



FINTECH OUTLOOK

The Digital Rupiah “Exploring the CBDC Framework and Its Prospect in Indonesia”

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List of Abbreviations

AML-CFT	Anti Money Laundering and Counter Terrorism Financing
US	United States
ATM	Automated Teller Machine
Bappebti	Commodity Futures Supervisory Agency
BI	Bank Indonesia
BI-ETP	Bank Indonesia Electronic Trading Platform
BI-RTGS	Bank Indonesia Real Time Gross Settlement
BI-SSSS	Bank Indonesia Scriptless Securities Settlement System
BIS	Bank for International Settlements
BSSN	State Cyber and Cypher Agency
CBDC	Central Bank Digital Currency
CBDC BI	Central Bank Digital Currency Bank Indonesia
CBN	Central Bank of Nigeria
CCP	Central Counter Party
DLT	Distributed Ledger Technology
DNDF	Domestic Non-Deliverable Forward
DvP	Delivery versus Payment
ECB	European Central Bank
FGD	Focus Group Discussion
GDP	Gross Domestic Product
G2P	Government to Person
IMF	International Monetary Fund
ITSK	Financial Sector Technology Innovation
KDR	Khazanah Digital Rupiah
KTP	Citizen Identity Card
KYC	Know your customer
NFC	Near Field Communication
NPWP	Taxpayer Identification Number
OJK	Financial Services Authority
OP	Monetary Operations
PET	Privacy Enhanced Technology
PJP	Payment Service Provider
PoA	Proof of Authority
PoW	Proof of Work
P2P lending	Peer-to-peer lending
r-Rupiah	Retail Rupiah
SMS	Short Messaging Service
SPOF	Single Point of Failure
Suptech	Supervisory Technology

SUVBI	Bank Indonesia Foreign Reserves Sukuk
SVBI	Bank Indonesia Foreign Reserves Securities
SVC	Stored Value Card
FinTech	Financial Technology
IT	Information Technology
SME	Small and Medium Enterprises
MSME	Micro, Small and Medium Enterprises
UPI	Unified Payment Interface
USD	United States Dollar
UU	Law
PPSK	Financial Sector Development and Enhancement Law
w-Rupiah	Wholesale Rupiah



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Introduction

1.1. Background on the Global and Indonesian Financial Ecosystem

The global trend in cash usage moves inversely with the upward trend for digital transactions. This oppositional trend became further accelerated by the COVID-19 pandemic. If this phenomenon were to be left alone, it could exacerbate limitations for groups of people facing difficulties in accessing non-cash payment methods. Meanwhile, the role of private entities in pricing policies and facilitating access to payment instruments has increased.¹

On the other hand, this upward trend of digital transactions has been accompanied by a global increase in demand for crypto assets. A McKinsey survey in 2022 found that 22% of respondents from India, 20% from Brazil, and 14% from the United States (US) included crypto assets in their investment portfolios. Meanwhile, the United Kingdom (UK) government found that 10% of citizens aged 18 and above owned crypto assets as of May 2022. The European Central Bank (ECB) also indicated digital asset ownership by households from six major European Union (EU) countries reached about 10%.²

Indonesia itself has a significant potential market for digital finance due to the age distribution of its population. The 15-64 years old age group, which has the highest digital engagement, accounts for 60.18% of Indonesia's total population according to the 2022 census data from Statistics Indonesia (BPS).³ Furthermore, the national digital infrastructure has been expanding rapidly compared to other countries, making Indonesia the country with the fourth-highest mobile penetration in the world.⁴ This has led to the digitalization of the financial services sector, which in turn triggered a trend of rapid growth with the digital economy projected to grow about 15% by 2025 according to the e-Economy SEA 2023's findings by Google, Temasek, and Bain.⁵

The phenomenon of growing demand for crypto assets is also occurring in Indonesia in line with this digitalization. The number of crypto asset investors in Indonesia surged from 16.3 million people in September 2022 to 17.91 million people as of September 2023.⁶ Meanwhile, the total value for crypto asset trading transactions in Indonesia from January to September 2023 reached Rp94.41 trillion. However, due to the decentralized characteristics of crypto assets, this trend is also accompanied by consumer protection risk, industry disruption risk, as well as macro-financial risks that include shadow banking, shadow currency, and even shadow central banking.⁷

1.2. Digital Payment Evolution and the Emergence of Digital Currencies

Digital payments emerged in the 1960s with the implementation of magnetic stripe technology on credit cards, which record user information on electronic payment terminals. The Interbank Card, the predecessor to Mastercard, was launched in 1966 as the first interbank card system to

¹ Ingles, Stevan, “Going Cashless”, International Monetary Fund, June 2018. <https://tinyurl.com/mtkyva7a>

² Denecker, d'Estienne, Gompertz, et al, “Central bank digital currencies: An active role for commercial banks”, McKinsey, Oct. 13, 2022. <https://tinyurl.com/msxek5t6>

³ BPS.go.id “Sensus Longform”, Jan. 30, 2023. <http://tinyurl.com/4nu6ms58>

⁴ Bank Indonesia, “Proyek Garuda: Menavigasi Arsitektur Digital Rupiah”, Pg. 6, Nov. 30, 2022.

⁵ Google.com, “SEA E-Economy 2023”, Pg. 86, Nov. 1, 2023.

⁶ Liputan6.com “Investor Kripto di Indonesia Sentuh 17,91 Juta hingga September 2023” Oct. 30, 2023 <http://tinyurl.com/y688rfvk>

⁷ Bank Indonesia, “Proyek Garuda: Menavigasi Arsitektur Digital Rupiah”, Pg. 10, Nov. 30, 2022.

compete with BankAmericard, the predecessor to Visa.⁸ In the same year, the Bank of Delaware pioneered debit cards, providing electronic payment access to bank customers without credit cards.⁹

Online payments were introduced in 1980 by the United American Service with the instant settlement technology. The service was accessed from a customer's personal computer to the bank's TRS-80 computer via a modem produced by the electronic retailer Radio Shack.¹⁰ InterBold, a joint venture of International Business Machines Corporation (IBM) and Diebold, was the first entity to add interbank transfer features to Automated Teller Machines (ATMs).¹¹

Digital payments via mobile phones initially occurred offline through Short Message Service (SMS) before the advent of mobile internet in 1999.¹² NTT Docomo later introduced digital payments based on applications in Japan in 2004. The payment model on the company's mobile phone products was implemented through an offline feature called osafu-keitai with Near Field Communication (NFC) technology.¹³

Non-bank digital payments began in the early 1970s with Stored Value Cards (SVCs) using closed systems for students and public transportation in the US. The Electronic Benefit Transfer Card, which replaced paper food stamps, was the first open system SVC.¹⁴ Meanwhile, Zopa in the UK became a pioneer in the fintech industry in 2005 by introducing services facilitating peer-to-peer (P2P) lending activities among its users.¹⁵

The first digital currency not directly based on a central bank-issued currency was e-gold, which was launched in 1996 and based on the value of gold as well as silver.¹⁶ Later, eCash, which was introduced in 1997 by DigiCash through collaboration with Mercantile Bank, became the pioneer of cryptocurrencies. eCash used cryptographic technology to secure transaction privacy from user bank accounts to merchants.¹⁷

Bitcoin became the first cryptocurrency in 2009 by integrating cryptography and implementing DLT, forming a blockchain structure. Unlike the preceding eCash, Bitcoin and crypto assets that launched after it are managed based on P2P consensus. Transactions using Bitcoin and other cryptocurrencies are processed by crypto asset "miners" through massive and complex calculations using specialized hardware.¹⁸

On the other hand, the use of crypto assets for transactions often encounters extreme fluctuations in price. This is due to two factors. First, there is no benchmark or reference for the value of crypto assets. Second, the small number of crypto users. This led to the creation of stablecoins. BitShares introduced the world's first stablecoin, bitUSD, in 2014. bitUSD is crypto-collateralized because its

⁸ Forbes, "When Were Credit Cards Invented: The History of Credit Cards", Jul. 27, 2021, <https://tinyurl.com/yhzd3w4h>

⁹ Marketplace, "A short history of the debit card", Aug. 18, 2011, <https://tinyurl.com/mrytc263>

¹⁰ ABA Banking Journal, "Nine Young Bankers Who Changed America: Thomas Sudman", 26 Juni 2017, <https://tinyurl.com/2hm2sck7>

¹¹ The Atlantic, "A Brief History of the ATM", Mar. 26, 2015, <https://tinyurl.com/38rjudha>

¹² Corporate Finance Institute, "Mobile Banking – Overview, History, Types, Importance", Jul. 14, 2020, <https://tinyurl.com/2f8rnfws>

¹³ Wall Street Journal, "Long Before Apple Pay, Japan Had 'Mobile Wallet'", Sep. 11, 2014, <https://tinyurl.com/4fvt862x>

¹⁴ Federal Reserve Board, "A Summary of the Roundtable Discussion on Stored-Value Cards and Other Prepaid ProductsSkip to Content", Jan. 12, 2005, <https://tinyurl.com/5aa5bwmp>

¹⁵ Forbes, "Happy Birthday Zopa, The Inventor Of P2P", May 6, 2015, <https://tinyurl.com/y7j5ubyc>

¹⁶ Wired, "Bullion and Bandits: The Improbable Rise and Fall of E-Gold", Jun. 9, 2009. <https://tinyurl.com/9se97hzk>

¹⁷ Forbes, "Requiem for a Bright Idea", Nov. 1, 1999. <https://tinyurl.com/49bu46jm>

¹⁸ Bitcoin, "Frequently Asked Questions", Sep, 16, 2013, updated Aug. 18, 2023. <https://tinyurl.com/5n6p2zte>

value relationship with the US Dollar (USD) was indirectly linked by its main blockchain token, BTS, being valued at US\$2 per token in anticipation of BTS tokens' volatility. Meanwhile, Tether became the first fiat-collateralized stablecoin because its tokens' value is directly tied to the USD at US\$1 per token.¹⁹

1.3. Reasons and Scope of CBDC Exploration in Indonesia

Financial and economic digitalization has led to changes in people's preferences worldwide, including in Indonesia, towards a growing emphasis on fast, cheap, secure, and reliable financial services. This shift has been reinforced by the acceleration of digitalization resulting from the COVID-19 pandemic.²⁰ However, financial digitalization has also led to the emergence of risks such as shadow banking and cyberattacks, as well as an escalation of fraud, money laundering, and consumer data misuse risks due to the difficulty in enforcing laws on digital business models with borderless operations.²¹ In 2023, over US\$3 trillion of illegal funds flowed through the global financial system according to Nasdaq research. These illegal funds included US\$782.9 billion from the drug trade, US\$346.7 billion from human trafficking, and US\$11.5 billion from terrorism financing. Additionally, there was US\$485.6 billion of funding losses due to various fraud scams and bank fraud schemes across the world.²²

The emergence of Central Bank Digital Currency (CBDC) as an issue is driven by the development of blockchain technology, which introduced the decentralized financial transaction system. This system has led to the "cryptonization" phenomenon. The disruption caused by "cryptonization" can lead to an escalation of shadow banking risks, as well as the emergence of shadow currency and shadow central banking risks.²³

The increasing demand for crypto assets potentially poses shadow currency and shadow central banking risks because concerns have been raised that their issuance, circulation, and control – whether in the current system or in the framework of Web 3.0 that integrates crypto assets – could develop into areas of digital currency beyond the authority of any jurisdiction. The realization of these risks threatens a country's monetary sovereignty and has the potential to disrupt the transmission function of monetary policies from a country's central bank.²⁴

These factors motivated Bank Indonesia (BI) to plan the implementation of the Digital Rupiah as Indonesia's CBDC, which is currently in the research and development stage. The significant initiation of the Digital Rupiah Project began with the issuance of a white paper to explain the Digital Rupiah's concept, objectives, and the initial design of its mechanism. That stage was followed by the issuance of a consultative paper to inform the direction of the Digital Rupiah's development and serve as a way to accumulate input for the technical and general consideration aspects of BI's CBDC development.²⁵

¹⁹ Sun, Wu, and Kwok, "Security Tokens and Stablecoins Quick Start Guide: Learn how to build STO and stablecoin decentralized applications", Pg. 101, Apr. 30, 2019.

²⁰ Bank Indonesia, "Proyek Garuda: Menavigasi Arsitektur Digital Rupiah", Pg. 6, Nov. 30, 2022.

²¹ See Footnote: Bank Indonesia, "Proyek Garuda: Menavigasi Arsitektur Digital Rupiah", Pg. 7, Nov. 30, 2022.

²² Yahoo Finance, "Nasdaq CEO: Financial crime is now a multitrillion-dollar epidemic", Jan. 16, 2024. <http://tinyurl.com/4jwsumx4>

²³ Bank Indonesia, "Proyek Garuda: Menavigasi Arsitektur Digital Rupiah", Pg. 2, Nov. 30, 2022.

²⁴ Bank Indonesia, "Proyek Garuda: Menavigasi Arsitektur Digital Rupiah", Pg. 12, Nov. 30, 2022.

²⁵ AFTECH, "Masukan dan Pandangan atas Consultative Paper Tahap I Bank Indonesia : 'Proyek Garuda: Wholesale Rupiah Digital Cash Ledger'", Pg. 3, July 2023.

1.4. The CBDC Fintech Outlook

1.4.1. Objectives

Due to the relative novelty of CBDCs, documentation, research and analysis on the subject is limited. The concept of large-scale transactions capable of being performed with effectively no institutional intermediary is a frontier field with no historical equivalence. For the first time in history, there is a significant and tangible risk of defection by certain segments of consumers, creating shadow banking and shadow currency. Meanwhile, data regarding the impacts of policies targeting decentralized finance is also limited, whereas the technology and methods of exploitation continue to develop rapidly.

For that reason, we have launched this CBDC Fintech Outlook with an emphasis on BI's Project Garuda, implementing a Digital Rupiah built on an infrastructure of blockchain. This Fintech Outlook covers a generalized breakdown of BI's Digital Rupiah implementation roadmap, an analysis on the feasibility of the project, benchmarking with the CBDC implementation of other countries, and our recommendations on the topic.

The systemic approach used for this Fintech Outlook starts with a basic introduction to the financial, economic, and technological development that eventually led to the demand for a CBDC. A basic description on the concept of CBDC, its differences with conventional cryptocurrency, insights from BI that detail the reasons behind their design for the Digital Rupiah, the legal framework underlying the Digital Rupiah, the potential benefits and drawbacks to Digital Rupiah implementations, and obstacles with BI's Digital Rupiah design.

Ultimately, this Fintech Outlook hopes to supplement BI's documentation on Project Garuda. We aim to provide a different perspective on Project Garuda, emphasizing the impact the project will have on existing industries, especially Fintech, and how stakeholders can be accommodated by the project moving forward. As an added value, this outlook also strives to add additional context to BI's design that may not have been elaborated in the white paper, such as the responsibilities and costs undertaken by validating nodes. Moreover, we will also be leveraging industry experience to make projections on the transmission of the Digital Rupiah to the r-Rupiah market and, subsequently, the consumers, with an emphasis on the consequences to the payment system, financial inclusion, and social impacts.

1.4.2. Limitations of the study

This case study, which focuses on the adoption and implementation of the CBDC in Indonesia, encounters several important limitations that must be acknowledged for a comprehensive understanding of its findings and conclusions.

1. **Evolving Global CBDC Landscape:** One major limitation of this study arises from the rapidly evolving nature of the global CBDC landscape. Many countries are still in the early stages of adopting and experimenting with digital currencies, making it challenging to draw definitive conclusions or establish benchmark examples. The fluctuating global CBDC environment means that policies, technologies, and implementation strategies are continually changing, potentially rendering some findings from this study temporary or context-specific.
2. **Lack of Comprehensive International Benchmark Examples:** Due to the novelty of CBDC, there is a limitation in the availability of comprehensive benchmark examples. Each country

has unique economic, regulatory, and technological contexts that influence its approach to CBDC. Consequently, comparisons or lessons drawn from other countries should be carefully considered, as they may not directly apply or be relevant in the Indonesian context.

3. **Limited Access to Public Resources and Comprehensive Data:** Another significant limitation is the restricted access to public resources and comprehensive data regarding CBDC initiatives, both within and outside Indonesia. Many aspects of CBDC development and implementation are often kept confidential due to security concerns, proprietary technology, and strategic considerations. The lack of detailed publicly accessible information hampers the depth and coverage of the analysis that can be conducted.
4. **Technological and Regulatory Uncertainty:** The technological infrastructure and regulatory framework for CBDC are still under development in many regions, including Indonesia. This uncertainty poses challenges in predicting long-term impacts, potential risks, and success factors for CBDC implementation. Therefore, study findings in this area may change as the technology and regulatory landscape evolves.
5. **Specifics of Cultural and Economic Context:** The unique cultural, economic, and banking sector characteristics of Indonesia play a crucial role in the adoption and effectiveness of CBDC. These distinctive national attributes may limit the generalization of the study's findings to other contexts.
6. **Potential for Rapid Policy Changes:** Considering that CBDC is closely tied to national monetary policies, there is a possibility of rapid and unforeseen policy changes that could impact the implementation and effectiveness of CBDC in Indonesia. This study may not fully encompass the implications of sudden policy changes of this nature.

