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Central Bank Digital Currencies

Tools for an Inclusive Future?

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Central Bank Digital Currencies (CBDCs)[1] have rapidly evolved from a sci-fi concept to a plausible alternative to cash that is being studied by central banks all over the world. According to a Belfer Center tracker, over 50 central banks have pursued or are engaging in CBDC work as of August 2020.[2] However, while 10 central banks have already piloted or announced plans to pilot a CBDC in the near term, most are in the early stages of research and experimentation.

In this brief, we outline the common motivations driving central bank work on CBDCs. We then explore CBDCs' potential impacts on financial inclusion, a primary motivation in developing and emerging markets that has also gained significant traction in developed economies during the COVID-19 related global recession. We conclude that **for CBDCs to achieve its financial inclusion goals, more technical advancement in offline adaptability and policy deliberations around issues of identity and traceability are needed**.

1 A central bank digital currency is the digital form of a country's fiat currency. It is issued and guaranteed by the country's principal monetary authority.

2 "National Digital Currencies: The Future of Money?." Infographic & Chart, Updated August 2020. https://www.belfercenter.org/publication/national-digital-currencies-future-money

What are the motivations for Central Banks to develop CBDCs?

With increasingly ubiquitous digital payment applications, many countries are moving towards a "less cash" society. In 2018, for example, nearly 30 percent of U.S. adults did not use cash at all in a typical week, compared to less than 25 percent in 2015.[3] In China, non-cash payment transactions surged over 50 percent year-on-year in 2019.[4] Governments have become increasingly interested in understanding how CBDCs can complement or replace cash in the last several years. Based on a survey by the Bank of International Settlements of 66 central banks in the second half of 2019, the 5 most common motivations for exploring a CBDC are payment safety, payment efficiency, financial stability, monetary policy implementation, and financial inclusion.[5]

The current COVID-19 pandemic has underscored some of these motivations, as governments explore digital payments alternatives amid concerns about viral transmission through physical cash as well as the need to quickly and efficiently distribute stimulus payments.[6]

Safety of the payment system & currency sovereignty

While private digital currencies have been active in financial markets for more than a decade, CBDCs could prove attractive as a credible public alternative with the assurance of central bank backing, interchangeable with fiat cash. Compared to private cryptocurrencies and digital payment solutions, CBDCs put the central bank and national government at the helm of trade-offs between anonymity and transparency of financial transactions, rather than private sector firms. The anonymity/transparency tradeoff is a critical technical and policy design choice for policymakers who may seek to reduce the social costs from financial crimes and national security concerns, on the one hand, and protect individual data privacy, on the other.

3 "More Americans Are Making No Weekly Purchases with Cash." Pew Research Center (blog). Accessed July 22, 2020. https://www.pewresearch.org/fact-tank/2018/12/12/more-americans-are-making-no-weekly-purchases-with-cash/.

4 "Chinese Non-Cash Payments Rise in 2019." Accessed July 22, 2020. http://english.www.gov.cn/statecouncil/ministries/202003/17/content_WS5e70b94dc6d0c201c2cbe853.html.

5 Boar, Codruta, Henry Holden, and Amber Wadsworth. "Impending Arrival: A Sequel to the Survey on Central Banking Digital Currency," 2020. https://www.bis.org/publ/bppdf/bispap107.pdf.

6 "Our Cash-Free Future Is Getting Closer" The New York Times. Accessed July 22, 2020. https://www.nytimes.com/2020/07/06/business/cashless-transactions.html.

In addition to competition from private digital currencies, policymakers are also incentivized to explore CBDCs due to the threat of competition from foreign CBDCs that can undermine the sovereignty of their own currency. The economic and geopolitical implications of CBDC competition could see an emerging power like China challenge the long-standing dominance of the US dollar.[7]

Efficient means of payment

Central banks are further exploring the potential operational efficiency gains of both retail and wholesale CBDCs. Retail CBDCs could improve the efficiency of payments, ranging from point of sale, online, and peer-to-peer. For example, merchants pay substantial fees for taking credit card payments, which reflect operational costs for card-issuing banks. Digital money provided by the central bank could be accessible at no cost to merchants and individuals. However, such gains would likely be small in economies already with low-cost payment solutions such as in Denmark.[8] Even in countries that already have efficient and sophisticated digital payment systems, a cross-border retail CBDC has the potential to reduce cost and accelerate speed for users making payments across jurisdictions.

