a range of variables reflecting capital controls is significant (not reported), suggesting that capital controls have neither hampered nor favoured crypto adoption. The tested variables include the Chinn-Ito financial openness index (Chinn-Ito, 2006), overall restrictions on all asset categories, overall restrictions on either inflows or outflows, and the same measures for money market flows alone (Fernandez et al., 2016). However, these data only cover part of the sample period and therefore may not fully reflect recent developments. It should also be noted that the dependent variable reflects owning or using cryptocurrencies as such, while capital controls may affect the volume of transactions. The econometric analysis in He et al. (2022) that uses transaction volume as a dependent variable finds a statistically significant negative effect of the Chinn-Ito index.

Eight, the high significance and negative sign of the coefficient on per capita income in the regressions with robust standard errors and with a logit Generalized Linear Model (tables A2 and A3) suggest that crypto adoption is relatively more important in poorer than in richer countries. This finding was already noted in connection with figures 1 and 2 above and underlines the importance of examining the impact of crypto adoption especially for developing countries.

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<sup>48</sup> The coefficient on the cost of remittances in the regressions on a logit Generalized Linear Model is significant but the negative sign would suggest that crypto adoption increases with lower costs of remittances.

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**Table A1 Drivers of crypto adoption**

|                          | <b>Dependent variable: <math>\log(\text{adopt}/(1-\text{adopt}))</math></b> |                     |                     |                     |                     |                     |                     |                   |
|--------------------------|---|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|-------------------|
|                          | <b>(1)</b>  | <b>(2)</b>          | <b>(3)</b>          | <b>(4)</b>          | <b>(5)</b>          | <b>(6)</b>          | <b>(7)</b>          | <b>(8)</b>        |
| Population above 65      | -0.28***<br>(-4.21)   | -0.30***<br>(-4.30) | -0.28***<br>(-4.31) | -0.28***<br>(-4.36) | -0.27***<br>(-3.61) | -0.21***<br>(-2.95) | -0.30***<br>(-4.24) |                   |
| Mobile cellular          | 0.08*<br>(1.70)   | 0.09*<br>(1.80)     | 0.09*<br>(1.85)     | 0.10**<br>(2.01)    | 0.13<br>(1.30)      | 0.10**<br>(2.12)    | 0.12*<br>(1.89)     | 0.51***<br>(4.55) |
| Exchange rate            | -0.10***<br>(-2.85)   |                     |                     |                     |                     |                     |                     |                   |
| Exchange rate volatility |   | 0.08**<br>(2.26)    |                     | 0.05<br>(1.37)      |                     |                     |                     |                   |
| Inflation                |   |                     | 0.11**<br>(2.14)    | 0.09*<br>(2.00)     | 0.11**<br>(2.02)    | 0.09*<br>(1.98)     | 0.09*<br>(1.91)     | 0.57<br>(1.52)    |
| Banks                    |   |                     |                     |                     | -0.05<br>(-0.69)    |                     |                     |                   |
| Control of corruption    |   |                     |                     |                     |                     | -0.12*<br>(1.72)    |                     |                   |
| Remittances/GDP          |   |                     |                     |                     |                     |                     | 0.01<br>(0.13)      |                   |
| Cost of remittances      |   |                     |                     |                     |                     |                     |                     | -0.08<br>(-1.22)  |
| Adjusted R-squared       | 0.48  | 0.45                | 0.48                | 0.49                | 0.48                | 0.49                | 0.46                | 0.42              |
| Number of observations   | 168   | 168                 | 168                 | 168                 | 156                 | 168                 | 110                 | 48                |
| Number of countries      | 56  | 56                  | 56                  | 56                  | 53                  | 56                  | 55                  | 16                |

*Sources:* UNCTAD estimations based on data from Statista, IMF International Financial Statistics database, World Bank World Development Indicators, World Bank Cost of Remittances database, and ITU World Telecommunication/ICT Indicators database.

*Note:* All explanatory variables are standardized. Results for the constant are not reported. Results are robust to estimations with Ordinary Least Squares and robust standard errors and with a Logit Generalized Linear Model (see tables A2 and A3).