Given these limitations, the findings and conclusions of this study should be interpreted with an understanding of the dynamic and evolving nature of CBDC implementation, both within Indonesia and globally. Continuous monitoring and analysis will be crucial to keep up with the latest developments in this field.

2

CBDC: Definition, Concept, and Classification

Before delving into complex topics such as the technical design of CBDCs or analyzing BI's implementation strategy, we must first define what a CBDC is, both conceptually and in its practical form. This step is crucial not only for introducing CBDCs as a relatively new monetary instrument, but also for aligning understanding with the reader. For this reason, this chapter will begin by discussing the concept of CBDCs, including their general characteristics, before then addressing Digital Rupiah, which is BI's issued CBDC.

2.1. The Basic Concept of CBDC

Central Bank Digital Currencies (CBDCs) are digital payment tools denominated in the currency of a specific country. CBDCs represent a direct liability or obligation of the central bank as the monetary authority of a CBDC-issuing country. It is the newest type of central bank-issued currency following physical fiat currency, banknotes, and electronic deposits in commercial banks otherwise known as demand deposits in the central bank.²⁶

The design of CBDC infrastructure tends to be based on distributed ledger technology (DLT), which is commonly used in crypto assets. DLT has synergy with CBDCs that have cash-like characteristics, making it the common option in token-based retail CBDCs. Meanwhile, a centralized CBDC design, which utilizes or the centralized ledgers, has more synergy with account-based CBDC design since it requires management intermediaries and operational frameworks for system security features.

²⁷

The division of roles between central banks and Payment Service Providers (PJPs) in the distribution and management of wholesale and retail CBDC can have one or two tiers. In single-tier retail CBDC, the central bank onboards individuals and CBDC merchants as well as directly manages retail transaction settlements. Meanwhile, the two-tier CBDC system includes hybrid CBDCs and intermediated CBDCs.²⁸

In the hybrid CBDC system, the PJPs' hold the role of handling the onboarding of individuals and merchants, aiding in the enforcement of Anti-Money Laundering and Countering the Financing of Terrorism (AML-CFT) regulations, as well as directly managing retail CBDC transaction settlements. Meanwhile, the monetary authority's role in this system is in support of PJPs, and the central bank can take the place of a problematic PJP with the support of periodically-compiled data on all retail CBDC balances.²⁹

In the intermediated CBDC system, PJPs take on all the roles they have in the hybrid CBDC system in addition to recording all retail CBDC balances. Meanwhile, the monetary authority's role is to periodically operate the wholesale CBDC system for PJPs. Like in the hybrid CBDC system, interbank transactions through PJP demand deposit instruments in the central bank are settled through wholesale CBDC.³⁰

²⁶ Bank for International Settlements, “Central bank digital currencies: foundational principles and core features”, Pg. 3-4, Oct.9, 2020.

²⁷ Bank for International Settlements, “Central bank digital currencies: foundational principles and core features”, Pg. 12-13, Oct.9, 2020.

²⁸ Bank for International Settlements, “Annual Economic Report: June 2021”, Pg. 77-78, June 2021.

²⁹ Bank for International Settlements, “Annual Economic Report: June 2021”, Pg. 78-79, June 2021.

³⁰ Ibid

2.2. Differences Between Wholesale and Retail CBDCs

CBDCs can be categorized into two types based on their scope of application, namely wholesale and retail CBDCs. Wholesale CBDCs are provided by the central bank to PJPs for transfers in the interbank market. The operation of this CBDC type is similar to the role of demand deposits in the central bank, as transactions between financial institutions using these deposits are settled in the monetary authorities. The value for each unit of wholesale CBDC transactions is generally larger than that of retail CBDCs.³¹

Meanwhile, retail CBDCs are aimed at the general consumer, on a scale that can resemble a household's access to cash, for use in consumer and corporate financial transactions. Like wholesale CBDCs, retail CBDCs also represent a direct claim on the central bank. However, the utilization of retail CBDCs is more akin to the usage of cash and digital currency. Both wholesale and retail CBDCs can be implemented within a single CBDC ecosystem.³²

Wholesale CBDCs offer several benefits, including increased efficiency and speed of settlement transactions between financial institutions, as well as reduced transaction settlement costs in terms of expenses, system damage impact, and the consequences of delayed transactions. The presence of a wholesale CBDCs separate from the retail market can also enhance the financial system's resilience, reduce liquidity shortage risks, avoid the risk of disintermediation, and minimize the possibility of personal data breaches. However, the realization of wholesale CBDCs' effects on monetary policy is not swift and does not directly impact a country's financial system.³³

The advantages of retail CBDCs include reducing the central bank's cost of producing cash by promoting a decline in the currency type's usage, being more protected against criminal usage due to easier monitoring and facilitating financial access for groups of people not covered by traditional financial systems. The implementation of monetary policy through retail CBDCs could also be faster and more directly affect a country's financial system. However, retail CBDCs risk causing banking disintermediation and can easily overstep the bounds of personal data privacy.³⁴

2.3. How CBDC Differs from Other Forms of Digital Currency

The distinction between privately owned digital money from financial service businesses, SVC balances, cryptocurrencies, and stablecoins compared to CBDCs lies in the central bank's level of involvement. CBDCs are a direct liability of the central bank and is neither private money like uncollateralized cryptocurrencies and stablecoins, nor is it money that has its value directly or indirectly based on the central bank's currency like electronic money from financial service businesses, SVC balances, and other types of stablecoins.³⁵

While their function resembles demand deposits in the central bank, which have been operating digitally, wholesale CBDCs differ from other forms of central bank money because CBDCs use cryptographic technology and a ledger system derived from cryptocurrencies. However, the usage of this system by wholesale CBDCs can also differ from wholesale cryptocurrencies and

³¹ Bank for International Settlements, “Annual Economic Report: June 2021”, Pg. 70, June 2021.

³² Bank for International Settlements, “Annual Economic Report: June 2021”, Pg. 72, June 2021.

³³ Overgaag, Alexandra, “Wholesale CBDC vs. retail CBDC: Key differences”, Cointelegraph. <https://tinyurl.com/ymm8rnj>

³⁴ Ibid

³⁵ See Footnote: Bank for International Settlements, “Central bank digital currencies: foundational principles and core features”, Pg. 3-4, Oct. 9, 2020.

stablecoins as they do not necessarily have to use DLT and can opt for a centralized ledger system.

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As a type of digital currency owned by a country's monetary authority, CBDCs are also shielded from the extreme fluctuations that cryptocurrencies may experience. As a direct liability of the central bank and not a currency directly or indirectly tied to fiat currency, CBDCs also lack the risk of value fluctuations caused by differences in the reserves of the currency or commodities backing the obligations of the circulated currency, as seen in the case of Circle's USD Coin where 8% of its reserves were affected by the Silicon Valley Bank's bankruptcy.³⁷

³⁶ See Footnote: Bank for International Settlements, “Central bank digital currencies: foundational principles and core features”, Pg. 12-13, Oct. 9, 2020.

³⁷ CNBC, “Stablecoin USDC breaks dollar peg after firm reveals it has \$3.3 billion in SVB exposure”, Mar. 11, 2023, <https://tinyurl.com/4pz8yy4j>

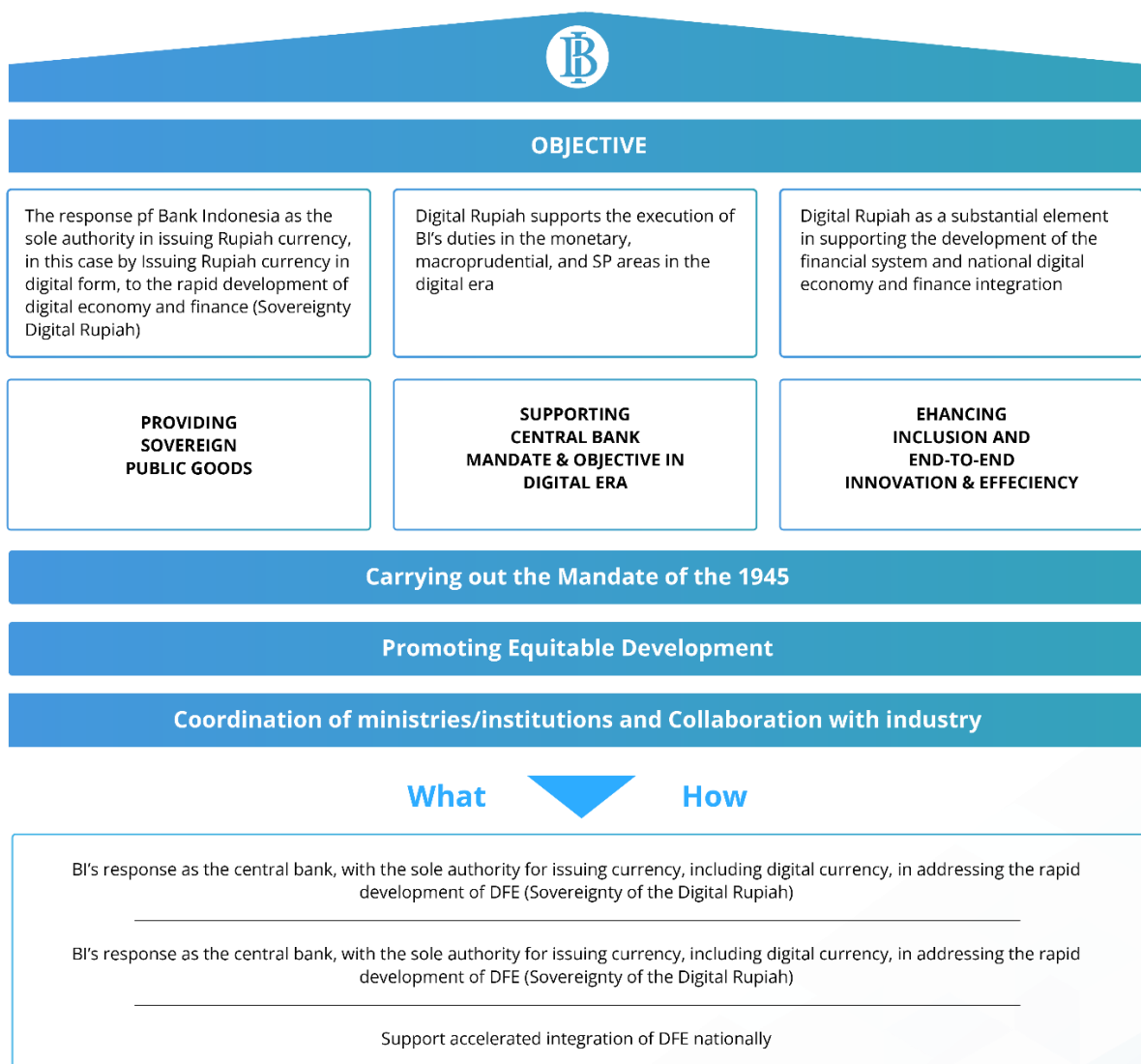
3

The Garuda Project's Vision: Focus on Wholesale CBDC and Its Transmission to Retail CBDC

The Garuda Project is an initiative exploring the design of Indonesia’s CBDC as part of the effort to maintain Rupiah’s sovereignty in the digital age. This initiative indicates that the implementation of Rupiah Digital aims to develop Indonesia’s monetary instruments and not just to support the digital economy market. On the other hand, this project means that Project Garuda reflects a different perspective compared to other CBDC developments, focusing on optimizing digital transactions. Therefore, this chapter will briefly outline the unique insights from Project Garuda and BI’s findings exploring their CBDC design.

3.1. The Garuda Project’s Objectives and Methodology

Figure 1. The Garuda Project’s Foundation and Objectives



(Source: Bank Indonesia, “Proyek Garuda: Menavigasi Arsitektur Digital Rupiah,” Page 17, November 30, 2022.)

In reference to **Figure 1**, the Garuda Project’s objectives reflect the need for BI, as the sole body having the authority to issue Indonesia’s official currency, to respond to rapid developments in digital financial economics. The project aims to accelerate the integration of the national digital financial economy and strengthen BI's role in the international financial system. Moreover, the

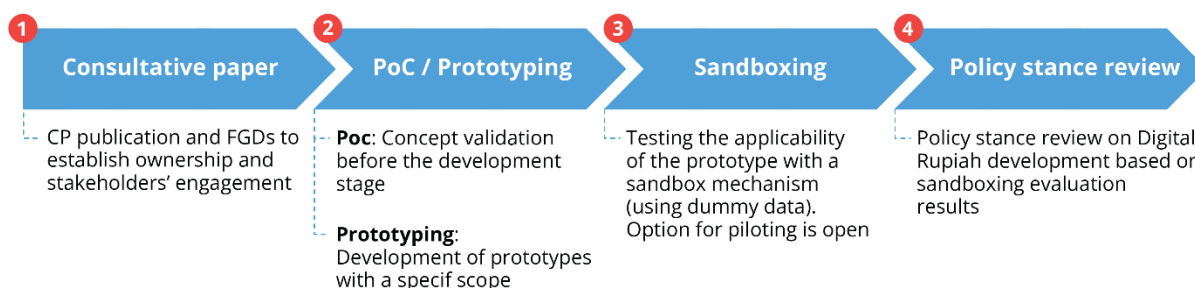
project seeks to establish the Digital Rupiah as a legitimate digital payment tool that complements cash, supports financial inclusion and innovation, as well as contribute to overall system efficiency.³⁸

As stated in chapter 2, the Digital Rupiah is issued as a liability of BI to its holders that serves as a medium of exchange, unit of account, and store of value. The first CBDC type, the wholesale Digital Rupiah (w-Digital Rupiah), will be used for for wholesale transaction settlements, which include foreign exchange transactions, money market transactions, and Monetary Operations (OM). Second, the retail Digital Rupiah (r-Digital Rupiah) will be issued for retail transactions, catering to payments and transfers by both individuals and businesses.³⁹

The development of Digital Rupiah is divided into three stages:

1. BI develops the design for w-Digital Rupiah issuance, destruction, and fund transfers among its participants;
2. BI expands the scope of w-Digital Rupiah utilization by elaborating various additional use cases in support of financial market transactions;
3. BI will test pilot the integrated design between w-Digital Rupiah and r-Digital Rupiah.⁴⁰

Figure 2. The Digital Rupiah Sequence



(Source: Bank Indonesia, “Garuda Project: Wholesale Digital Rupiah Cash Ledger,” Page 5, January 31, 2023.)

Each stage will go through steps selected by BI to ensure the Digital Rupiah is built with the right design. Referring to **Figure 2**, these steps include public consultation, proof of concept, prototyping, piloting, sandboxing, and policy review. BI published a Consultative Paper at the start of 2023 as the implementation of the first stage, and the document aims to engage the public in the Digital Rupiah development process so that its stakeholders can provide input to be part of the elements strengthening the Digital Rupiah.⁴¹

User access to w-Digital Rupiah will be conducted through token-based verification. The use of tokens is considered by BI to be suitable for w-Digital Rupiah because it can facilitate transactions in the financial market that tend to be more complex than retail transactions. BI has also chosen this type of verification for the w-Digital Rupiah to complement its BI Real-Time Gross Settlement (BI-RTGS) account-based verification system.⁴²

³⁸ Bank Indonesia, “Proyek Garuda: Menavigasi Arsitektur Digital Rupiah”, Page 3, Nov. 30, 2022.

³⁹ Bank Indonesia, “Proyek Garuda: Menavigasi Arsitektur Digital Rupiah”, Page 4, Nov. 30, 2022.

⁴⁰ Bank Indonesia, “Proyek Garuda: Wholesale Rupiah Digital Cash Ledger”, Page 5, Jan. 31, 2023.

⁴¹ Lihat Catatan Kaki: Bank Indonesia, “Proyek Garuda: Wholesale Rupiah Digital Cash Ledger”, Page 5, Jan. 31, 2023.

⁴² Bank Indonesia, “Proyek Garuda: Menavigasi Arsitektur Digital Rupiah”, Page 22, Nov. 30, 2022.