On the wholesale side, CBDCs could provide more direct interbank and cross-border payments, faster settlement, and lower intermediary costs, while not being constrained by bank settlement hours. The existing cross-border payment model relies on the real-time gross settlement (RTGS) infrastructure where counterparties could be exposed to credit and settlement risk from their correspondents. In a 2018 joint study by the Central Banks of Canada, UK and Singapore on the use of wholesale CBDCs as an alternative to cross-border payments, researchers found limited benefits over the existing model if a wholesale CBDC cannot be exchanged across borders. However, if a jurisdiction-specific wholesale CBDC can be exchanged across borders or if there is a single universally accepted wholesale CBDC, it could significantly improve counterparty credit and payment and settlement risks.[9]

7 Kumar, Aditi, and Eric Rosenbach. "Could China's Digital Currency Unseat the Dollar?," June 4, 2020. https://www.foreignaffairs.com/articles/china/2020-05-20/could-chinas-digital-currency-unseat-dollar.

8 "Central Bank Digital Currency in Denmark?" Accessed July 22, 2020. https://www.nationalbanken.dk/en/publications/Pages/2017/12/Central-bank-digital-currency-in-Denmark.aspx.

9 "The BoC, BoE and Monetary Authority of Singapore Share Assessment on Emerging Opportunities for Digital Transformation in Cross-Border Payments." Accessed July 22, 2020. http://www.bankofengland.co.uk/news/2018/november/boe-boc-mas-joint-report-digital-transformation-in-cross-border-payments.

Financial stability

In the current monetary system, central bank money is available in two forms: physical cash or (digital) reserves. Cash is universally accessible, while reserves are only available to commercial banks who maintain wholesale accounts with the central bank. For individuals to hold digital money, they need to post deposits at commercial banks, and use commercial bank-issued digital money, like debit and credit cards. CBDCs could offer an alternative for individuals to access digital money through direct claims against the central bank. While commercial banks inevitably possess some degree of risk and the threat of bank runs, a central bank-issued digital currency could be a more stable alternative.

However, while CBDCs could provide a lower-risk alternative to commercial banks, the broad adoption of CBDCs could be disruptive to the traditional commercial bank business model with potential downstream impacts on the availability of credit to individuals and businesses. Since commercial bank deposits can become a less reliable source of funding compared to digital money backed by the central bank, CBDCs could be disruptive to the traditional commercial bank business model.[10] Additionally, unless the new CBDC system works with a commercial bank intermediary, central banks would need to acquire operational capabilities that commercial banks currently handle, such as customer onboarding, due diligence, know-your-counterparty (KYC), and payment processing responsibilities.

Monetary policy implementation

CBDCs have the potential to facilitate central bank monetary policy implementation through several avenues. Interest-bearing CBDCs could ensure that interest rate changes by the central bank are directly passed through to end consumers. This, in turn, could reduce commercial banks' ability to independently set deposit interest rates. There is also potential for central banks to have greater visibility into how money is being spent in the economy, such as in the informal or e-commerce sectors, allowing more targeted monetary or fiscal policy support where it's most needed. CBDCs could further allow central banks to reduce the effective zero lower bound on interest rates; however, the policy benefits of this are debated, as it could reduce the profitability of financial institutions.[11]

10 Union, Publications Office of the European. "The Impact of Digitalisation on the Monetary System: Monetary Dialogue Papers, December 2019." Website. Publications Office of the European Union, December 11, 2019. http://op.europa.eu/en/publication-detail/-/publication/343749d5-1d4c-11ea-95ab-01aa75ed71a1/language-en/format-PDF.

11 Achord, S & Chan, J & Collier, I & Nardani, S & Rochemont, Sabrina. (2018). A Cashless Society Benefits, Risks and Issues (Interim Paper). https://www.actuaries.org.uk/system/files/field/document/Understanding%20CBDCs%20Final%20-%20disc.pdf.