**Table A2 Regression results with Ordinary Least Squares and robust standard errors**

|                              | <b>Dependent variable: <math>\log(\text{adopt}/(1-\text{adopt}))</math></b> |                     |                     |                     |                     |                     |                   |
|------------------------------|---|---------------------|---------------------|---------------------|---------------------|---------------------|-------------------|
|                              | <b>(1)</b>  | <b>(2)</b>          | <b>(3)</b>          | <b>(4)</b>          | <b>(5)</b>          | <b>(6)</b>          | <b>(7)</b>        |
| Share of population above 65 | -0.23***<br>(-6.07)   | -0.24***<br>(-6.18) | -0.23***<br>(-5.97) | -0.23***<br>(-6.02) | -0.23***<br>(-5.67) | -0.26***<br>(-5.78) |                   |
| Mobile cellular              | 0.08**<br>(2.46)  | 0.09***<br>(2.65)   | 0.09**<br>(2.55)    | 0.09***<br>(2.73)   | 0.11**<br>(2.31)    | 0.11***<br>(2.74)   | 0.48***<br>(4.92) |
| Per capita income            | -0.08**<br>(-2.03)  | -0.08**<br>(-2.14)  | -0.08**<br>(-2.03)  | -0.07*<br>(-1.87)   | -0.08*<br>(-1.90)   | -0.12**<br>(-2.52)  |                   |
| Banks                        |   |                     |                     |                     | -(0.03)<br>(-0.57)  |                     |                   |
| Exchange rate                | -0.09**<br>(-2.52)  |                     |                     |                     |                     |                     |                   |
| Exchange rate volatility     |   | 0.08**<br>(2.19)    |                     | 0.05<br>(1.42)      |                     |                     |                   |
| Inflation                    |   |                     | 0.09**<br>(2.50)    | 0.07**<br>(1.99)    | 0.09**<br>(2.44)    | 0.06<br>(1.57)      | 0.57***<br>(3.72) |
| Remittances/GDP              |   |                     |                     |                     |                     | -0.04<br>(-0.80)    |                   |
| Cost of remittances          |   |                     |                     |                     |                     |                     | -0.08<br>(-1.07)  |
| Adjusted R-squared           | 0.29  | 0.28                | 0.29                | 0.3                 | 0.29                | 0.37                | 0.29              |
| Number of observations       | 168   | 168                 | 168                 | 168                 | 168                 | 110                 | 48                |
| Countries                    | 56  | 56                  | 56                  | 56                  | 56                  | 55                  | 16                |

Sources: See Table A1.

**Table A3 Regression results with a Logit Generalized Linear Model**

|                              | <b>Dependent variable: <i>adopt</i></b> |                     |                     |                     |                     |                     |                    |
|------------------------------|---|---------------------|---------------------|---------------------|---------------------|---------------------|--------------------|
|                              | <b>(1)</b>                              | <b>(2)</b>          | <b>(3)</b>          | <b>(4)</b>          | <b>(5)</b>          | <b>(6)</b>          | <b>(7)</b>         |
| Share of population above 65 | -0.23***<br>(-5.29)                     | -0.24***<br>(-5.40) | -0.23***<br>(-5.25) | -0.24***<br>(-5.33) | -0.22***<br>(-4.80) | -0.25***<br>(-5.11) |                    |
| Mobile cellular              | 0.10***<br>(2.96)                       | 0.09***<br>(2.80)   | 0.10***<br>(2.45)   | 0.10***<br>(3.12)   | 0.13***<br>(2.84)   | 0.12***<br>(3.41)   | 0.58***<br>(5.57)  |
| Per capita income            | -0.14**<br>(-2.43)                      | -0.14**<br>(-2.39)  | -0.14**<br>(-2.43)  | -0.13**<br>(-2.22)  | -0.15**<br>(-2.34)  | -0.18**<br>(-2.54)  |                    |
| Banks                        |   |                     |                     |                     | -(0.04)<br>(-0.85)  |                     |                    |
| Exchange rate                | -0.11***<br>(-2.52)                     |                     |                     |                     |                     |                     |                    |
| Exchange rate volatility     |   | 0.08***<br>(2.59)   |                     | 0.05<br>(1.48)      |                     |                     |                    |
| Inflation                    |   |                     | 0.09***<br>(3.06)   | 0.08***<br>(2.83)   | 0.09***<br>(3.62)   | 0.08***<br>(2.70)   | 0.79***<br>(5.78)  |
| Remittances/GDP              |   |                     |                     |                     |                     | -0.02<br>(-0.53)    |                    |
| Cost of remittances          |   |                     |                     |                     |                     |                     | -0.14**<br>(-2.13) |
| LR statistic                 | 95                                      | 85.7                | 92.3                | 95                  | 83.3                | 87.1                | 39.5               |
| Number of observations       | 168                                     | 168                 | 168                 | 168                 | 168                 | 110                 | 48                 |
| Countries                    | 56                                      | 56                  | 56                  | 56                  | 56                  | 55                  | 16                 |