Meanwhile, user access to r-Digital Rupiah is differentiated to segmentation based on tiering and transaction value capping. The token-based r-Digital Rupiah will be used to facilitate transactions up to a certain value so it could approach the flexibility of cash. However, this flexibility needs to be restricted towards a certain limit to maintain payment integrity and fulfill the commitment to Indonesia’s Anti-Money Laundering and Counter-Terrorism Financing (AML/CFT). Therefore, BI will choose the account-based r-Digital Rupiah for transactions beyond that limit.⁴³

The DLT system will be used as the technological platform for w-Digital Rupiah because BI considers it able to address the single point of failure (SPOF) risk, enhance transaction integrity, and promote efficiency. The type of DLT for w-Digital Rupiah will use a permissioned design that BI deems more secure and suitable for high-value but low-volume transactions, such as financial market transactions in the financial market in general.⁴⁴

However, permissioned DLT is insufficient to facilitate retail transactions with their high volume. BI is concerned that DLT’s scalability limitations may restrict the speed of retail settlements. Therefore, a centralized ledger system is being considered for use by r-Digital Rupiah. Nevertheless, BI remains open to using DLT for r-Digital Rupiah if available technological solutions can address these scalability issues.⁴⁵

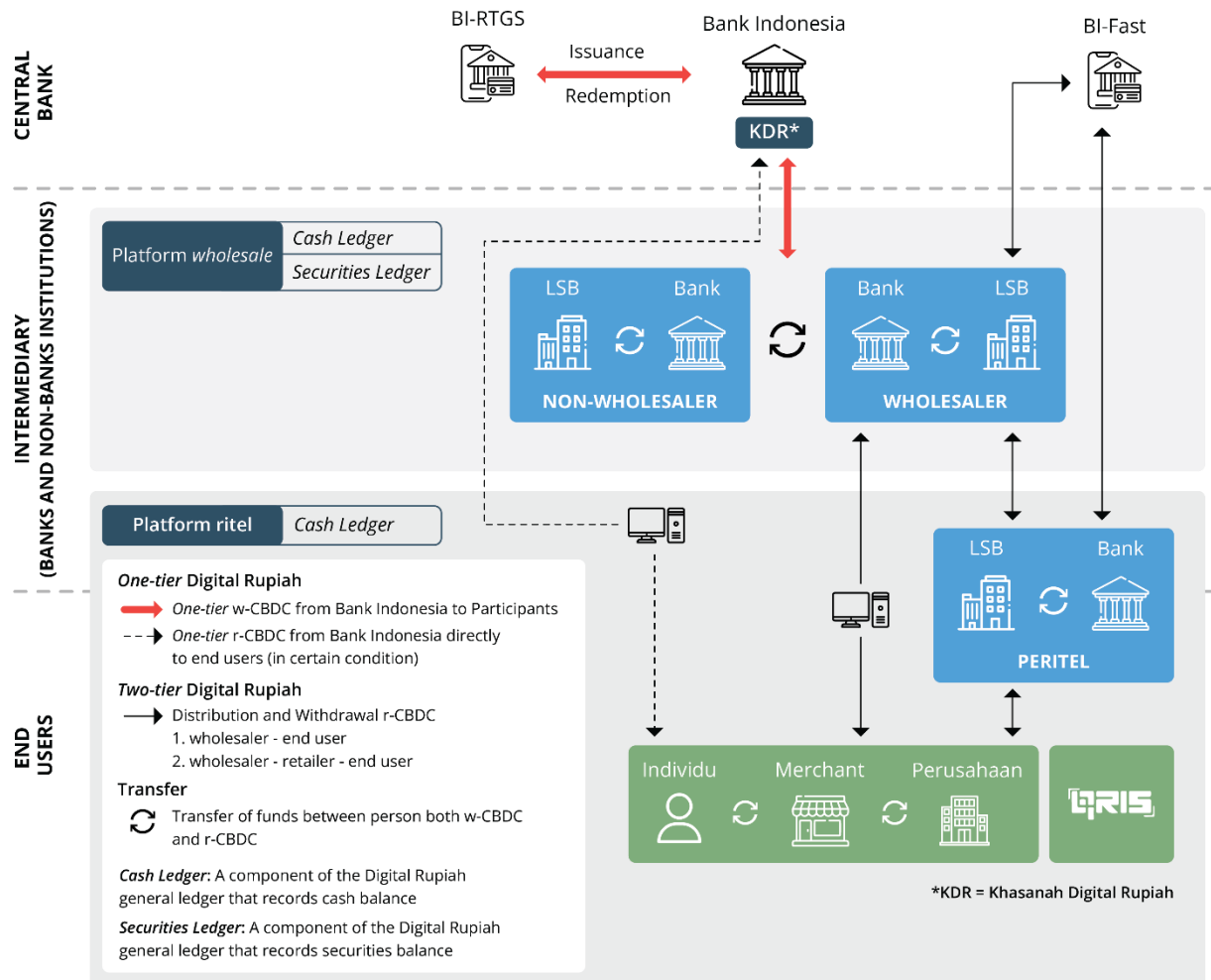
⁴³ Lihat Catatan Kaki: Bank Indonesia, “Proyek Garuda: Wholesale Rupiah Digital Cash Ledger”, Page 5, Jan. 31, 2023.

⁴⁴ Bank Indonesia, “Proyek Garuda: Wholesale Rupiah Digital Cash Ledger”, Page 6, Jan. 31, 2023.

⁴⁵ Lihat Catatan Kaki: Bank Indonesia, “Proyek Garuda: Wholesale Rupiah Digital Cash Ledger”, Page 6, Jan. 31, 2023.

BI's planned cycle for the Digital Rupiah by BI is as follows:

Figure 3. Digital Rupiah Business Model Design



(Source: Bank Indonesia, “Garuda Project: Navigating the Digital Rupiah Architecture,” Page 25, November 30, 2022.)

The Digital Rupiah cycle begins with the issuance of w-Digital Rupiah through the transfer of funds from participants' current accounts at BI to their technical accounts in BI-RTGS. This transaction will simultaneously trigger the issuance of tokens in the Digital Rupiah Treasury (KDR) on the w-Digital Rupiah platform. The transfer of w-Digital Rupiah funds among transaction participants in the wholesale market, whether as wholesalers or non-wholesalers within the w-Digital Rupiah platform, does not involve the KDR;

1. r-Digital Rupiah is issued through the conversion of w-Digital Rupiah by wholesalers who also act as direct retailers to end-users, wholesalers to end-users through retailers, and directly from BI to end-users only in certain cases. The issuance of r-Digital Rupiah is done to meet customer demand or to form reserves;
2. Digital Rupiah is used for transactions by its users, whether in the wholesale or retail markets;
3. The Digital Rupiah cycle concludes with the redemption process. This process begins with the collection of the retail CBDC, with wholesalers receiving the release of r-Digital Rupiah through

retailers or directly from end-users. Afterwards, wholesalers wishing to reduce their Digital Rupiah supply can exchange r-Digital Rupiah for w-Digital Rupiah, and then convert that wholesale CBDC into a current account balance at BI.⁴⁶

4. The KDR plays a central role in the Digital Rupiah cycle as a node in the w-Digital Rupiah platform with the sole mandate to issue and delete w-Digital Rupiah tokens. The issuance process of the wholesale CBDC in the KDR occurs based on demand, and the KDR remains at a zero-balance position like before the issuance when the w-Digital Rupiah enters circulation. Therefore, the KDR serves as the single gateway to ensure the Digital Rupiah supply's validity, completeness, security, and accuracy.⁴⁷

The Digital Rupiah platform is divided into wholesale and retail platforms to accommodate the scalability needs of the CBDC system and minimize exposure to operational risks, such as the risk of cyberattacks, to the national financial system's stability. Although they are separate, both platforms are targeted to synchronize seamlessly to realize the Digital Rupiah cycle.⁴⁸

BI views the Digital Rupiah development as a collaborative process, with the monetary authority playing a role in developing the DLT platform for w-Digital Rupiah and the r-Digital Rupiah platform. Hardware investments for nodes operated by BI, KDR, wholesalers, and non-wholesalers will be carried out individually by each node participant. Meanwhile, investments in digital wallets as user interface access for both CBDC platforms, including expenditures related to the know-your-customer (KYC) process, will be conducted individually by participants in the Digital Rupiah system according to their roles.⁴⁹

3.2. Key Findings, Challenges and Lessons Learned

The Digital Rupiah's benefits in terms of transaction efficiency, security, and innovation potential are the reasons why the CBDC needs support, especially as part of the effort to accelerate digital financial inclusion and improve digital financial literacy in Indonesia. In this regard, the principle of participant diversification through the wholesaler and non-wholesaler categories as well as the principle of role diversification with the validator and non-validator categories in the w-Digital Rupiah ecosystem needs to be emphasized by BI, because the financial services sector could enhance the Digital Rupiah's effectiveness, adoption rate, and financial inclusion through innovations in financial products and services.⁵⁰

The principle of interoperability between the Digital Rupiah and existing payment systems also needs support to improve the efficiency of the Indonesian payment system and prevent the risk of market fragmentation. Additionally, the sandboxing element should be a priority in the Digital Rupiah roadmap to increase the involvement and participation of non-bank financial institutions

⁴⁶ Bank Indonesia, “Proyek Garuda: Menavigasi Arsitektur Digital Rupiah”, Page 25-26, Nov. 30, 2022.

⁴⁷ Bank Indonesia, “Proyek Garuda: Menavigasi Arsitektur Digital Rupiah”, Page 25, Nov. 30, 2022.

⁴⁸ Lihat Catatan Kaki: Bank Indonesia, “Proyek Garuda: Menavigasi Arsitektur Digital Rupiah”, Page 25, Nov. 30, 2022.

⁴⁹ Bank Indonesia, “Proyek Garuda: Menavigasi Arsitektur Digital Rupiah”, Page 26-27, Nov. 30, 2022.

⁵⁰ AFTECH, “Masukan dan Pandangan atas Consultative Paper Tahap I Bank Indonesia : ‘Proyek Garuda: Wholesale Rupiah Digital Cash Ledger’”, Page 36, July 2023.

so that both the potential for innovation and potential risks that may arise during the CBDC implementation process can be improved and mitigated, respectively.⁵¹

However, consumers’ understanding of the current Digital Rupiah design is still relatively low, especially on the CBDC’s principles and technical guidelines. Therefore, more extensive promotion involving industry stakeholders is necessary for the Digital Rupiah’s design, technical guidelines, and standards such as infrastructure, security, and capital reserve standards which will be set by BI and could be studied and considered by related industries before the CBDC is launched. Additionally, strengthening the regulatory framework for the Digital Rupiah’s infrastructure network system with related industries’ participation should be a primary focus in mitigating risks posed by the CBDC, such as the threat of cyberattacks, misuse of personal data, transaction continuity, and the stability of the monetary and payment systems.⁵²

⁵¹ Lihat Catatan Kaki: AFTECH, “Masukan dan Pandangan atas Consultative Paper Tahap I Bank Indonesia : ‘Proyek Garuda: Wholesale Rupiah Digital Cash Ledger’”, Page 36, July 2023.

⁵² Lihat Catatan Kaki: AFTECH, “Masukan dan Pandangan atas Consultative Paper Tahap I Bank Indonesia : ‘Proyek Garuda: Wholesale Rupiah Digital Cash Ledger’”, Page 36, July 2023.

4

Benefits and Challenges in the Case of CBDC Usage in FinTech

BI has stated that the implementation of Digital Rupiah will follow a do no harm policy, which means that Digital Rupiah will avoid causing disruption or disturbances to financial platforms once implemented. Although this principle is important the question on the minds of market players is how this principle will be upheld. This chapter will answer that question with a brief explanation of BI's strategy for integrating Digital Rupiah with existing modern financial platforms. Furthermore, this chapter will also address other relevant questions regarding the application of Digital Rupiah, such as the benefits and changes that Digital Rupiah will bring.

4.1. Seamless Integration with Modern Financial Platforms

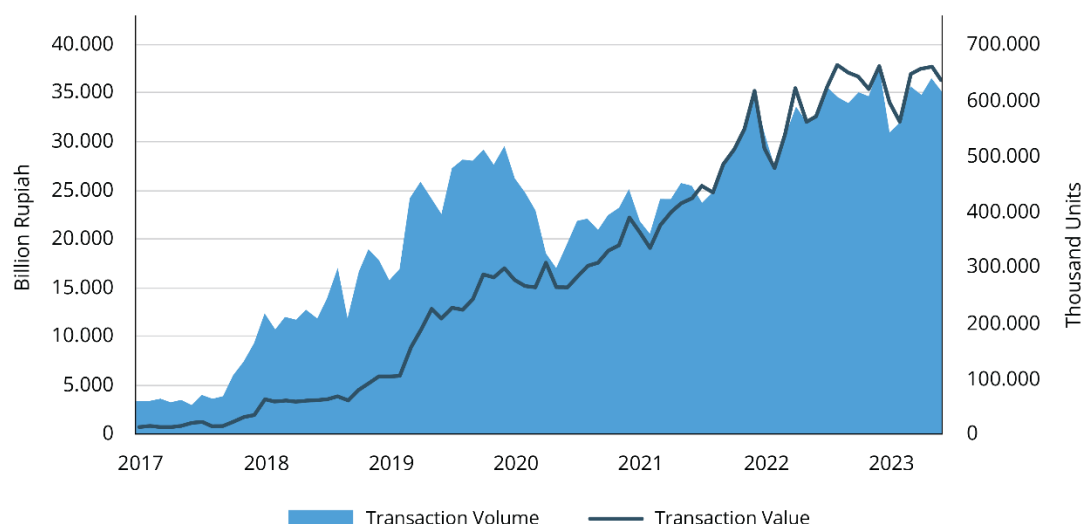
It is undeniable that the fintech industry plays a crucial role in improving financial inclusion and the broader Indonesian economy. The fintech industry has contributed to the improvement of financial inclusion in Indonesia through innovations in financial products and services, which are driven by the acceleration of digital access for the Indonesian people. OJK data showed a positive trend for financial inclusion in Indonesia, with it increasing from 59.74% in 2013 to 85.1% in 2022.

The Indonesian fintech industry's development has been propelled by massive innovation and internet penetration. One such innovation occurs in the payment system industry, with electronic payment transaction volume rapidly increasing by leveraging smartphones and applications. **Graph 1** below illustrates the development of e-money transaction volumes, showing an increase since 2018. E-money transaction value has also increased since mid-2019 and during the COVID-19 pandemic. Government-imposed mobility restrictions due to the COVID-19 pandemic triggered changes in ways of life for both consumers and merchants, accelerating the adoption of electronic payment systems. The use of electronic payment systems, which are safer, more convenient, and widely accepted, has driven the high adoption of electronic payment methods during the pandemic, including among new consumers. Additionally, the increased adoption of electronic payment methods has also been fueled by the perception of higher safety from the risk of COVID-19 transmission in comparison with transactions using non-electronic or cash payments.⁵³

Moreover, merchants' increasing acceptance of the adoption of electronic payment systems and the shift towards a cashless society, along with the growth of e-commerce, has contributed to the increasing value of digital payment platforms. Currently, the value of e-money transactions has reached Rp373 trillion as of October 2023, a 42-fold surge from the same period in 2017.

⁵³ Bank for International Settlements, “Covid-19 accelerated the digitalisation of payments”, Dec. 9, 2021. <http://tinyurl.com/z586pzcp>

Graph 1. Value and volume of E-Money transactions in Indonesia



Source: CEIC

The increase in e-money transactions illustrates the established digital payment ecosystem in Indonesia. The ecosystem created by the fintech industry presents its opportunities for accelerating the adoption of each digital innovation, including in the context of the Digital Rupiah. In this context, BI needs to continue emphasizing the 3i principles, namely integration, interoperability, and interconnection. The Digital Rupiah also needs to be designed to coexist with existing payment system infrastructure.

Meanwhile, restricting participation in the CBDC will only limit the opportunities for innovation, especially in the context of the fintech industry where innovation plays a crucial role in growth and development. Additionally, restricting participation will position the Digital Rupiah as a competitor to fintech, which would negate the potential of increased efficiency.

Box 1. Competition Between the People’s Bank of China (PBoC) and Digital Companies

After undergoing an extensive review process, the PBoC officially piloted the Digital Yuan in four regions across China in 2020. China being the host of the 2022 Winter Olympics provided momentum to accelerate the Digital Yuan pilot’s evaluation process to gauge public interest. From there, China expanded access to Digital Yuan towards 10 regions. By the end of 2022, the Digital Yuan application could be downloaded on the iPhone Operating System (iOS) and the AppStore.⁵⁴ Other than fulfilling goals of accelerating financial inclusion and cross-border transactions, the issuance of Digital Yuan is expected to reduce the financial stability risks associated with cryptocurrencies and the monopolistic power held by large digital companies.

However, the application directly issued by the PBoC has become a direct competitor to private digital companies such as Alipay and WeChat. There were already 120 million registered Digital Yuan wallet accounts even with access still very limited in China. As a result, the transaction value generated from the Digital Yuan reached CN¥1.8 trillion, or equivalent to US\$250 billion.⁵⁵ That transaction value is relatively low, accounting for only 0.16% of the total money supply (M0) in

⁵⁴ Nikkei Asia, “China’s Digital Yuan Struggle Underscores Challenges for Central Bank”, Oct. 26, 2023, <http://tinyurl.com/va5e8a5u>

⁵⁵ Reuters, “China’s Digital Yuan Transactions Seeing Strong Momentum, Says CBank Gov Yi”, Jul. 19, 2023, <http://tinyurl.com/5n8ujabr>

China. It is also lower than the transaction value in 2022, which reached nearly CN¥500 trillion from mobile payments.⁵⁶ The digital payment system in China is dominated by Alipay and WeChat, with each having 1.3 billion and 900 million users, respectively.⁵⁷

Nevertheless, it is important to note that the Digital Yuan’s achievements were made in about three years within a very limited geographic scope. Meanwhile, companies like Alipay have been in existence for the past two decades. This context can serve as a valuable lesson for designing Digital Rupiah in Indonesia on the importance of prioritizing greater collaboration and synergy between the government and the private sector for better innovation and provision of financial products and services to the public at large.