Financial inclusion

Leveraging digital technology, CBDCs have the potential to extend financial access to unbanked and underbanked populations. With two-thirds of the world's 1.7 billion unbanked adults owning a mobile phone and women overrepresented in the unbanked population, digital technology has great potential to promote financial inclusion and equity.[12,13] A key motivation, therefore, is to explore if governments can leverage the experiences of fintech solutions to advance financial inclusion with CBDCs, increasing adoption by digitizing the delivery of government payments such as tax refunds and COVID-19 stimulus checks.

Are CBDCs the best solution for financial inclusion?

The World Bank's 2017 study found that 31 percent of adults, or about 1.7 billion individuals, are unbanked (without an account at a financial institution or access to mobile money).[14] This is not a challenge prevalent in only developing countries. In the United States, around 6.5 percent of households are unbanked and 18.7 percent of households are underbanked (have an account but use alternative financial services such as check cashing, payday loans, or money orders in the last 12 months).[15]

What are the alternative financial inclusion solutions? How can CBDCs contribute? ***The twin challenges of financial inclusion include accessibility to financial services and efficiency of those services.*** Various fintech solutions have attempted to address each of these, with mixed results.

12 World Bank. "Financial Inclusion on the Rise, But Gaps Remain, Global Findex Database Shows." Accessed July 22, 2020. https://www.worldbank.org/en/news/press-release/2018/04/19/financial-inclusion-on-the-rise-but-gaps-remain-global-findex-database-shows.

13 Demirgüç-Kunt, Asli, Leora Klapper, Dorothe Singer, Saniya Ansar, and Jake Hess. 2018. The Global Findex Database 2017: Measuring Financial Inclusion and the Fintech Revolution. Washington, DC: World Bank. https://globalfindex.worldbank.org/sites/globalfindex/files/chapters/2017%20Findex%20full%20report_chapter2.pdf

14 World Bank. "Financial Inclusion on the Rise, But Gaps Remain, Global Findex Database Shows." Accessed July 22, 2020. https://www.worldbank.org/en/news/press-release/2018/04/19/financial-inclusion-on-the-rise-but-gaps-remain-global-findex-database-shows.

15 "FDIC: 2017 FDIC National Survey of Unbanked and Underbanked Households." Accessed July 22, 2020. https://www.fdic.gov/householdsurvey/.

Access

Many recent efforts to promote financial access revolve around fintech or digital payment solutions. The aim of these initiatives is to provide individuals with access to at least one transaction account to complete payments, safely store value, and serve as a gateway to other financial services.

Digital payments and mobile money have driven remarkable financial access in many developing economies. In China, third-party mobile payment applications Alipay and WeChat Pay grew from 455 million active users in 2013 to nearly 2 billion in 2018.[16] While increased mobile phone penetration and connectivity played a key role in their development, the two mobile payment giants were able to rapidly reshape China's payments landscape as they were building upon high levels of bank account ownership (79 percent).[17] In Sub-Saharan Africa, mobile money initiatives like M-pesa bypassed the need for accounts at financial institutions and improved financial access. Between 2014 and 2017, while the share of adults with a financial institution account remained flat in the region, the share with a mobile money account nearly doubled, to 21 percent.[18]

What can CBDCs offer that private payment solutions cannot? **Trust** is a key barrier to the existing mobile payment scheme due to the fear of fraud. Unlike mobile money and private digital payment solutions, CBDCs are a central bank-backed legal tender that could provide not only credibility and stability, but also greater traceability, allowing authorities to recoup value in cases of fraud.[19]

Efficiency

Reducing the delay between when a check is deposited and when the funds can be available can reduce the need for low-income households to seek payday loans or to pay overdraft fees. The consequences of the delay are particularly salient for these households at the end of the month when bills are due before paycheck funds become available. In the United States, the Federal Reserve's

16 Klein, Aaron. "China's Digital Payments Revolution." Brookings (blog), April 27, 2020. https://www.brookings.edu/research/chinas-digital-payments-revolution/.

17 The Global Findex Database 2014 : measuring financial inclusion around the world (English). Policy Research working paper;no. WPS 7255 Washington, D.C. : World Bank Group. http://documents.worldbank.org/curated/en/187761468179367706/The-Global-Findex-Database-2014-measuring-financial-inclusion-around-the-world.

18 World Bank. "Financial Inclusion on the Rise, But Gaps Remain, Global Findex Database Shows." Accessed July 22, 2020. https://www.worldbank.org/en/news/press-release/2018/04/19/financial-inclusion-on-the-rise-but-gaps-remain-global-findex-database-shows.