Sources: See Table A1.

## Appendix 2: Experiences with fast retail payment systems in selected developing countries

This appendix discusses the fast retail payment systems in Brazil and India. These examples show how central banks can provide low-cost fast payment systems that boost financial inclusion, while providing security and KYC and AML/CTF compliance through government regulation. These features are similar to those of CBDCs. Both systems also face similar, and mostly unresolved, issues of interoperability regarding cross-border transactions. By contrast, holdings of CBDCs are a claim on the central bank, rather than on private intermediaries, and CBDCs may have additional functionalities, such as programmability or offline use. However, they also face additional technological challenges.

### India's Unified Payments Interface (UPI)

UPI was developed by the National Payments Corporation of India and introduced in 2016, with a view to promoting financial inclusion and a cashless economy. It is a smartphone application that allows cheap and instantaneous transactions to move seamlessly peer-to-peer between bank accounts across various payment providers and financial institutions, without needing to enter bank details or use a credit or debit card. To open and access an account with a UPI-participating institution, customers use unique digital identifiers. UPI-payments are free of charge. UPI is regulated by the Reserve Bank of India (RBI) with data managed by authorized account aggregators that are allowed to share customer data only with customer knowledge and consent, helping to maintain privacy. This digital foundational infrastructure combining an identity rail, a payment rail, and a data-sharing rail as a public good has been called the "India stack".

UPI-adoption has grown strongly in India. Between November 2021 and November 2022, the volume of transactions almost doubled to reach 73 billion, and the monetary value of transactions grew by about 50 per cent to roughly 120 trillion Rupee, after both the volume and value of transactions had already roughly doubled between November 2020 and November 2021. This infrastructure is also regularly used to make direct benefit transfers to 706 million beneficiaries and has allowed rapid deployment of emergency support. Merchants in Bhutan, Cambodia, Malaysia, Nepal, the Philippines, Singapore, and Thailand also accept UPI payments through QR-code payment systems common in Asia, with ongoing negotiations for the inclusion of other countries. Moreover, in February 2023, UPI was connected to Singapore's fast payment system PayNow to allow instant and affordable transfers between the two countries.

*Source:* D'Silva D, Filková Z, Packer P and Tiwari T (2019). The design of digital financial infrastructure: lessons from India, BIS Papers No 106, <https://www.bis.org/publ/bppdf/bispap106.pdf>; Wadhwa B, Amla I and Salkever A, "As Silicon Valley fantasizes about Web3, India leaps ahead on payments", *Fortune*, 30 June 2022, <https://fortune.com/2022/06/30/blockchain-india-upi-payments-global-reach/>; "Money transfers between India-Singapore to be easier soon. Here's why", *Mint*, 11 November 2022, <https://www.livemint.com/news/money-transfers-between-india-singapore-to-be-easier-soon-here-s-why-11668134762788.html>; Singh SK, Singh SS and Singh VL (2022). The adoption of Unified Payments Interface in India. Trends and implications. *Economic and Political Weekly*, 26 November, 57(48): 22–25; National Payments Corporation of India, UPI statistics, <https://www.npci.org.in/what-we-do/upi/product-statistics>; IMF, Article IV consultation 2022, <https://www.imf.org/en/Publications/CR/Issues/2022/12/21/India-2022-Article-IV-Consultation-Press-Release-Staff-Report-and-Statement-by-the-527283>.