Fintech involvement is not just in the context of the r-Digital Rupiah, as it could also be pursued for the w-Digital Rupiah ecosystem. This involvement can be in the form of various roles, including validating nodes, non-validating nodes, or non-nodes. For example, the design of Australia’s w-CBDC provides participation opportunities for non-bank institutions. In the context of the US’ stablecoins market, only insured and supervised depository institutions have the chance to issue stablecoins. On the other hand, regulations in the EU differ slightly, with stablecoin issuers not limited to insured and regulated depository institutions like banks. Nevertheless, other rules must be met by those non-bank institutions, such as minimum capital requirements and minimum reserve values that must be held by said institutions.⁵⁸

The potential efficiency generated by w-CBDC for transactional needs and storing the value of money could provide more room for innovation in the fintech industry. Additionally, a collaborative model in utilizing the Digital Rupiah infrastructure should be emphasized to enhance efficiency and drive innovation. This space for innovation can be instrumental in enhancing competitiveness, not only in the fintech industry but also in the real sector and among micro, small, and medium-sized enterprises (MSMEs). Moreover, opportunities to access liquid assets as an alternative financial product in the wholesale market can help diversify sources of financing and expand financial access without increasing credit risks.⁵⁹

However, BI must balance the potential for innovation and the risks associated with the inclusion of non-bank institutions in the Digital Rupiah ecosystem, such as security, privacy, or monetary and payment system stability risks. Therefore, principles and standards established by BI in collaboration with relevant industry players are needed to ensure the Digital Rupiah ecosystem’s security amid non-bank institutions’ entry into it. Specific principles and standards based on clear and non-overlapping regulations are also necessary to provide certainty for the fintech industry. In this regard, clear legal frameworks focusing on the balance between innovation, inclusion, payment system risks, and misuse of personal data are essential. Additionally, sandboxing features need to be adopted because it would mitigate systemic risks that may arise from the involvement of new participants in the Digital Rupiah ecosystem. Regulators can therefore act as

⁵⁶ Slotta, Daniel, “Annual transaction value of mobile payments in China from 2013 to 2022 (in trillion yuan)”, Statista, Sep. 29, 2023, <http://tinyurl.com/3vc2mrvbw>

⁵⁷ Tech Wire Asia, “Ten Years Later, Alipay is Still the Most Popular Digital Wallet in the World”, Aug. 23, 2022, <http://tinyurl.com/2s3tdh2k>

⁵⁸ Allen, Gu, and Jagtiani, “Fintech, Cryptocurrencies, and CBDC: Financial Structural Transformation in China” *Journal of International Money and Finance*, Vol. 12, June 2022. <http://tinyurl.com/4jfumc9y>

⁵⁹ Reserve Bank of Australia, Commonwealth Bank of Australia, National Australia Bank, et al, “Project Atom: Exploring a Wholesale CBDC for Syndicated Lending”, Dec. 8, 2021. <http://tinyurl.com/2utyctv8>

mediators and enablers for the engagement and strengthening of synergies as well as good collaboration between banking and non-banking financial institutions in the Digital Rupiah ecosystem.

In light of conditions in other countries, BI needs to establish standards for the involvement of non-banking financial institutions in the Digital Rupiah ecosystem. The first standard is the need for a robust network infrastructure to prevent potential cyber threats. The network system also needs to ensure that zero-knowledge-proof principles are maintained to allow verification without revealing transaction-related information.⁶⁰ The second is the use of digital and system capabilities to strengthen and expedite KYC processes. Additionally, the financial institutions that are going to be involved need to build payment systems as part of AML/CFT efforts. The third standard focuses on strengthening systems and mechanisms to ensure consumer protection, both in terms of transaction security and liquidity risk. By focusing on the implementation of these principles, the potential risks during the Digital Rupiah implementation phase can be mitigated and avoid widespread impacts on society.

4.2. Potential for Financial Inclusion and Literacy

One of the central banks' motivations for implementing CBDC is to enhance financial inclusion, especially for central banks in developing and emerging markets.⁶¹ Financial inclusion refers to the accessibility and availability of financial services for all segments of the population, while financial literacy relates to the comprehension of financial products and services as well as the ability to make appropriate and wise financial decisions.⁶²

CBDC has the potential to enhance financial inclusion by providing direct access for citizens to receive aid, make payments, and participate in trade. Improvement of financial inclusion is a common goal for 80% of central banks currently exploring CBDC.⁶³ CBDC provides a platform accessible through mobile phones or other digital devices, reducing the need for physical banking infrastructure, which is often unavailable in remote areas or inaccessible to the general public.

Global financial inclusion has increased over the past decade. Financial account ownership rose from an average of 51% in 2011 to 76% in 2021 according to the World Bank's Global Findex, with 71% in developing countries alone.⁶⁴

⁶⁰ RBA, 2021

⁶¹ [CBDC and financial inclusion: Changing the paradigm \(Part 1\) \(worldbank.org\)](https://www.worldbank.org/press/2021/04/cbdc-and-financial-inclusion-changing-the-paradigm-part-1)

⁶² World Bank, “Financial Inclusion: Overview”, [http://tinyurl.com/23rsj9e3](https://tinyurl.com/23rsj9e3)

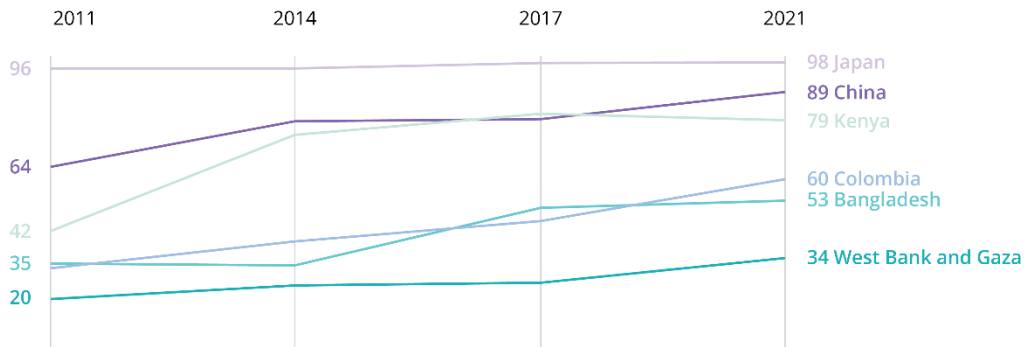
⁶³ Bank for International Settlements, “Central bank digital currencies - executive summary”. [http://tinyurl.com/6z223ncb](https://tinyurl.com/6z223ncb)

⁶⁴ Demirgüç-Kunt, Klapper, Singer, et al, “The Global Findex Database 2021: Financial Inclusion, Digital Payments, and Resilience in the Age of COVID-19”, Overview, World Bank, 2022. [http://tinyurl.com/59sjk6ca](https://tinyurl.com/59sjk6ca)

Figure 4. Global Financial Account Ownership From 2011 to 2021

Adults with an account (%), 2011 - 2021

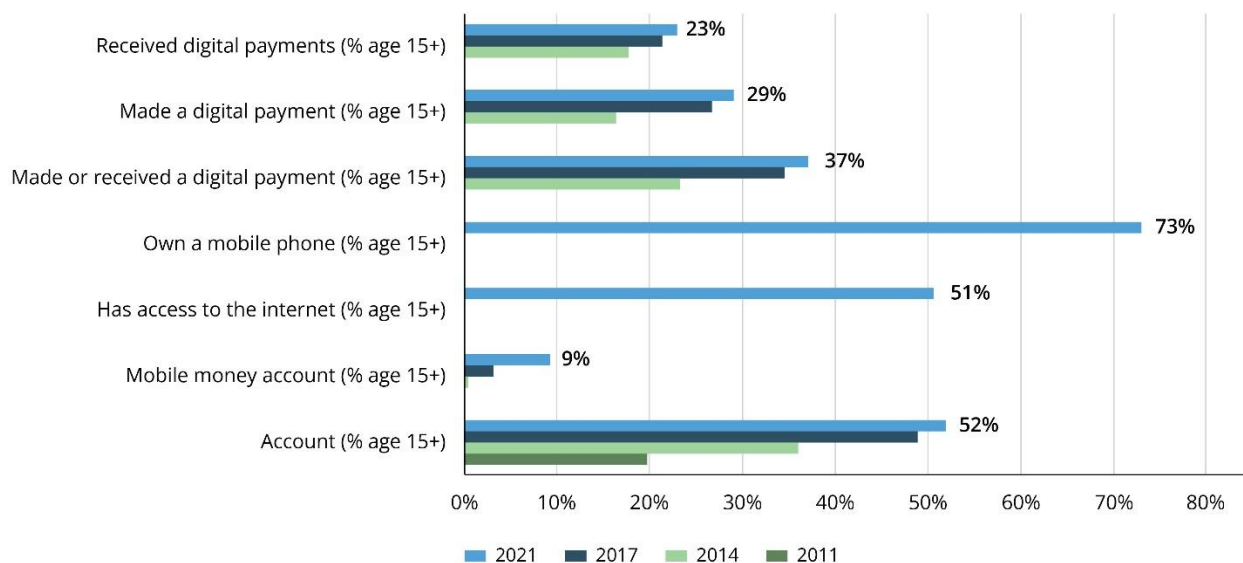
Region ■ East Asia and Pacific ■ Europe and Central Asia ■ High-income economies
 ■ Latin America and the Caribbean ■ Middle East and North Africa ■ South Asia ■ Sub-Saharan Africa



Source: Global Findex database, World Bank

Like other countries’ CBDCs, Indonesia’s Digital Rupiah is expected to have significant potential to contribute towards improving financial inclusion and literacy, potentially furthering BI’s progress to meeting financial inclusion targets. That is because CBDCs could not only expand financial access but also reduce transaction costs and bring the opportunity cost for end-users closer to cash. Therefore, the Digital Rupiah is expected to increase financial account ownership among Indonesians aged 15 and above, which was previously recorded at 52% in 2021 according to the Global Findex Database.⁶⁵ The same data also indicated the CBDC’s usage potential, with 73% of the population aged 15 and above owning mobile phones and 37% of them making digital payments.

Graph 2. Financial Statistics in Indonesia



Source: Global Findex database, World Bank.

⁶⁵ World Bank, “The Global Findex Database 2021”. <http://tinyurl.com/ytm8brzf>

Research conducted by various institutions, including central banks⁶⁶ and academic institutions, indicated that CBDC can enhance financial inclusion in developing countries.⁶⁷ CBDC has specific aspects that support financial inclusion, such as it being a secure and widely accepted form of digital money, the possibility of offline payments, as well as lower costs and greater accessibility.⁶⁸ An example of successful CBDC innovation in the use of digital wallets can be seen in Nigeria. Nigeria became the first country in Africa to launch a CBDC, the e-Naira. Transactions using the e-Naira have risen by 63% to 22 billion. The number of wallets for the CBDC rose by 12 times to 13 million wallets since October 2022.⁶⁹ CBDC provides a platform that can be accessed via mobile phones or other digital devices, reducing the need for physical banking infrastructure, which is often unavailable in remote areas.⁷⁰

It would be enlightening to compare the changes in Indonesia’s financial inclusion percentage after the Digital Rupiah was implemented.

4.2.1. Expanding Financial Access

The Bank for International Settlements (BIS) emphasized that CBDC could ensure that the public still has access to the safest form of money amid economic digitalization, a claim over the central bank.⁷¹ That guarantee is crucial in areas with limited access to traditional banking facilities, as CBDC provides a more easily accessible platform for financial transactions. CBDC also has the potential to provide access to financial services for those without a bank account, especially in remote areas of Indonesia. That potential would be a significant step in information technology development that could have a major impact on the financial sector, including technology-based transactions such as electronic money and digital payments.⁷²

CBDC is seen as a tool to overcome barriers to financial inclusion. Traditional financial inclusion strategies have not yielded significant results despite extensive efforts to include individuals and small businesses without access to the financial system. Researchers have found that public policies aimed at reducing barriers or providing incentives are insufficient at accommodating the financially disadvantaged segments of society.⁷³ CBDC could, with its design, address access barriers that affect digital financial services. Their convenience, affordability, and security could encourage inclusive consumer adoption.⁷⁴ However, their effectiveness depends on the specific financial needs and barriers in each country.⁷⁵

The International Monetary Fund (IMF) and the World Bank highlighted that CBDC has the potential to enhance financial inclusion by providing a risk-free and widely accepted form of digital money

⁶⁶ Kompas.com, “Menilik Potensi dan Manfaat Rupiah Digital di Masa Depan”, Dec. 13, 2022. <http://tinyurl.com/28wm8ye7>

⁶⁷ Juanda, Irawan, Probokawuryan, et al, “Desain Rupiah Digital sebagai Central Bank Digital Currency Indonesia dalam Upaya Mencapai Inklusi Keuangan dan Pemulihan Ekonomi”, 2022. <http://tinyurl.com/3yun5dj4>

⁶⁸ Emanuella, Claudia Saymindo, “Central Bank Digital Currency (CBDC) Sebagai Alat Pembayaran Di Indonesia”, *Jurist-Diction* 4, no. 6, Pg. 2243–2276, Nov. 5, 2021. <https://e-journal.unair.ac.id/JD/article/view/31845>

⁶⁹ Coinvestasi, “9 Negara Ini Lakukan Uji Coba CBDC”, May 14, 2023. <http://tinyurl.com/bdh7n6p3>

⁷⁰ Babu, Satish & Abraham, K.M., “Central bank digital currencies: policy and operational perspectives for India”, *CSIT* 9, Pg. 85–94, Jul. 2, 2021. <http://tinyurl.com/327vyumw>

⁷¹ Bank for International Settlements, “BIS Innovation Hub work on central bank digital currency”, <http://tinyurl.com/3aps44en>

⁷² See Footnote: Juanda, Irawan, Probokawuryan, et al, “Desain Rupiah Digital sebagai Central Bank Digital Currency Indonesia dalam Upaya Mencapai Inklusi Keuangan dan Pemulihan Ekonomi”, 2022. <http://tinyurl.com/3yun5dj4>

⁷³ World Bank Blogs, “CBDC and financial inclusion: Changing the paradigm (Part 1)”, 3 Oktober 2022. <http://tinyurl.com/bddxrr9e>

⁷⁴ Lihat Catatan Kaki: World Bank Blogs, “CBDC and financial inclusion: Changing the paradigm (Part 1)”, 3 Oktober 2022.

<http://tinyurl.com/bddxrr9e>

⁷⁵ World Bank Blogs, “CBDC and financial inclusion: Changing the paradigm (Part 1)”, Oct. 3, 2022. <http://tinyurl.com/bddxrr9e>

that could even be used for offline payments.⁷⁶ CBDC may also help provide banking access to populations without bank accounts, especially in developing countries, by incentivizing the opening of bank accounts to access CBDC wallets. That increased access could then increase overall lending and reduce the risk of bank disintermediation.⁷⁷

4.2.2. Reducing Transaction Costs

CBDC has the potential to reduce transaction costs, making transactions more economical for the public. While specific information on the cost comparisons between traditional services and the Digital Rupiah is not yet available, the general trend in digital currencies has shown a more efficient transaction model compared to traditional banking systems.

The US Federal Reserve, the US' central bank,⁷⁸ and the IMF⁷⁹ noted that CBDC reduction of transaction costs would benefit low-income households. Moreover, CBDC offers the potential to simplify cross-border payments, introduce streamlined distribution channels, and promote interoperability across jurisdictions. However, achieving those improvements will require significant international coordination.

4.2.3. Enhancing Financial Literacy

The implementation of CBDC could create opportunities for digital financial education. Educational programs could enhance the public's understanding of how CBDC works and its benefits, enabling more informed financial decision-making and better utilization of digital financial services. For example, Sweden has experienced increased financial literacy after the implementation of its CBDC, e-Krona. The experience demonstrated the potential positive impact of CBDC on financial comprehension and inclusion.⁸⁰ In Europe, a digital education program launched concurrently with the digital euro has improved digital financial literacy among the public.

The Digital Rupiah has significant potential to enhance financial inclusion and literacy in Indonesia. Only 52% of the Indonesian population aged 15 and above have financial accounts according to Global Findex Database 2021.⁸¹ Meanwhile, the OJK recorded the country's financial inclusion index reaching 85.10% in 2022, a 3 percent increase from 2017.⁸² However, there are still challenges such as high service costs and low accessibility that need to be addressed. The Digital Rupiah has the potential to overcome these constraints, since it does not require physical branch offices and offers lower transaction costs.