19 Cenfri. "Central Bank Digital Currency (CBDC) and Financial Inclusion," June 10, 2019. https://cenfri.org/publications/central-bank-digital-currency-cbdc-and-financial-inclusion/.

FedNow project aims to include more depository institutions into the Fed payment system to expand access to real-time payments. However, the project will not go live until 2023 or 2024.[20]

The potential **interoperability** offered by CBDCs could reduce the processing costs and operational friction between multiple providers, financial institutions, and point-of-sale devices. For mobile money providers that rely on commercial banks as traditional distributors of liquidity, CBDCs could provide **instant payment clearance** and **liquidity on-demand**, reducing their reliance on commercial banks and reducing liquidity risks and costs.[21]

What are the conditions for CBDCs to effectively promote financial inclusion?

CBDCs are not necessarily the silver bullet to improving financial access. While filling certain gaps that existing mobile money and digital payment systems failed to address, the benefits of CBDCs must be weighed against its policy and technical challenges. It also runs the risk of crowding out promising private sector initiatives that provide fast, efficient payment solutions. A 2020 joint study by the Bank of International Settlements and the World Bank went as far as concluding that "while CBDCs could be designed with financial inclusion in mind and to mitigate challenges for other policy areas, if the main objectives are access to and usage of transaction accounts, CBDCs are not likely to be the first and most straightforward choice for the time being."[22] Given this assessment, **what are the key limitations to financial access that CBDCs must aim to address to promote financial inclusion, without reinforcing the existing barriers and widening the digital divide?**

20 Board of Governors of the Federal Reserve System. "Federal Reserve Announces Plan to Develop a New Round-the-Clock Real-Time Payment and Settlement Service to Support Faster Payments." Accessed July 22, 2020. https://www.federalreserve.gov/newsevents/pressreleases/other20190805a.htm.

21 Cenfri. "Central Bank Digital Currency (CBDC) and Financial Inclusion," June 10, 2019. https://cenfri.org/publications/central-bank-digital-currency-cbdc-and-financial-inclusion/.

22 "Payment Aspects of Financial Inclusion in the Fintech Era," April 14, 2020. https://www.bis.org/cpmi/publ/d191.htm.

Identity and legal status

A key pillar of financial inclusion is identity, as it is often a foundational requirement for obtaining a bank account. The World Bank estimates that around 1 billion people living in developing countries lack any proof of legal identity.[23] The lack of legal identity particularly marginalizes undocumented immigrants as they are barred from access to basic financial services. Further, in an increasingly cashless society, foreign travelers, whether for leisure or business, would require access to the country's CBDC in order to participate in any economic activity.

In the United States, Professor Morgan Ricks has argued for general public access to FedAccounts, bank accounts that the Federal Reserve offers primarily to banks that consist of entries in a digital ledger and provide **instant payments** and **full government backing**. The challenge of efficiently distributing pandemic stimulus checks have renewed the calls for direct public access to FedAccounts. However, a FedAccounts CBDC would still require individuals to set up accounts at the central bank, requiring proof of legal identity.[24]

Governments must reimagine financial access and its reliance on traditional identity-based accounts. The Digital Dollar Project proposed a token-based design aimed at moving beyond the traditional model of banking based on accounts.[25] Token-based CBDC transactions can be validated using the token object rather than the user's identity. However, the token must still be accompanied by a minimum set of user-identity requirements in order to counter financing of terrorism or illicit activities.[26]

A threshold approach can be taken to strike the optimal balance between accessibility and traceability. Similar to how U.S. regulators determined that cash payments over $10,000 require IRS filing, a threshold could be established to facilitate small-value CBDC transactions with fewer user-identity requirements. The **programmability** feature unique to CBDCs, essentially designer money with rules logic built into it, would allow for these specific design attributes and wallet thresholds to be built into the digital token itself.

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23 Principles on Identification for Sustainable Development: Toward the Digital Age: Principles on identification for sustainable development: toward the digital age (English). Washington, D.C.: World Bank Group. http://documents.worldbank.org/curated/en/213581486378184357/Principles-on-identification-for-sustainable-development-toward-the-digital-age.