## **Brazil's Pix**

The Central Bank of Brazil (CBB) launched the Pix retail instant payment system in November 2020. It is accessible to anyone who holds a demand, savings, or prepaid-payment account with a participating institution. CBB designed Pix for high speed (99 per cent of payments should be completed within 10 seconds); continuous availability; low cost (transfers are free for individuals and low-cost for legal entities); convenience and ease of use (transfers are initiated through an alias or QR code); high safety (security protocols are at least as robust as for other digital payments); and multiplicity of use cases (combining transfers between persons, businesses, and the government). Pix aims at financial inclusion and a faster, lower cost, and more digitized retail payment system. While there is no minimum limit for payments or transfers, participating institutions can set maximum transaction limits per user, day, or month to address the risk of fraud and comply with AML/CFT rules. CBB assumes the role of rule maker and developer, operator and manager of the centralized settlement infrastructure, and led the coordination of users. Regarding privacy, Pix transactions must comply with the Brazilian General Data Protection Act, which establishes rules on collecting, handling, storing and sharing of the personal data managed by organizations. Participating institutions are responsible for KYC-processes. To avoid problems related to interoperability of different payment system, boost usage and financial inclusion, and create network effects, CBB mandated large banks and other large payment institutions to provide Pix services, and do so free of charge for individuals. The number of users increased from 56 million in December 2020 to 140 million in November 2022, representing over two thirds of the adult population, with the number of transactions increasing from 144'000 to 2.6 million during the same period.

*Source:* Central Bank of Brazil, Pix, [https://www.bcb.gov.br/en/financialstability/pix\\_en](https://www.bcb.gov.br/en/financialstability/pix_en); Lobo B and Brandt CE (2021). Pix: The Brazilian fast payments scheme. *Journal of Payments Strategy and Systems*, 15(4): 367–375; Duarte A, Frost J, Gambacorta L, Koo Wilkens P and Shin HS (2022). Central banks, the monetary system and public payment infrastructures: lessons from Brazil's Pix, BIS Bulletin No. 52; UNCTAD, 2022a; Appendino et al. (2023).

## Appendix 3: Experiences with CBDCs in selected developing countries

This appendix discusses the experience of selected developing countries at the frontier of CBDCs. It aims at identifying insights, lessons, and open questions. Given the small sample and widely diverging country-specific circumstances, what can be gleaned from these experiences does not necessarily apply elsewhere. Nevertheless, these experiences point to difficulties in ensuring an uptake of CBDCs and underline the importance of understanding the needs of potential users and respective targeting of operation and design features, while not neglecting that modernizing the traditional financial system might meet user demands equally well but in a less-challenging way; ensuring institutional capacity to perform assigned tasks; deciding the extent and form of collaborating with private intermediaries; confronting the trade-off between data privacy and KYC-AML/CFT compliance; and considering users' readiness to use digital payments and making CBDC-use compatible with the existing financial system. Challenges related to CBDC use for cross-border payments have yet to be resolved.

### The Bahamas Sand Dollar

In October 2020, the Bahamas was the first country to launch a sovereign digital currency, the Sand Dollar. Its main objective is to achieve greater financial inclusion especially in the remote areas of the archipelago. It also aims at reducing costs, improving the efficiency of the payment system, and reducing the illicit use of money. Moreover, being a disaster-prone country, the Bahamas also intends employing the CBDC to facilitate assistance payments to and within afflicted areas. The Sand Dollar operates through a two-tiered system, where the Central Bank issues and distributes the CBDC to selected financial institutions, which issue CBDC wallets and handle retail payments; monitors holdings by maintaining the ledger of all individual holdings of the CBDC; and sponsors a centralized KYC-AML/CFT compliant infrastructure, which is provided by a private contractor (NZIA). Users can pay participating merchants through an app or a pre-paid card. They can choose between a small wallet, which provides anonymity, and a large wallet. Holdings do not bear interest. Providing offline functionality has proven complicated technologically, which impairs payments between islands and the use of the Sand Dollar for disaster relief transfers. The Sand dollar has been created exclusively for domestic purposes, with cross-border payments continuing through traditional commercial bank channels.