The Digital Rupiah's implementation must be accompanied by effective educational strategies and supportive policies to realize its full potential. Like other major financial innovations, the Digital Rupiah's success will depend on its integration into the Indonesian financial ecosystem, the

⁷⁶ Lanquist, Ashley & Tan, Brandon, “Central Bank Digital Currency's Role in Promoting Financial Inclusion”, International Monetary Fund, Sep. 22, 2023. <http://tinyurl.com/urc7hbbk>

⁷⁷ Tan, Brandon, “Central Bank Digital Currency and Financial Inclusion”, International Monetary Fund, Mar. 17, 2023. <http://tinyurl.com/2jb26aut>

⁷⁸ Federal Reserve Board, “Money and Payments: The U.S. Dollar in the Age of Digital Transformation”. <http://tinyurl.com/4n5mmu6r>

⁷⁹ Stanley, Andrew. “The Ascent of CBDCs”, International Monetary Fund, September 2022. <http://tinyurl.com/3ah5ahcm>

⁸⁰ Central Bank of Kenya, “Discussion Paper on Central Bank Digital Currency: Comments from the Public”, February 2022. <http://tinyurl.com/mmpds677>

⁸¹ The World Bank, “Global Financial Inclusion (Global Findex) Database 2021 – Indonesia 2021”, Dec. 7, 2022. <http://tinyurl.com/yrfetkhz>

⁸² Otoritas Jasa Keuangan, “Siaran Pers: Survei Nasional Literasi dan Inklusi Keuangan Tahun 2022”, Nov. 22, 2022. <http://tinyurl.com/3vj9kj5j>

regulatory framework given by BI, and the Indonesian public's responsiveness to digital financial services.⁸³

A study conducted by the Centre for Financial Regulation and Inclusion (Cenfri) in collaboration with the Alliance for Financial Inclusion (AFI) investigated CBDC's potential role in enhancing financial inclusion for countries with developing and emerging markets. It focused on use cases such as domestic remittances, trade, and business transaction payments, as well as government payments to individuals. The study concluded that CBDC design should align with its context and purpose as well as consider the specific needs in the market, especially those belonging to vulnerable communities. CBDC could overcome financial inclusion barriers but also poses risks of reinforcing existing barriers if not carefully designed.^{84,85}

4.3. Improving Public Policy Quality and Economic Stabilization

A country's CBDC design will certainly determine its implications for public policy and the economy. However, it is undeniable that the Digital Rupiah could bring various benefits for improving the quality of Indonesia's public policy and economic stability.

One of the potential benefits of the Digital Rupiah's implementation is how it could enhance data quality in Indonesia through the creation of granular data. Data generated from the Digital Rupiah has the potential to positively impact asymmetric information risks when leveraged by financial institutions, including fintech. Well-recorded transactions will facilitate financial institutions in identifying individual characteristics, including borrowers' potential. Efficiency will be gained from offering lower credit interest rates to individuals with lower risk profiles and better compliance. With more competitive interest rates, financial institutions could channel more loans that could boost investment and drive overall economic growth.⁸⁶

Moreover, the utilization of granular data by financial institutions, including fintech, could also support the Digital Rupiah issuance principle of promoting innovation and efficiency. The use of granular data could enhance innovation on broader access to financial products and services for providers of innovative credit scoring and fintech, as well as promote financial inclusion.

However, the use of granular data needs to be driven by consumer consent as the basis for personal data protection efforts. Regulations derived from the Personal Data Protection Law (UU PDP) need to be promoted so they can provide good standards in data storage and management to ensure public privacy. Therefore, a balance between facilitating innovation through the Digital Rupiah and reducing the risk of personal data misuse as a form of protection for the public could be achieved.

Another benefit of the Digital Rupiah for public policy is related to social assistance programs as part of the Government-to-Person (G2P) program. One of the main challenges of social security is the accuracy of distribution to the right recipients, the speed of reception, and the program's

⁸³ Republika.id, “Menimbang Kehadiran Rupiah Digital”, Aug. 2, 2022. <http://tinyurl.com/hepvn2fp>

⁸⁴ Cenfri, “The potential of CBDCs for financial inclusion”, Sep. 9, 2022. <http://tinyurl.com/rv7x92hx>

⁸⁵ Alliance for Financial Inclusion, “Central Bank Digital Currency – an opportunity for financial inclusion in developing and emerging economies?”, Sep. 4, 2022. <http://tinyurl.com/y23xdauj>

⁸⁶ See Footnote: Tan, Brandon, “Central Bank Digital Currency and Financial Inclusion”, IMF Working Papers No. 2023/069, Mar. 17, 2023. <http://tinyurl.com/2jb26aut>

utilization. Granular data created by the Digital Rupiah could address these challenges. Granular data could also help to create a database of eligible aid recipients. Additionally, usage of the Digital Rupiah through fintech could also help minimize the time gap for aid recipients, ensuring that aid is received in real-time and in the correct amount. These efforts could help the government reduce distribution costs, bring access points closer to aid recipients, improve the quality of social assistance, and increase recipient coverage.⁸⁷

Furthermore, the Digital Rupiah could be designed for the utilization of funds from said social assistance programs. The CBDC could help address the challenges of enacting those programs through cryptographic technology. Social assistance funds could be tailored by the Digital Rupiah to be exclusively for spending on essential needs such as rice, meat, milk, and the like. Furthermore, these funds could be barred from being used for non-essential needs like cigarettes, sodas, and similar things. This development would make aid supervision easier, and optimization as well as modernization of the G2P program could be achieved.

4.4. Innovation Opportunities in the Financial Sector

In the evolving global context, the implementation of CBDC represents an innovation opportunity in the financial sector. For example, BIS has highlighted the importance of CBDC in significant changes to the financial system, with the private sector playing a major role in introducing it to the market.⁸⁸ Considering these innovation opportunities, a group consisting of seven central banks, namely Bank of Canada, Bank of England, Bank of Japan, European Central Bank, Federal Reserve, Sveriges Riksbank, and Swiss National Bank is collaborating alongside BIS to explore retail CBDC as a CBDC for the general public.⁸⁹

As a digital financial innovation, CBDC has been the focus of many countries, including Indonesia with its Digital Rupiah. It represents a revolutionary step in integrating technology into the financial system.⁹⁰ The Digital Rupiah in specific is targeted to accelerate Indonesia’s national digital economic and financial integration through innovation in the financial sector.

CBDC has the potential to enhance financial inclusion by providing direct access for the public to receive social assistance, make payments, and participate in trading.⁹¹ The use of mobile money accounts to expand financial inclusion in Sub-Saharan Africa has demonstrated CBDC’s adoption to improve the financial well-being of underserved communities. Increased financial inclusion is a common goal for 80% of central banks currently exploring CBDC. Retail CBDC could help those without financial access and underserved populations in two ways, namely by establishing a more inclusive digital payment ecosystem and creating financial data identities.⁹²

There are several significant innovation opportunities in the financial sector due to CBDC in addition to financial inclusion, including transaction efficiency improvement, data insights, financial service customization, monetary and financial stability, security and transparency,

⁸⁷ AFTECH, Demographic Institute FEB UI, and TNP2K G2P, “Modernization of Government to Person (G2) Through Financial Technology (Fintech) Solution in Indonesia”, November 2020, <http://tinyurl.com/ys72y7jb>

⁸⁸ CoinDesk, “CBDCs Are ‘Central’ to Innovating Financial Systems, BIS Chief Says”, Nov. 8, 2023. <http://tinyurl.com/3mc5p76r>

⁸⁹ See Footnote: Bank for International Settlements, “Central bank digital currencies - executive summary”. <http://tinyurl.com/6z223ncb>

⁹⁰ Fintech News Singapore, “Indonesia’s Digital Rupiah Game Plan: Everything You Need to Know”, Dec. 8, 2022.

<http://tinyurl.com/exmvfe6w>

⁹¹ Ripple, “Unlocking Financial Inclusion with CBDCs”, 21 April 2021. <http://tinyurl.com/6cdtxe4>

⁹² Ripple, “Unlocking Financial Inclusion with CBDCs”, Apr. 21, 2021. <http://tinyurl.com/6cdtxe4>

regulatory and ecosystem development, as well as adaptation to new technological and financial product innovations.

4.4.1. Transaction Efficiency through Payment System Improvement

CBDC has the potential to enhance the speed and efficiency of transactions through transformations in the payment system which encompass interbank, cross-border payments, and cross-jurisdiction payments,⁹³ that affect both retail and wholesale financial transactions.⁹⁴ This innovation could aid in synchronizing delivery and payment, resulting in a more efficient and real-time payment system as well as significantly reducing transaction time and costs.⁹⁵ Such efficiency is not only beneficial for the domestic economy but also has broad implications for international trade and remittances. The benefits of this innovation could impact both wholesale and retail transactions, particularly for small-scale transactions.⁹⁶

The impact of improved transaction efficiency due to CBDC could benefit not just domestic transactions, but also cross-border ones. CBDCs can revolutionize cross-border payments by making them faster and more cost-effective. This innovation could be key to promoting diversity in payment options, and it could also significantly benefit international business and trade.⁹⁷ Research in Kenya indicated that the implementation of digital currency impacted the efficiency of transaction costs and remittances by up to 75%.⁹⁸ The remittance cost for Indonesia as of December 2023 reached US\$8.41 based on data from Wise.⁹⁹ Therefore, that cost could potentially be reduced to US\$6.3 with the introduction of CBDC.

4.4.2. Data Insights and Financial Service Adjustments

The implementation of CBDCs could offer valuable insights into consumer behavior and spending patterns. Financial institutions can leverage the data to adjust their services more effectively and adapt to evolving economic trends. The data can also be used by central banks and the private sector to develop suitable financial products or research the reasons for the low usage or uptake of a financial product. In addition to financial product aspects, the data insights can also be beneficial for evidence-based policymaking.

4.4.3. Monetary and Financial Stability

The Bank of England noted that CBDCs could support a more robust payment landscape that ensures fast, efficient, and reliable transactions.¹⁰⁰ That can be highly significant in maintaining monetary and financial stability, as emphasized by the IMF which stressed that the right CBDC design could modernize the payment system and protect central bank money in the digital age.¹⁰¹

⁹³ Warta Ekonomi, “Central Bank Digital Currencies (CBDC) di Asia: Peluang dan Tantangan”, Sep. 25, 2023. <http://tinyurl.com/zdje7r9x>

⁹⁴ See Footnote: Bank for International Settlements, “BIS Innovation Hub work on central bank digital currency”, <http://tinyurl.com/3aps44en>

⁹⁵ Lihat Catatan Kaki: Warta Ekonomi, “Central Bank Digital Currencies (CBDC) di Asia: Peluang dan Tantangan”, 25 September 2023. <http://tinyurl.com/zdje7r9x>

⁹⁶ See Footnote: Warta Ekonomi, “Central Bank Digital Currencies (CBDC) di Asia: Peluang dan Tantangan”, Sep. 25, 2023. <http://tinyurl.com/zdje7r9x>

⁹⁷ [BIS Innovation Hub work on central bank digital currency \(CBDC\)](http://tinyurl.com/4547k7cf)

⁹⁸ Neubert, Michael, “Impact of digital currencies on economic development in Kenya”, 2018. <http://tinyurl.com/4547k7cf>

⁹⁹ Wise.com, “Send money to Indonesia”, December 2023.

¹⁰⁰ Bank of England, “Central Bank Digital Currency: opportunities, challenges and design”, 12 Maret 2020. <http://tinyurl.com/4xkzkvdc>

¹⁰¹ Soderberg, Kiff, Tourpe, et al, “How Should Central Banks Explore Central Bank Digital Currency?”, International Monetary Fund, Sep. 8, 2023. <http://tinyurl.com/3suauv7s>

However, central banks must implement CBDCs carefully. Research by the World Bank on the impact of CBDCs on monetary policy goals and operations showed negative effects on money supply, interest rates, exchange rates, and capital flows.¹⁰² The same research suggested for limiting CBDC ownership and not providing remuneration to CBDCs to reduce disintermediation risks, but those measures are insufficient. Central banks need to ensure that CBDC’s unwanted macroeconomic risks are identified and comprehensively mitigated.

4.4.4. Security and Transparency

CBDCs could offer higher levels of security and transparency compared to conventional currencies with the use of blockchain technology and DLT. They could also strengthen financial system stability through systemic resilience.¹⁰³ In traditional systems, transactions are only recorded in the main ledger held by the PJPs that provide transaction services. Only the PJP owning the ledger can guarantee the accuracy and reliability of those records.

Meanwhile, blockchain technology requires a decentralized digital ledger. Therefore, more than one party, which includes both PJPs and other institutions, will have copies of the ledger. Increased access to the ledger enhances transparency. Additionally, blockchain technology facilitates cross-referencing between the records of each copy of the ledger, thereby ensuring security.

4.4.5. Regulatory Development and Ecosystem

Since blockchain technology and its application in the financial industry are relatively new, the introduction of CBDCs should be accompanied by new regulatory frameworks and standards to promote a more transparent and compliant financial environment. On the other hand, the development of new regulations also needs to encourage the growth of new fintech ecosystems and promote collaboration between banks, non-bank financial service providers, and technology firms. In the context of Indonesia, BI’s technical design and regulatory development framework for the Digital Rupiah will be explained in more detail in Chapter 5. Meanwhile, regulatory considerations in the context of blockchain technology will be explained in Chapter 6.

4.4.6. Adaptation to New Technology and Financial Products

The implementation of CBDCs could allow integration with the latest technologies, such as blockchain and smart contracts. Therefore, the programming capability of CBDCs opens up opportunities to create smart contracts and other automated financial arrangements. This capability can lead to the development of new financial products and services that are more efficient, secure, and adjusted to individual needs.

Central banks must ensure that CBDCs are designed for interoperability,¹⁰⁴ both domestically and internationally, to maximize their potential.¹⁰⁵ Well-designed CBDCs have the potential to create

¹⁰² [Monetary Policy Implications of Central Bank Digital Currencies: Perspectives on Jurisdictions with Conventional and Islamic Banking Systems \(imf.org\)](https://www.imf.org/en/Publications/WP/Issues/2022/07/27/monetary-policy-implications-of-central-bank-digital-currencies-perspectives-on-jurisdictions-with-conventional-and-islamic-banking-systems-50909)

¹⁰³ See Footnote: Warta Ekonomi, “Central Bank Digital Currencies (CBDC) di Asia: Peluang dan Tantangan”, Sep. 25, 2023. <http://tinyurl.com/zdje7r9x>

¹⁰⁴ Emanuella, Claudia Saymindo, “Central Bank Digital Currency (CBDC) Sebagai Alat Pembayaran Di Indonesia”, *Jurist-Diction* 4, no. 6, Hal. 2243–2276, 5 November 2021. <https://e-journal.unair.ac.id/JD/article/view/31845>

¹⁰⁵ Ibid.

better national and regional payment infrastructure, improve access to global markets, and enhance financial inclusion for unbanked and underserved populations worldwide.¹⁰⁶

Although CBDCs offer many benefits, their enactment also faces various challenges, such as the need for a strong legal framework, cybersecurity issues, and risks related to privacy and economic stability. Therefore, successful implementation of CBDCs requires careful planning, a robust legal framework, and readiness to address security and economic stability challenges. Indonesia, along with other countries, can adopt this technology by learning from its application in other countries.

¹⁰⁶ See Footnote: Emanuella, Claudia Saymindo, “Central Bank Digital Currency (CBDC) Sebagai Alat Pembayaran Di Indonesia”, *Jurist-Diction* 4, no. 6, Pg. 2243–2276, Nov. 5, 2021. <https://e-journal.unair.ac.id/JD/article/view/31845>

5

Technical Design and Infrastructure

In addition to strengthening currency sovereignty, CBDC, in general, also offers various benefits such as improving financial access for the public, transaction efficiency, payment system resilience and mitigating the risks of illegal transactions. These benefits underlie the deepening research on CBDC, both by BI and other central banks.

On the other hand, the implementation of CBDC is not without challenges, both according to academic studies and the results of several limited trials. One crucial aspect of CBDC implementation, especially during the transition period, is to maintain parity in the degree of separation between the Central Bank and consumers, to ensure the effectiveness of monetary policies and mitigate disruptions to stakeholders.

5.1. Distribution of wholesale and retail

From the findings of BI outlined in the Project Garuda White Paper, Digital Rupiah will have a system divided into two tiers, namely wholesale (w-Rupiah) and retail (r-Rupiah). The wholesale ecosystem will consist of interbank transactions, money market transactions, or transactions with Bank Indonesia. The retail ecosystem will consist of transactions between payment service providers (PJPs) from both banks and non-banks and consumers.

Blockchain and DLT infrastructure will only be used in the wholesale ecosystem, while the retail ecosystem will continue to use a centralized system based on the databases of each PJP. This design is intended to address various concerns from the public, consumers, and the industry.