24 Ricks, Morgan and Crawford, John and Menand, Lev, FedAccounts: Digital Dollars (April 15, 2020). Vanderbilt Law Research Paper 18-33, UC Hastings Research Paper No. 287, George Washington Law Review, Forthcoming, http://dx.doi.org/10.2139/ssrn.3192162.

25 Digital Dollar Project. "Digital Dollar Project | Exploring a US CBDC." Accessed July 22, 2020. https://www.digitaldollarproject.org/exploring-a-us-cbdc.

26 World Economic Forum. "Central Bank Digital Currency Policy-Maker Toolkit." Accessed July 22, 2020. https://www.weforum.org/whitepapers/central-bank-digital-currency-policy-maker-toolkit/.

Technology

The Bank of Japan's July 2020 paper highlighted universal access and resilience as the main technical barriers that the central bank must investigate in its CBDC research. Retail CBDC platforms rely on mobile phones and connectivity for access.[27] While mobile phone penetration has increased sharply around the world, internet connectivity still varies greatly by region and country. In 2018, the average Sub-Saharan African country had 82 mobile phone subscriptions for 100 people, while in Latin America this number was 103.[28] Meanwhile, internet access was more limited, with 25 percent of the population using the internet in Sub-Saharan Africa in 2017 and 66 percent in Latin America in 2018.[29]

In developed economies, the disparity in broadband access continues to be a barrier to economic mobility for historically disadvantaged communities. In the United States, for example, the broadband gap is more than an urban/rural divide, according to an analysis by the Third Way. Breaking down broadband access by county and demographics, the study found that broadband availability "tends to be lower in counties that have significant Black and Native American populations," noting that broadband access is 16 percentage points higher in majority-white counties compared to majority-Black counties and is 45 percentage points higher compared to majority-Native American counties.[30] If only those with mobile phones and internet access can benefit from CBDCs, it is likely to reach the same groups of populations who already benefited from private digital payment solutions and fail to promote financial access. It can end up perpetuating the negative consequences of the digital divide.

In its July report, the Bank of Japan outlines the basic functional requirements for **offline payments:** safe storage of value that is tamper-resistant, transmission of information and payment instructions between users without internet connectivity, certification and authentication of both the user and device without internet connectivity, and battery or power.[31]

Exploration of offline solutions is underway. In 2017, a team of researchers from the University of Cambridge in the U.K. and the University of Strathmore in Kenya published findings from a preliminary study of a prototype system, DigiTally, which lets users make offline payments by copying

27 "決済システムレポート別冊「中銀デジタル通貨が現金同等の機能を持つための技術的課題」： 日本銀行 Bank of Japan." Accessed July 22, 2020. https://www.boj.or.jp/research/brp/psr/psrb200702.htm/.

28 "Mobile Cellular Subscriptions (per 100 People) | Data." Accessed July 22, 2020. https://data.worldbank.org/indicator/IT.CEL.SETS.P2.

29 "Individuals Using the Internet (% of Population) | Data." Accessed July 22, 2020. https://data.worldbank.org/indicator/IT.NET.USER.ZS.

30 "The Racial Equality and Economic Opportunity Case for Expanding Broadband – Third Way." Accessed July 22, 2020. https://www.thirdway.org/report/the-racial-equality-and-economic-opportunity-case-for-expanding-broadband.

31 "決済システムレポート別冊「中銀デジタル通貨が現金同等の機能を持つための技術的課題」： 日本銀行 Bank of Japan." Accessed July 22, 2020. https://www.boj.or.jp/research/brp/psr/psrb200702.htm/.

short strings of digits from one mobile handset to another. Piloting the system with a group of participants from a university in Nairobi, Kenya, the authors concluded that "although offline payments involve copying codes in both directions between the payer's phone and the payee's, the extra workload was acceptable to most users."[32]

More recently, China's CBDC plans include a dual offline technology that can ensure that transactions get processed in an offline environment.[33] In its 2018 and 2019 patent filings, the Industrial and Commercial Bank of China described two technical directions that will allow for the transfer or payment of the digital yuan when two mobile phones are in an offline environment - with the 2018 system designed without blockchain technology and the 2019 one using a blockchain-based design.[34] Both mechanisms would allow for secure, instant offline transactions between two parties that verifies coin validity in an offline setting and prevents double spending. However, the dual offline technology would still require confirmation on the network before the funds can be used again. While this dual offline technology can be valuable in circumstances where there is poor network signal strength, it would still require frequent access to the internet for payment settlement and balancing for the CBDC to be usable on a regular, ongoing basis.