While the Central Bank points to a positive correlation between the Sand Dollar and financial inclusion (Wright et al., 2022), IMF (2022) argues that the CBDC currently accounts for less than 0.1 per cent of currency in circulation and that there are limited avenues to use the Sand Dollar. Nevertheless, IMF (2022) sees a potential for the Sand Dollar to boost financial inclusion and payment system resilience, but recommends education campaigns and strengthened cybersecurity and oversight to safeguard financial integrity. Walker (2022) argues that continued growing use of debit cards and pre-paid credit cards, which can be used with the existing payment system and are accepted by a larger number of merchants, suggests that encouraging greater use of bank-issued credit cards and educating the older generation how to use electronic payments could have been more successful in boosting financial inclusion than introducing a CBDC.

In November 2022, the governor of the Central Bank listed four factors as particularly important from the Bahamas' experience: building a network of merchants that accept and encourage CBDC use; achieving interoperability with the traditional banking system; enlisting participation from the traditional banking sector and credit unions; and the importance of user education and inspiring confidence.

*Sources:* Central Bank of the Bahamas, "Project Sand Dollar, 24 December 2019, <https://www.centralbankbahamas.com/viewPDF/documents/2019-12-25-02-18-11-Project-Sanddollar.pdf>; Wright A, McKenzie SC, Bodie LR and Belle CL (2022), "Financial Inclusion and Central Bank Digital Currency in The Bahamas", July 26, 2022, <https://www.centralbankbahamas.com/viewPDF/documents/2022-09-23-13-49-13-CBDCupdated-paper.pdf>; IMF (2022), "The Bahamas – 2022 Article IV Consultation", <https://www.imf.org/en/Publications/CR/Issues/2022/05/06/The-Bahamas-2022-Article-IV-Consultation-Press-Release-Staff-Report-and-Statement-by-the-517631>; Walker MCW (2022), "How is the "world's most advanced central bank digital currency" progressing?", LSE blog, 22 November 2022, <https://blogs.lse.ac.uk/businessreview/2022/11/22/how-is-the-worlds-most-advanced-central-bank-digital-currency-progressing/#comments>; "The Bahamas' Experience with the Sand Dollar", Remarks by Governor John Rolle, 7 November 2022, <https://www.centralbankbahamas.com/viewPDF/documents/2022-11-10-16-42-59-European-Commission-Presentation-on-Sand-Dollar-Experience-20221107DG1.pdf>. Appendino et al. (2023).



## **Nigeria's eNaira**

In October 2021, the Central Bank of Nigeria launched a retail CBDC, the eNaira, attempting to foster financial inclusion, improve the availability of and access to central bank money, make payment systems more efficient and resilient, improve monetary policy effectiveness, enhance the government's capacity to deploy targeted social interventions, provide less costly channels for tax payments, and boost remittances going through formal channels. The eNaira relies on a two-tier structure, where the central bank issues and mints e-Nairas through the Digital Currency Management System (DCMS), while financial institutions maintain eNaira Treasury Wallets for holding and managing eNaira in the DCMS. Financial institutions are also responsible for onboarding of customers and ensuring KYC-AML/CFT compliance. Verification is based on permissioned DLT, in which the intermediaries make up nodes in the network. The central bank encouraged eNaira adoption by ordering banks to close operating accounts of cryptocurrency service providers in February 2021. It tried to boost both the use of eNaira for small retail payments, while hampering illicit transfers and avoiding competition with bank deposits, by capping the size of holdings and daily transactions, paying no interest on eNaira holdings, and offering new forms of digital identification to help the unbanked access eNaira. A bank verification number is required to open a retail customer wallet, implying that anonymity is not allowed.