The advantages offered by blockchain and DLT, especially network security through cryptography and database compliance assurance through DLT, are more needed by banking services and money market players. Furthermore, one of the goals of CBDC adoption is to facilitate more effective cross-border transactions. The achievement of this goal through CBDC will necessitate the use of uniform DLT protocols, even between two different countries. Of course, this implies that Digital Rupiah, at least at the w-Rupiah level, will need to utilize DLT.

For the retail segment, the urgency to adopt CBDC or blockchain infrastructure is a lot lower than in the wholesale segment. However, retail market participants can still benefit from the security and guarantees provided by blockchain infrastructure. For example, non-bank PJPs that focus on the retail segment generally keep their accounts within commercial banks. If their commercial banks are integrated into the Digital Rupiah wholesale ecosystem, the databases of these PJPs will be secured by each validator node in the wholesale ecosystem.

In theory, such implementations will provide Fintech players access to the security of blockchain infrastructure without incurring costs or other burdens from participating in DLT. Moreover, Fintech players will be able to continue their activities without interference so that Bank Indonesia may fulfill the do no harm principle from the CBDCs implementation process. Beyond that, Bank Indonesia's do no harm policy principles, in the implementation of CBDC, also encompass collaboration and synergy with the fintech industry, both in efforts to mitigate systemic risks and enhance public familiarity with fintech services.

5.2. Permissioned DLT Infrastructure

The two tiers of the Digital Rupiah, w-Rupiah and r-Rupiah will use different bases that go through different infrastructures. Digital Rupiah wholesale (w-Rupiah) will utilize Distributed Ledger Technology (DLT) features enabled by blockchain technology. However, w-Digital rupiah will use a permissioned DLT, not the DLT commonly used in cryptocurrencies like Bitcoin. Permissioned DLT provides features similar to DLT, namely security and transaction certainty through cryptographic technology and decentralized databases.

The main difference with Permissioned-DLT lies in the process of validator selection and approval of node creation for participants in the network. In general, each node can be considered as an entity conducting transactions within the blockchain network. When compared to regular DLT (permissionless) which emphasizes decentralization, Permissioned-DLT requires an approval process and restricts access to transactions, so not everyone can conduct transactions remotely without using financial institutions as intermediaries. This is necessary so that BI can fulfill its role as a regulator of the financial industry and central bank. Therefore, w-Digital rupiah cannot be fully decentralized.

Some of the advantages of Permissioned-DLT in the design of CBDC are as follows:

- **Resilience ranking:** A decentralized system distributes processing and data storage across multiple nodes, making it more resilient to system failure or cyber-attacks. In Permissioned DLT, the involved parties in the network have been preapproved, ensuring that only trusted entities can participate in the consensus process. This enhances the overall security and resilience of the system, making it more advanced compared to centralized systems that rely on a single point of control.
- **Enhanced Security and Transparency:** Permissioned-DLT systems provide robust cryptographic measures to secure transactions and data integrity. Each transaction is recorded transparently and cannot be altered, creating an audit trail that enhances transparency and accountability.
- **Reduced Risk Counterparty:** A centralized system relies on the central authority to manage transactions and record data. This poses a counterparty risk, as participants must trust the central authority to act in their best interests and maintain accurate records. In decentralized systems using Permissioned DLT, trust is distributed to all parties in the network that collectively validate and maintain the system. This reduces counterparty risk and enhances overall trust in the system.
- **Higher efficiency and speed:** By eliminating intermediaries and reducing the need for manual reconciliation, decentralized systems using permissioned DLT can enhance transaction efficiency and speed. The use of smart contracts in DLT systems allows for the automatic execution of predefined rules, streamlining processes, and reducing the time required for transaction settlement.
- **Flexibility and Innovation:** Decentralized systems based on permissioned DLT provide a flexible platform that allows for innovation and adjustments. BI can establish its own rules and policies within the system, enabling it to adapt to changing regulatory requirements and implement innovative features more easily compared to rigid centralized systems.

5.2.1. Use of Proof of Authority (PoA) in Permissioned DLT

In Permissioned-DLT systems, Proof of Authority (PoA) is used as a consensus mechanism to achieve agreement on ledger status, validator appointment, and authorization of new members. PoA is designed according to the needs of Permissioned-DLT networks where participant identities are known, and certain parties have the authority to validate and add new blocks to the blockchain. Therefore, PoA is commonly used in permissioned DLT networks for organizations, official institutions, or individuals with specific roles.

One of the main differences between PoA and Proof of Work (PoW) is the absence of a process involving complex puzzles or mining. In PoW, the mining process is required to assess the computer's capability in validating and completing blocks or transactions within the network. With this process, cryptocurrency networks like Bitcoin can have a large number of validators without sacrificing the principle of decentralization.

On the other hand, PoA and Permissioned-DLT systems also have an impact on network scalability. In PoW systems, network expansion tends to be relatively easy for two reasons. First, the mining process and the appointment of new validator nodes can be done anonymously, leading to a large number of validators in the PoW DLT network. The second reason is the existence of incentives to participate in block validation, where each validation is followed by the creation of tokens for the validator.

Incentives for token creation are sometimes also used in some types of cryptocurrencies with PoA systems. However, this would be challenging to implement in digital w-Rupiah because the creation of each Rupiah token requires authorization from Bank Indonesia.

Scalability issues in the PoA consensus system also impact network resilience. With a significantly smaller number of validators compared to the PoW consensus system, the risk of cyber-attacks on the w-Rupiah network becomes greater. The failure of one validator in the PoA system is equivalent to the failure of hundreds or even thousands of validators in the PoW system.

Therefore, the design of Digital w-Rupiah still requires a security system to protect against cyber-attacks commonly used in conventional digital networks. For example, network failures can be addressed by storing savings account data offline (cold wallet). Additionally, data can also be stored through cloud services. This can enhance the resilience of the w-Digital rupiah network but also involves costs as it requires third-party cloud providers in the w-Rupiah ecosystem.

6

Policy Framework: Law, Regulation, and Compliance

The Bank Indonesia's policy to launch Digital Rupiah as a digital currency will bring significant changes to Indonesia's monetary and financial system. It will not only influence the way payment transactions are conducted but also alter the dynamics of the entire Fintech industry. Comprehensive and adaptive regulations become crucial to accommodate innovation while ensuring stability, efficiency, and security in the use of Digital Rupiah. This section will discuss the regulatory framework and policies that need to be implemented to support the issuance and use of Digital Rupiah in Indonesia moving forward.

6.1. Monetary and Macprudential Policies

Along with BI's duties as the main authority of Indonesia's financial policy, Digital rupiah will have a role as one of BI's monetary and macroprudential instruments. To be able to integrate Digital rupiah, it will require adjustments to several laws that are already in effect as well as the issuance of a few new regulations.

6.1.1. Monetary Regulation and Payment System

Law No. 7 of 2011 concerning Currency stipulates that Bank Indonesia (BI) is the sole authority to issue currency in Indonesia. On the other hand, this law also determines the characteristics of the Rupiah that can be used as legal tender. Until now, the Rupiah has consisted of coins and banknotes. Even the Rupiah used in digital transactions in Indonesia is still meant to represent physical banknotes.

Afterwards, Law No. 4 of 2023 concerning the Development and Strengthening of the Financial Sector (UU P2SK) has become the legal basis to accommodate the development and implementation of Digital Rupiah in Indonesia. In Article 2 Paragraph 2, it is stated that Digital Rupiah has the same functions as paper and metal Rupiah, serving as a legitimate means of payment within the territory of the Unitary State of the Republic of Indonesia, a medium of exchange, and a store of value.

UU P2SK is a regulation designed to address the need for regulatory improvements to keep up with the developments in the economic and financial technology sectors. UU P2SK is an omnibus law intended to harmonize various financial regulations, including those related to the Fintech sector or innovations in the financial technology sector (ITSK). The implementation of CBDC, such as the planned Digital Rupiah by Bank Indonesia, requires regulations that align this new technology with the existing monetary system.

Moreover, UU P2SK also serves as the regulation currently underpinning the roles of financial sector supervisory institutions in Indonesia. With the introduction of Digital Rupiah, which will revolutionize Indonesia's digital payment system, UU P2SK has also clarified that the Digital Rupiah is fully under the monetary authority of BI.

6.1.2. Equitable Anti-Money Laundering and Counter-Terrorism Financing (AML-CFT) Regulations

The discourse on the adoption of Central Bank Digital Currency (CBDC) among the responsible institutions has been primarily discussing the features offered by CBDC in comparison to cash-based digital transactions. One of the most prominent features is traceability, which has the potential to reduce the illicit use of money. The common implementation of this feature is for Anti-

Money Laundering and Counter-Terrorism Financing (AML-CTF) measures. The significance of these mechanisms is outlined in Law No. 8 of 2010 concerning the Prevention and Eradication of Money Laundering Crimes and Law No. 9 of 2013 concerning the Prevention and Eradication of Terrorism Financing Crimes. These regulations ensure that Digital Rupiah transactions can be traced and monitored to prevent illegal activities. However, it is crucial to ensure that the implementation of AML/CTF does not result in excessive surveillance of the general public and does not hinder business growth.

Therefore, BI also proposes the use of Privacy Enhanced Technology (PET) and the implementation of tiering and capping mechanisms as alternative approaches to help maintain a balance between privacy protection and proportional implementation of AML-CTF in the application of Digital Rupiah.

PET is a technology designed to enhance user privacy while still allowing sufficient transparency for financial supervisory authorities. It may involve cryptographic techniques that enable transaction anonymity without sacrificing the ability to detect suspicious activities. Examples of PET usage in Digital Rupiah include implementing techniques such as "zero-knowledge proofs" or "confidential transactions," where transaction amounts are replaced with variables that only verify whether the user has a sufficient balance or not.

From the consumer's perspective, PET mechanisms are entirely in the hands of the administrators and it is challenging to obtain assurance about the quality of the PET protocols. Therefore, tiering mechanisms are also provided to consumers as an alternative that gives them the freedom to choose the amount of personal data they feel comfortable providing to financial institutions. This means that consumers need to provide personal data as collateral, such as ID cards and Tax Identification Numbers (NPWP), to carry out significant transactions because there is a limit (capped). Conversely, consumers may not need to provide any personal data at all for small transactions.

6.2. Money market policies

CBDC, as a digital exchange tool with a blockchain-based infrastructure, is being developed as a prospective solution to facilitate faster cross-border payments. This is evident in multilateral CBDC studies that existed before Digital Rupiah, such as Project Dunbar, Project mBridge, and Project Jura. Digital Rupiah is, of course, technologically developed with the capability to integrate with these cross-border blockchain protocols.

On the other hand, opening access to the global financial market like this requires a robust regulatory framework from BI and OJK. Without adequate regulations for the Digital Rupiah that align with global standards, Digital Rupiah risks being unable to participate in multilateral CBDC protocols.

At the same time, regulations for Digital Rupiah must also continue to encourage innovation without disrupting businesses in financial services, such as e-wallets and payment gateways. Historically, the Fintech industry has played a crucial role in enhancing consumer participation in financial markets and cross-border transactions. In theory, CBDC will enhance direct access from BI and banks to the financial market, so the goals of BI and OJK policies should ideally maintain the fintech sector's role in Indonesia's financial supply chain.

6.2.1. Exchange rate and liquidity management policies

With the emergence of Digital Rupiah and other CBDCs as currencies more easily traded with foreign currencies, BI will need to adjust its foreign exchange market policies to better align with lower administrative costs and subsequently lower barriers to entry. On the other hand, the increased speed of access to the foreign exchange market will significantly boost the demand for liquidity in the form of foreign exchange.

At the time of writing this Outlook, BI has recently issued the BI Foreign Securities (SVBI) and BI Foreign Sukuk (SUVBI) monetary instruments in October 2023 to provide foreign exchange liquidity to the financial sector. This was done as the banking foreign exchange reserves declined during the Q3 2023 period. As long as BI's foreign exchange reserves remain adequate, such policies will be necessary during the adoption period of Digital Rupiah. Of course, regulations need to ensure that Bank Indonesia's open market operations are not disrupted and that BI can continue to use existing instruments to control liquidity in the monetary system.

Additionally, the transition period for Digital Rupiah or CBDCs in other countries will increase the number of foreign assets that need to be managed, including both digital and physical currencies, in both Rupiah and foreign currencies. All of these factors represent some of the risks that may arise from the adoption of Digital Rupiah, requiring adjustments to BI's risk control policies and financial stability measures.

6.2.2. Participation policies based on liquidity management

The Digital Rupiah's potential to deepen the financial market can be leveraged by every participant in Indonesia's digital economy through the overall decrease in the cost of credit. This benefit will become more pronounced as financial institutions become more integrated with the multilateral CBDC infrastructure. In other words, Digital Rupiah participants with validator nodes will have unparalleled access to the global money market, even compared to other participants in the Digital Rupiah ecosystem.

With this, the question arises of who is eligible to become a validating node or even a non-validating node in the Digital Rupiah wholesale system. The final criteria for determining wholesale ecosystem participants are still being developed by BI. Although the potential benefits of the validator role are significant, the burdens to be borne by validators are also substantial. Some of the validator burdens include technological capacity to manage the validation process of the decentralized financial system, such as processing power and data retention capacity, adequate Digital Rupiah reserve ratios to ensure settlement finality and ledger adjustments, and substantial investments in both technology design and financing to guarantee the scalability of the w-Rupiah network.

Participants able to meet all these criteria still need approval from BI to be appointed as validating nodes. Currently, one of the criteria under consideration by BI is how important access to the money market is to the business of a prospective validator. This criterion is also being considered for non-validating nodes participating in the wholesale ecosystem.

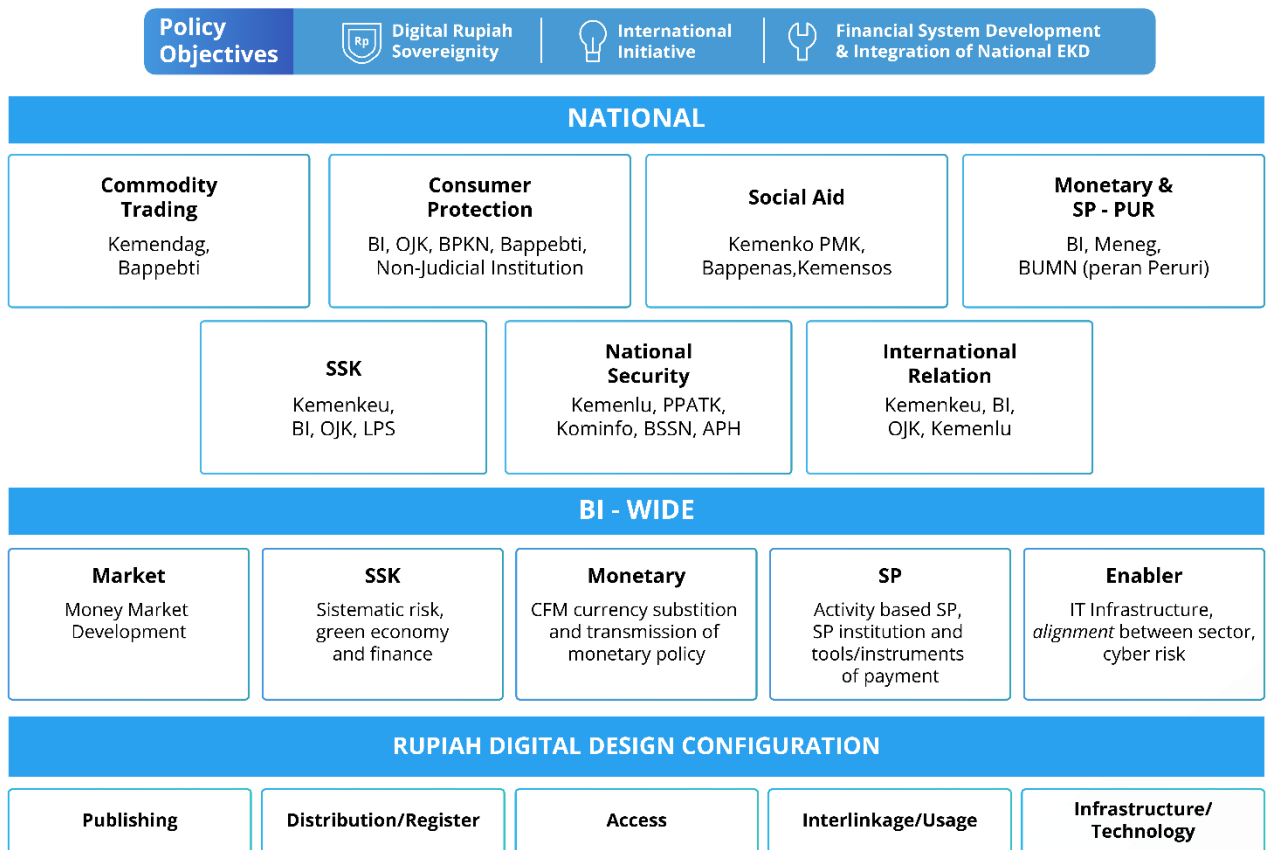
The appointment of inappropriate validators could risk damaging the entire network. Validators play a crucial role in a blockchain network as every transaction needs to be processed by each

validator. Given this risk, the validator selection process must also be accompanied by adequate support from BI and other regulatory authorities to mitigate all risks.