Digital entry points

While CBDCs can extend the reach of financial and payment services through digital mediums, they would likely still require some physical infrastructure to bridge the physical-digital divide. Particularly in dual fiat/digital currency systems, users will need access to financial infrastructure to convert cash into CBDCs or vice versa. A potential solution might be to integrate CBDC efforts with brick-and-mortar service locations, such as postal offices, as internet-enabled access points to set up digital wallets and settle balances on the network. In a House Financial Services Committee hearing on Financial Technology on June 11, 2020, Professor Mehrsa Baradaran noted that "the lack of a large physical footprint" is the "critical missing step into widespread fintech or digital account use."[35] Professor Baradaran advocated for leveraging the postal service to bridge the cash/

32 Baqer, Khaled, Ross Anderson, Lorna Mutegi, Jeunese Adrienne Payne, and Joseph Sevilla. "DigiTally: Piloting Offline Payments for Phones," 131–43, 2017. https://www.usenix.org/conference/soups2017/technical-sessions/presentation/baqer.

33 Faridi, Omar. "China's Virtual Yuan Will Use Dual Offline Technology to Ensure That the National Digital Currency Works Even with Poor Signal Strength." Crowdfund Insider, April 21, 2020. https://www.crowdfundinsider.com/2020/04/160374-chinas-virtual-yuan-will-use-dual-offline-technology-to-ensure-that-the-national-digital-currency-works-even-with-poor-signal-strength/.

34 ChainNews. "如何支持數字貨幣的雙離線支付：央行和工商銀行準備了三套方案." Accessed July 22, 2020. https://www.chainnews.com/zh-hant/articles/396797633503.htm.

35 "Virtual Hearing - Inclusive Banking During a Pandemic: Using FedAccounts and Digital Tools to Improve Delivery of Stimulus Payments | Financial Services Committee." Accessed July 22, 2020. https://financialservices.house.gov/calendar/eventsingle.aspx?EventID=406617.

digital divide, where the **physical presence** of post offices in every community can provide the necessary financial services for the unbanked and underbanked and access to FedAccounts.

Conclusion

CBDCs alone are not the solution to financial inclusion. Despite claims of financial inclusion as one of the driving motivations for CBDCs, **the proposed plans have yet to address, in a concrete way, how CBDCs can overcome the existing barriers to financial inclusion and add meaningful value in such a way that mobile money and public or private digital payment solutions already offer.**

While there might not be a single financial inclusion solution that can achieve both accessibility and efficiency, the private sector and tech community have a proven track record of developing cutting-edge technical solutions and efficient payment systems to meet consumer demand, and public sector actors are well-positioned to provide the credibility and regulatory framework required for widespread adoption. A cross-sector approach to CBDC development and implementation led by the government is more likely to strike the optimal balance than any party can do alone.

Appendix:

Key Questions for Policymakers on CBDC and Financial Inclusion

Accessibility

- How can individuals without reliable internet access use the CBDC?
- Is a smartphone or mobile phone required for CBDC? How can those without the necessary devices access the CBDC?
- What personal identity information would be required to use the CBDC?
- Can undocumented immigrants or foreign nationals access it? What about visitors to the country?

Adoption

- How can the CBDC be adopted broadly?
- How would the CBDC integrate with existing payment applications?
- Would the CBDC crowd out other private sector applications aiming to promote financial inclusion?
- Would the CBDC replace physical cash?
- What government services can be integrated and delivered with the CBDC?

Interoperability

- How would the CBDC interact with currencies in other jurisdictions? Can the CBDC be used abroad?
- Can the CBDC be used for remittances?

Privacy & Security

- What are the measures to ensure the security of the system and data collected?
- What design choices are in place to protect user data privacy?
- What is the regulatory and/or enforcement channel to monitor fraud and illicit activities?

Resilience

- Would the CBDC be functional in an offline environment? Are there limitations?
- Would the CBDC be functional in natural disaster emergency situations in an offline manner?

Stakeholder Management

- Are community stakeholders consulted and engaged in the CBDC development process?
- How are relevant private sector parties involved in the process?

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