Surveys suggest that after one year of its introduction only 0.5 per cent of Nigerians used the eNaira, while adoption of Bitcoin and other cryptocurrencies has increased despite the crypto ban and the introduction of the eNaira. Given that the eNaira has no offline functionality, low adoption probably reflects low internet penetration, but also beliefs in the inflation-proof status of cryptocurrencies and scepticism as to whether the eNaira can better protect against value erosion from inflation than the Naira. To boost eNaira-adoption, the central bank has sharply lowered caps on daily maximum customer ATM withdrawal for Naira and turned to a popular taxi service to offer customers paying in eNaira a 5 per cent discount.

*Sources:* Central Bank of Nigeria, "Regulatory guidelines on the eNaira", 25 October 2021, <https://www.cbn.gov.ng/Out/2021/FPRD/eNairaCircularAndGuidelines%20FINAL.pdf>; Central Bank of Nigeria, "Revised cash withdrawal limits", 6 December 2022, <https://www.cbn.gov.ng/Out/2022/CCD/RevisedCashWithdrawal.pdf>; and "One year into Nigeria's adoption of the eNaira", Further Africa, 8 November 2022, <https://furtherafrica.com/2022/11/08/one-year-into-nigerias-adoption-of-the-enaira/>.

## **Jamaica's JAM-DEX**

In 2021, the Bank of Jamaica (BOJ) started a pilot hybrid (wholesale and retail) CBDC, issuing CBDC to banks and financial institutions, as well as small retailers and individuals. The BOJ announced a phased launch of JAM-DEX in May 2022. BOJ aims at greater financial inclusion and a more efficient payment system that will also offer more services. To facilitate interoperability with existing financial market infrastructure, JAM-DEX does not use blockchain technology. This choice may boost CBDC uptake but also entails privacy risk, as a plaintext transaction database could be an easy target for hackers. To use JAM-DEX, consumers need an account which, however, is easier and simpler to obtain than regular accounts, and which has streamlined and simplified KYC-requirements. Consumers can access and transfer JAM-DEX on a digital device through a mobile wallet app. They can transfer and convert funds seamlessly between regular and JAM-DEX accounts.

*Sources:* Bank of Jamaica, "JAM-DEX Phased Rollout Progresses", 29 May 2022, <https://boj.org.jm/jam-dex-phased-rollout-progresses/>; Haynes N, "A Primer on BOJ's Central Bank Digital Currency," Bank of Jamaica, 27 March 2022, <https://boj.org.jm/a-primer-on-bojs-central-bank-digital-currency/>

## **China's e-CNY**

In December 2019, the People's Bank of China (PBOC) launched a pilot e-CNY in four large cities. The reach of the pilot has since been extended twice with more cities joining. In January 2022, PBOC extended the pilot also to enable domestic residents and foreign visitors to the Winter Olympics in February 2022 to use the e-CNY, with some restrictions such as access limits. In January 2022, e-CNY services became available on WeChat Pay, and some other Tech platforms also started accepting e-CNY payment in trial cities. Government initiatives to boost the uptake of the e-CNY include a lottery in Beijing through which it distributed 40 million digital yuan in June 2021 and, more generally, the “red envelop” campaign through which gift vouchers have been distributed to Chinese residents. The e-CNY mainly aims at extending financial inclusion and digitalization to remote regions that remain unbanked and underserved by private mobile-payment operators, such as AliPay and WeChat Pay, while ensuring that the renminbi continues to be the dominant currency in China.

PBOC operates a two-tier system. It issues e-CNY to authorized operators (including eligible commercial banks, payments service providers, and telecom operators) that circulate e-CNY to the public. Recognizing problems of DLT regarding scalability, the system uses a mix of technologies, based on distributed and platform-based design, designed to support rapid scaling of e-CNY transactions. Second-tier operators, such as state-owned banks and Internet banks, are responsible for KYC-AML/CFT compliance and data storage, though they can grant the PBOC access to user data. Second-tier operators work with other banks and payment service providers in developing user interfaces and customer services. Consumers can withdraw e-CNY from bank accounts to smartphone e-wallets and make payments by holding the phone close to a point-of-sale device. Holdings of e-CNY bear no interest and are capped to limit competition with bank deposits. Transaction anonymity relies on a tiered approach with lower thresholds allowing for greater anonymity. As the e-CNY can only pass between approved e-wallets, China's authorities can deny access to potential speculators or illicit uses. The e-CNY is programmable, allowing to set limits on how much can be sold for foreign currencies. An important characteristic of e-CNY use is offline functionality, which is achieved through hardware-based e-CNY wallets, placed inside mobile phones or held as cards, which can make payments to another mobile phone wallet in physical proximity without Internet access. Storage encryption, double signature, as well as use limitations before being required to go back online and to access the main ledger, are to prevent abuse and fraud.