6.3. Supervisory framework and financial authority of the Digital Rupiah

Synergy and coordination among regulatory and supervisory institutions are key elements in the successful implementation of the Digital Rupiah in Indonesia. Collaboration between BI, OJK, BSSN, and Bappebti should be directed toward creating a robust and flexible framework to support innovation and growth while ensuring security, stability, and public trust.

Figure 5. Digital rupiah Supervisory Framework



Source: Garuda Project White Paper

Part of the framework for Digital Rupiah supervision has been outlined in the White Paper for Project Garuda. Monetary aspects will be under BI’s supervision, but BI will coordinate with OJK for aspects related to stability in the financial sector. BSSN will act more as a cybersecurity consultant and auditor, providing training programs to ensure BI’s capability to manage cybersecurity, and will also collaborate with BI in developing the framework and protocols for Digital Rupiah’s cybersecurity. Additionally, the deposit and inventory of financial assets that have been tokenized with Digital Rupiah will be managed by Bappebti and OJK in accordance with policy adjustments specified in the P2SK law.

Thus, there needs to be regulation that facilitates coordination and communication between BI, OJK, and BSSN to ensure integrated supervision of Digital Rupiah and services from the Fintech industry.

Given the inherent cyber risks in digital operations, especially at the level of personal data protection frameworks, BI, OJK, and BSSN also need to collaborate in designing consumer protection rules for Digital Rupiah users. These regulations should also be accompanied by public education on the use and benefits of Digital Rupiah, considering that security risks often occur at the consumer level due to human error.

6.3.1. Wholesale and Retail Monitoring System

Digital Rupiah introduces several new issues that do not arise in physical Rupiah transactions. Firstly, Digital Rupiah is divided into two levels: wholesale (w-Rupiah) and retail (r-Rupiah). These two levels of Digital Rupiah also have different infrastructures, with w-Rupiah using DLT-based infrastructure and r-Rupiah using centralized infrastructure.

On one hand, these differences also simplify the monetary policy organizational aspect for BI and OJK because w-Rupiah can practically be considered a representation of transactions in the money market, while r-Rupiah represents transactions in the real market. On the other hand, these differences potentially disrupt BI's monetary policy transmission.

At the time of writing this Outlook, there is still no technical explanation regarding the conversion process from w-Rupiah to r-Rupiah. Given that this conversion involves migrating between two systems with different infrastructures, this conversion will undoubtedly be associated with an administrative burden. Will the conversion between w-Rupiah and r-Rupiah be ensured at a 1:1 ratio? If so, which party will bear the burden of this conversion?

Considering BI's commitment to maintaining the do-no-harm policy principle, the fintech industry, especially non-bank Payment Service Providers (PJP), will act as the front end of Digital Rupiah or the convergence point between w-Rupiah and r-Rupiah. Non-bank PJP has so far borne the burden of storing financial data that should not be imposed on consumers. Additionally, non-bank PJPs also bear the burden of renting virtual accounts and settlement services from commercial banks without tax exemptions enjoyed by banking institutions. With the implementation of the Digital Rupiah, will the Fintech industry bear the burden of conversion between w-Rupiah and r-Rupiah? Can this burden be imposed on consumers?

Considering all the new issues arising from the implementation of Digital Rupiah with these infrastructure differences, a flexible legal framework needs to be developed. BI is expected to establish a controlled environment (regulatory sandbox) at each future stage, from the wholesale trial phase to the retail trial phase.

The background features a blue gradient with faint, semi-transparent financial charts. On the right side, there is a candlestick chart with several vertical bars. On the left side, there are several thin, curved lines representing a line graph or trend lines.

7

Economic and Monetary Implications

This chapter will attempt to outline the broad implications of Digital Rupiah in a concise manner. The implications can broadly be divided into three categories: implications for the monetary system, implications for traditional banking and financial institutions, and implications for its role in future global trade and cross-border transactions.

7.1. Monetary Policy Implications

A key principle that should be at the forefront of BI's strategy for introducing the Digital Rupiah is to ensure it does not disturb Indonesia's monetary stability and financial system, which is part of BI's own do no harm policy. Therefore, the issuance of Digital Rupiah must not compromise the monetary policy objectives of a country. BI's role in maintaining monetary stability, payment systems, as well as prices and exchange rates cannot be compromised during the adoption process of the Digital Rupiah in any design or form. Identification and concrete mitigation steps related to the opportunities and challenges of the Digital Rupiah need to be taken to maintain monetary stability and support economic growth.

To briefly recap, the white paper from BI, it is explained how the initiative to issue Digital Rupiah aims to reduce potential risks arising from rapid digitization, especially the risk of defection through mass crypto adoption. This would cause digital disruption, and trigger the creation of shadow banking and shadow currency. The clarification in the P2SK Law that categorizes crypto assets as commodities, not as means of payment, has already minimized the potential risk of shadow currency that could disrupt monetary stability; however, the added competitive value of the Digital Rupiah hopes to remove that risk completely.

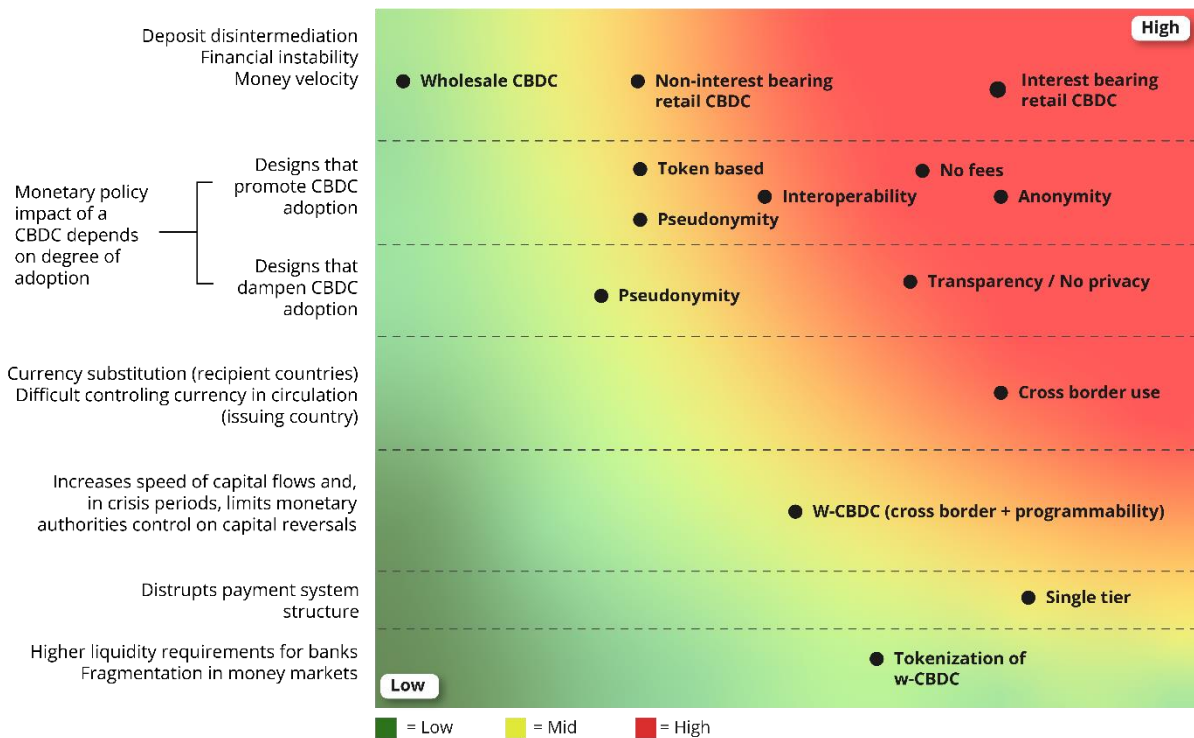
Nonetheless, the impact on monetary stability and the financial system will heavily depend on the chosen design of Digital Rupiah. For example, interest-bearing r-Digital Rupiah and its use for cross-border transactions pose higher monetary risks compared to non-interest-bearing w-Digital Rupiah or r-Digital Rupiah without interest. Transaction limitations can also reduce monetary stability risks, although they may decrease the value of CBDC for adoption.

Following the do no harm policy, BI decided that Digital Rupiah can only be accessed from BI through the conversion of Giro accounts held by financial institutions in the BI-RTGS. This means that the amount of money in circulation will not be altered. Theoretically, this removes the monetary risk associated with the issuance of Digital Rupiah.

Additionally, BI plans to implement non-interest bearing and transaction limits to minimize any other potential monetary risks from Digital Rupiah. The impact on monetary stability will only be visible in the increased speed of currency circulation. However, in the early stages, the implications for circulation speed are not apparent due to the adjustment period needed for wider public adoption. Eventually, the ease and speed of Digital Rupiah transactions can enhance the circulation speed of the currency.¹⁰⁷ However, the development of Supervisory Technology (Suptech) utilizing technology and supported by real-time transaction data will be able to mitigate risks that materialize through acceleration.

¹⁰⁷ Jiemeng Yang and Guangyou Zhou, "A Study on the Influence Mechanism of CBDC on Monetary Policy: An Analysis Based on e-CNY", *PLoS One* Vol. 17 (7), (2022), <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9269387/>

Figure 6. Monetary Implications of CBDC Based on Risks



Source: Inutu Lokonga (2023)

Meanwhile, in the distribution process to end-consumers, the conversion of Digital Rupiah needs to offer the widest range of options so that the conversion can be carried out in various ways, starting from the conversion of physical money to savings, and electronic money. These options will facilitate the integration and broader adoption of the Digital Rupiah because the public has already become accustomed to the existing payment systems. Additionally, these various distribution options do not increase monetary risks, as they only convert existing liabilities in financial institutions without altering the amount of money in circulation.

7.2. Impact on Traditional Banking and Financial Institutions

After examining its implications for financial institutions, the issuance of Digital Rupiah undoubtedly holds significant potential benefits. One potential benefit is the increased efficiency it can generate, such as real-time settlement and immediate finality, which would enhance efficiency among inter-bank payments and other financial intermediaries. Additionally, efficiency is achieved through extended operational hours through autonomous operations, thus lowering human intervention. In this regard, Digital Rupiah has the potential to boost transactions between intermediaries, shorten settlement cycles, and reduce the risk of human errors in transactions. On the other hand, Digital Rupiah can also facilitate innovation by leveraging DLT and smart contracts, particularly in the issuance of securities and token settlement for financial assets. Consequently, Digital Rupiah would enhance the profitability of both banking and non-banking financial institutions, as well as open the door for financial product or service innovations to the wider public.

On the other hand, there are some risks that BI would need to consider in the implications of Digital Rupiah design on financial institutions. As previously explained, w-Digital Rupiah is

expected to have lower risks compared to r-Digital Rupiah. Nevertheless, under certain conditions, w-Digital Rupiah still has the potential to create fragmentation in the structure of the interbank market. This could occur if the integration between the w-Digital Rupiah market and the conversion system from physical Rupiah to Digital Rupiah within the existing payment ecosystem is not up to sufficient levels. This segmentation may potentially reduce the efficiency benefits brought by the w-Digital Rupiah or even limit the effectiveness of BI's monetary policy interventions. Furthermore, fragmentation will increase the need for higher liquidity in both markets.¹⁰⁸ Therefore, the principle of interoperability needs to be emphasized in the synergy between the w-Digital Rupiah initiative and the existing payment system.

Meanwhile, higher risks to monetary stability and the payment system will become more apparent when the Digital Rupiah initiative enters the retail market. Hence, the identification of potential emerging risks is necessary, especially before the r-Digital Rupiah is implemented in subsequent phases as part of the Bank Indonesia Digital Rupiah roadmap.

In general, the risks of CBDC adoption in the monetary and payment systems are influenced by two main factors: the "value" of the CBDC design and the level of digital adoption in a country. The value here can be interpreted in several ways, such as having interest, high liquidity, or new technological features.

In the case of the Digital Rupiah, which is non-interest bearing by design, the demand for it would be relatively lower, stable, and predictable. Thus, the effects will be easier to mitigate. In contrast, CBDC with high liquidity in other countries or new expansive technological features also carries the risk of substituting existing payment systems.

On the other hand, the impact of CBDC will be higher in countries with lower levels of digitization. This is because there are greater opportunities for penetration and adoption of CBDC-based payment systems. Indonesia's financial inclusion index, which reached 85% in 2022, indicates a greater potential for penetration from the Digital Rupiah. Historically, this factor can also be seen in the money velocity of M1 in the United States since 1960, correlating with payment system product innovations. A similar situation occurred in China, where money velocity sharply increased after the introduction of mobile-based payments.¹⁰⁹

Meanwhile, the potential impact of the issuance of Digital Rupiah on financial institutions can be seen through at least two main channels: when there is a substitution between Digital Rupiah and physical money and when there is a substitution between Digital Rupiah and deposits.¹¹⁰

During the substitution between Digital Rupiah and physical money, cash, transactions between users will become faster. The speed and instability of money flow can affect the relationship between money, inflation, and Gross Domestic Product (GDP). Hence, additional monetary and supervisory policy instruments are needed to control inflation.

¹⁰⁸ Inutu Lukonga, "Monetary Policy Implications of Central Bank Digital Currencies: Perspectives on Jurisdictions with Conventional and Islamic Banking" *IMF Working Papers No.2023/060*, (2023), <https://www.imf.org/en/Publications/WP/Issues/2023/03/17/Monetary-Policy-Implications-Central-Bank-Digital-Currencies-Perspectives-on-Jurisdictions-531074>

¹⁰⁹ Inutu Lukonga, 2023

¹¹⁰ Inutu Lukonga, 2023

On the other hand, substitution between Digital Rupiah and deposits will weaken monetary policy interventions through credit channels and interest rates. **Table 1** below illustrates the financial balance between individuals, financial institutions, and the Central Bank when adopting r-CBDC. The design of the Digital Rupiah that applies competitive interest with deposit interest will increase the risk of this substitution. As a result, the value of deposits in the liability balance of financial institutions will decrease, as seen in **Table 1**. **Graph 3** below shows the projected demand for deposits after the launch of Digital Yuan, which is China's CBDC product. It is evident that after the launch of Digital Yuan (t0), the demand for deposits will decrease, although this decrease will stabilize after some time.

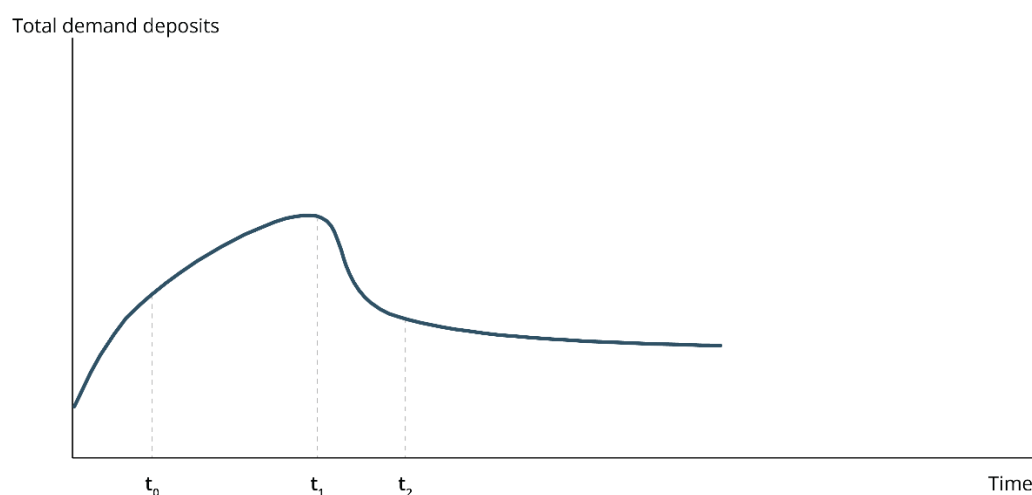
Table 1. Balance Sheets in a retail CBDC ecosystem

Household Balance Sheet		Commercial Bank Balance Sheet		Central Bank Balance Sheet	
Assets	Liabilities	Assets	Liabilities	Assets	Liabilities
Deposits -100 local currency deposit	Other	Loans	Deposits -100 local currency deposit	CB Operations	CB Reserve Account -100 local currency
CBDC +100 Digital cash		CB Reserve Account -100 local currency	CB loans	Other	CBDC +100 Digital cash
Cash		Other	Capital		Cash
Balance of Operations 0 local currency	Balance of Operations 0 local currency	Balance of Operations -100 local currency	Balance of Operations -100 local currency	Balance of Operations 0 local currency	Balance of Operations 0 local currency

■ Decrease ■ Increase ■ Account name

Source: Inutu Lukonga (2023)

When a substitution occurs rapidly, limited liquidity and potential insolvency will be the next risks for financial institutions. This can trigger market segmentation where healthy intermediaries prefer not to provide liquidity to unhealthy intermediaries. To prevent a drop in deposit demand, financial institutions will raise deposit interest rates, which will ultimately increase the cost of credit.