According to a former official of the PBOC, e-CNY uptake has been low, with its cumulative circulation reaching only 100 billion yuan (\$14 billion) during the first two years of the trial. One reason may be that it acts only as a substitute for cash and can be used only for consumption while, e.g., AliPay offers additional functions, including investment, insurance, and consumer lending.

Apart from its domestic use, the e-CNY could be used at some point to settle a share of Chinese imports and exports, particularly in the context of the Belt and Road Initiative with the e-CNY programmed to be exchangeable only with approved firms, thereby supporting the internationalization of the renminbi. China is also taking part in pilot projects to test a potential multi-CBDC framework (mBridge).

*Sources:* PBOC (2021). Progress of Research & Development of E-CNY in China, July, <http://www.pbc.gov.cn/en/3688110/3688172/4157443/4293696/2021071614584691871.pdf>. Deutsche Bank (2021). Digital yuan: what is it and how does it work? July, <https://www.db.com/news/detail/20210714-digital-yuan-what-is-it-and-how-does-it-work>; Allen F, Gu X and Jagtiani J (2022). Fintech, Cryptocurrencies, and CBDC: Financial Structural Transformation in China, Federal Reserve Bank of Philadelphia Working Paper 22-12, <https://doi.org/10.21799/frbp.wp.2022.12>; Xu J (2022). Developments and implications of central bank digital currency: The case of China e-CNY. *Asian Economic Policy Review*, 17 (2), 235– 250, <https://doi.org/10.1111/aep.12396>; “Former PBOC official says China's digital yuan is little used”, Reuters, 29 December 2022, <https://www.reuters.com/technology/former-pboc-official-says-chinas-digital-yuan-is-little-used-caixin-2022-12-29/>.

## **India's e-Rupee**

In November 2022, RBI launched a pilot account-based wholesale CBDC for the settlement among nine banks of secondary market transactions in government securities, with a view to making the interbank market more efficient. Other wholesale transactions and cross-border payments are envisaged for future pilots. In December 2022, RBI launched a token-based retail CBDC as a digital complement to cash and UPI, and as an alternative to cryptocurrencies. It mainly aims at reducing operational costs involved in physical cash management and fostering financial inclusion. The retail e-Rupee covers select locations and closed user groups of participating customers and merchants. It is based on a two-tiered model, issued by RBI and distributed by intermediaries, with initially four participating banks offering wallets stored on mobile devices, and it can be used in person-to-person and person-to-merchant transactions. The e-Rupee relies on DTL-technology and preserves cash-like anonymity for small value transactions.

*Sources:* Reserve Bank of India, "Concept Note on Central Bank Digital Currency", 7 October 2022, <https://rbi.org.in/Scripts/PublicationReportDetails.aspx?UrlPage=&ID=1218>; Reserve Bank of India, "Operationalisation of Central Bank Digital Currency-Wholesale (e₹-W) Pilot", 31 October 2022, [https://www.rbi.org.in/Scripts/BS\\_PressReleaseDisplay.aspx?prid=54616](https://www.rbi.org.in/Scripts/BS_PressReleaseDisplay.aspx?prid=54616); Reserve Bank of India, "Operationalisation of Central Bank Digital Currency – Retail (e₹-R) Pilot", 29 November 2022, <https://rbidocs.rbi.org.in/rdocs/PressRelease/PDFs/PR12755768C88D86624673A14B2C7F5CF68908.PDF>.