Graph 3. The potential implications of CBDC on deposit demand

This substitution also has the potential to occur not only with bank deposits but also with electronic money in the fintech industry. Although Digital Rupiah will not bear interest, the potential for substitution still exists due to the latest features provided by Digital Rupiah. Thus, the value of electronic money, which is a liability/obligation of the fintech industry, will decrease because Digital Rupiah constitutes a liability/obligation of BI.

Several policies need to be prepared to mitigate these risks. Policies to increase minimum reserves to reduce the risk of deposit outflows can be an option. However, this will impact the further depletion of long-term loan availability in the market. Additionally, innovation from the fintech industry needs to be encouraged through participation and utilization of features within the Digital Rupiah ecosystem. Thus, the risk of disintermediation in financial institutions can be mitigated.

In addition to the potential impact on the balance sheet and disintermediation in the interbank market, the adoption of Digital Rupiah also has the potential to impact digital assets. Naturally, the impact of this price will depend significantly on the advanced policies that Bank Indonesia will implement. Through the affirmation in the P2SK Law regarding crypto assets as commodities and Digital Rupiah becoming a means of payment, Digital Rupiah and crypto assets will complement each other, instead of substituting one another. Therefore, in conditions of interoperability and synergy achieved between Rupiah and other digital assets, Digital Rupiah can help open up space and access for the public to these digital assets and potentially increase demand for digital assets.

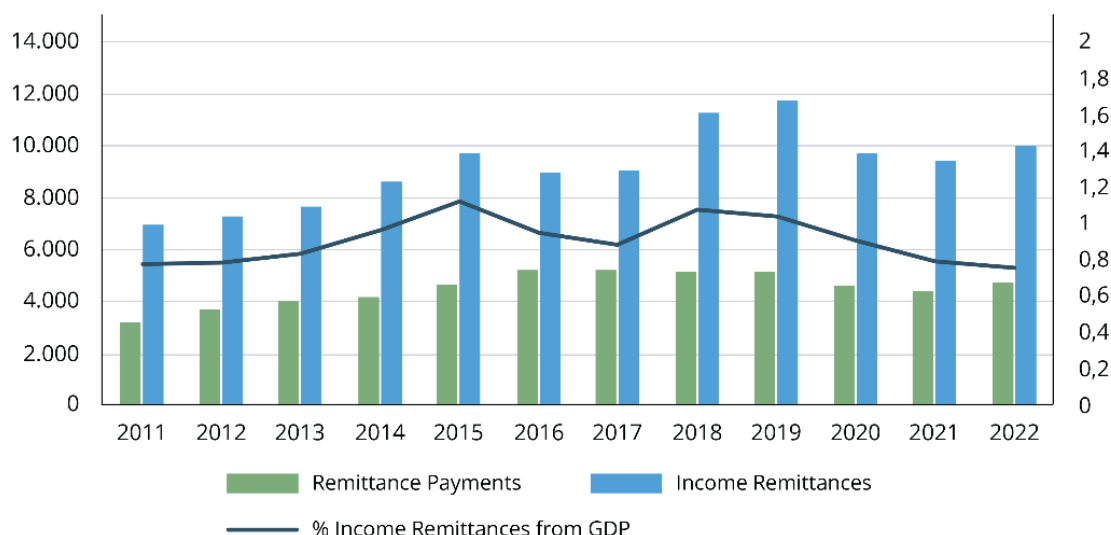
7.3. Role in Global Trade and Cross-Border Transactions

Another implication of the implementation of Digital Rupiah is its impact on cross-border transactions. Digital Rupiah will facilitate cross-border transactions, making personal transfers, such as remittances, even more convenient. In addition to the convenience, Digital Rupiah can reduce intermediaries' costs, which have been substantial and significant for those conducting personal transfers, especially for smaller amounts. Therefore, the adoption of Digital Rupiah for cross-border transactions can increase transaction volume and revenue in the secondary income balance.

The remittance receipts in Indonesia have been steadily increasing over the past decade, despite showing a nominal decrease since the COVID-19 pandemic. Moreover, personal transfers in the

form of remittances from Indonesian migrant workers have significantly contributed to Indonesia's Gross Domestic Product (GDP), even exceeding 1% of Indonesia's GDP in recent years. The large number of migrant workers abroad, reaching 3.5 million people, presents a significant opportunity for Indonesia to continue increasing income and improving the balance of payments surplus through the utilization of Digital Rupiah.

Figure 7. Income and Payment of Remittance Transfers (in million US\$)



Source: World Bank (2023)

Nevertheless, the Digital Rupiah also carries risks in the context of exchange rate volatility and the risk of capital outflow. These risks may arise when access to CBDC products from abroad becomes easier, leading to faster substitution between Digital Rupiah and CBDC products in other countries. Furthermore, these risks persist even without the issuance of Digital Rupiah by BI. Therefore, aspects of collaboration with other central banks need to be prioritized, both in bilateral and multilateral forms, to mitigate the potential occurrence of these risks while adhering to the policy principle of not disrupting monetary stability and the financial system as part of the do no harm policy.

8

Socio-cultural Considerations and Impacts

The previous chapter discussed the macroeconomic implications of Digital Rupiah and only briefly touched upon the implications for Indonesian society. Therefore, this chapter will specifically focus on the social impact of Digital Rupiah, considering Indonesia’s demographic characteristics and how these characteristics influence the aforementioned impact.

On the other hand, the implementation period of Digital Rupiah will also provide an opportunity for education, which will enable the promotion of financial literacy among the public. This chapter will also discuss this opportunity.

8.1. Addressing the Needs of Diverse Demographics

One of the underlying principles in formulating the Digital Rupiah is how to maximize its potential to drive financial inclusion. However, this effort is not without challenges as it requires mapping the characteristics of Indonesian society along with respective challenges based on demographic and geographical characteristics.

Certainly, the efforts and programs implemented by BI, OJK, and the Government to enhance financial inclusion have been commendable. The level of financial inclusion, which stood at 59.74% in 2013, has been successfully increased to 85.1% in 2022. Innovations in digital financial services have played a significant role in this increased level of inclusion. However, there are still aspects that need to be optimized for better access to financial services.

The first aspect is the uneven access to financial services in Indonesia. Looking at the chart below, it is evident that there is still a disparity in the level of financial inclusion between regions. As shown in **Table 2**, while DKI Jakarta and North Sumatra have inclusion rates at 96.6% and 95.58%, respectively, only 70.39% of the population in West Sulawesi and 74.81% in Lampung have access to formal financial service products.

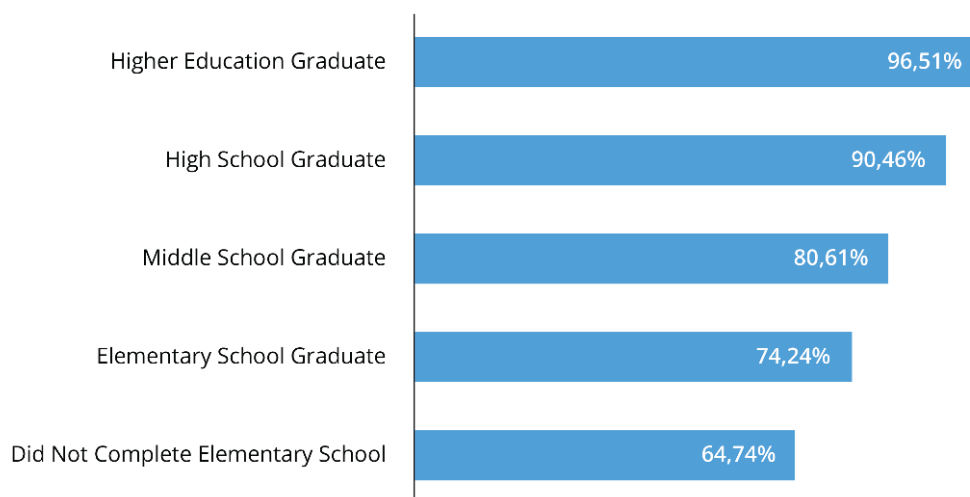
Table 2. Provinces with the Highest and Lowest Financial Inclusion Index in Indonesia

Three Provinces with the Highest Inclusion Index in Indonesia	Three Provinces with the Lowest Inclusion Index in Indonesia
DKI Jakarta (96.62%)	West Sulawesi (70.39%)
North Sumatra (95.58%)	Lampung (74.8%)
East Kalimantan (93.25%)	Papua (76.36%)

Source: OJK (2022)

Meanwhile, disparities can also be observed in access to financial service products based on the education level of the population. As can be seen in **Graph 3**, Roughly 96.5% of individuals with a higher education background have access to formal financial products/services. In contrast, only 64.74% of individuals with no schooling/who haven't completed primary school have access to formal financial products/services. This figure is even lower than the region with the lowest inclusion rate in **Table 2**, which is West Sulawesi (70.39%).

Graph 4. Financial Inclusion index based on education



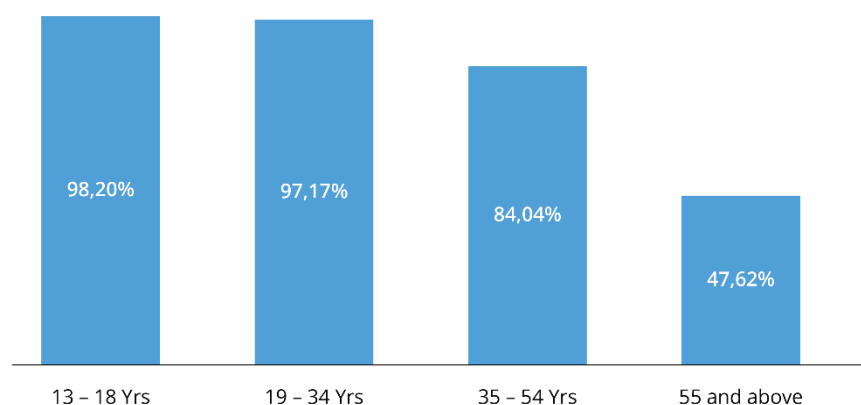
Source: OJK (2022)

From a gender perspective, disparities in access to formal financial institutions also occur, although not as pronounced as regional and educational disparities. About 86.28% of men have access to formal financial services compared to roughly 83.88% of women.

In addition to regional, educational, and gender aspects, Indonesia's demographic structure also needs attention when designing strategies to improve the level of financial inclusion. Despite benefiting from a demographic dividend, where the working-age population is larger than the non-working-age population, the significant number of elderly citizens necessitates the government and industry to prepare specific strategies for deepening financial inclusion.

According to the 2020 population census, about 36.2 million Indonesians fall into the category of being above 55 years old. Meanwhile, only 47.6% of the population aged 55 and above are connected to the internet (APJII, 2023).¹¹¹ This disparity becomes evident, especially when compared to penetration rates in other age groups, such as the age group of 19-34 years (97%) and 35-53 years (84%).

¹¹¹ APJII, Survei Penetrasi & Pelaku Internet 2023”, (2023), <https://survei.apjii.or.id/>

Graph 5. Internet Penetration Rate Based on Age Groups

Source: APJII (2023)

Considering these differing characteristics, specialized handling is likely necessary to ensure that the Digital Rupiah issuance initiative can contribute to deepening financial inclusion as mandated by BI. Financial literacy remains a primary issue, and efforts are needed to promote financial education. In this regard, BI needs to collaborate with the industry to enhance public awareness of formal financial products or services, including Digital Rupiah and others.

Addressing regional disparities, the offline functionality feature initiated by BI could be one of the answers to deepening financial inclusion. Regions that currently lack adequate internet connectivity or have blank spot areas will be enabled to transact through this feature.

Furthermore, the utilization and expansion of "agents", parties tasked with socialization, as an extension of financial institutions continue to be crucial. The role of these "agents" is commonly employed by conventional banks and fintech industries. Therefore, BI can collaborate with the existing ecosystem and strive to broaden its coverage. These "agents" serve several purposes, including facilitating Digital Rupiah registration for individuals without internet access or smartphones, building public trust in formal financial institution products/services, and facilitating cash-out for digital money. The significant prevalence of physical currency in Indonesia makes the cash-out function essential for the adoption of Digital Rupiah.

China also has programs specifically designed for the elderly and children. Introducing a "wallet" (not an e-wallet) for CBDC in the form of a card, is expected to make it easier and faster for the elderly and children to adopt CBDC. Such specific programs can be strategic options for BI, particularly in deepening financial inclusion within specific demographic groups.

Box 2. Digital Yuan "Wallet" for the Elderly and Children

The increasing elderly population in China poses its own set of challenges that need to be addressed. While smartphone ownership is generally high in China (72%)¹¹³, it is not the case in rural areas and among the elderly population. The primary challenge for the adoption of digital financial services in this group is trust, or also known as digital trust. People in this age group feel the need to confirm multiple times as they fear making mistakes in digital service applications and tend to trust conventional banking services more due to visibility or physical representation in savings books.¹¹²

Recognizing this challenge, the Chinese government made a breakthrough by introducing a "wallet" (hard wallet) for Digital Yuan. This physical wallet takes the form of a card (not an e-wallet), making people more familiar and secure in storing and using Digital Yuan. This program is specifically aimed at accelerating the adoption of Digital Yuan among the elderly and children. The wallet contains a script key that can be used for safer access and transactions.¹¹³

This program demonstrates the Chinese government's commitment to deepening financial inclusion, prioritizing user-friendly approaches for groups with lower digital capabilities. Through this program, it is hoped that the use of Digital Yuan can be accelerated, expanding the level of integration of the population into formal financial products or services.

8.2. The Role of CBDC in Promoting Financial Literacy

One of the biggest challenges faced by Indonesia is the remarkably low level of financial literacy. The existence of a "gap" between the level of financial inclusion and literacy signals a serious concern for the government. This means that many people have adopted formal financial services without a good understanding of the products/services or their associated risks. Therefore, one key to the success of Digital Rupiah is the need for further efforts to promote financial education.

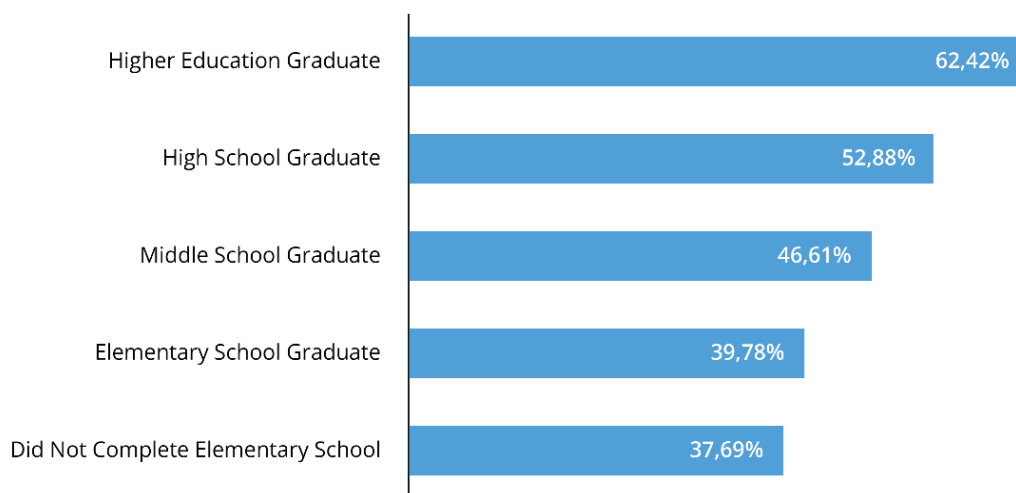
Financial literacy levels in Indonesia have been shown to increase from year to year. The financial literacy index in Indonesia reached 49.68% in 2022, up from the achievement of 21.84% in 2013. However, this figure still lags significantly behind the level of financial inclusion in Indonesia, which reached 85.1% in 2022.

One issue with the level of financial literacy in Indonesia can be observed in the educational background. There is a noticeable gap between the literacy levels of people with higher education and those with lower education. As can be seen in **Graph 5**, the financial literacy index for people with higher education is 62.4%. Meanwhile, the index for people with no schooling or incomplete primary education and those who have completed primary education is only 37.69% and 39.8%, respectively. However, it is interesting to note that the literacy level is not exceptionally high even among those with higher education backgrounds. This indicates that overall financial literacy remains a significant issue in Indonesia.

¹¹² Lingzhi Yi, "On the Ground Insights: Financial Health of the Ageing and the Elderly in China", UNCDF. 9 Juni 2022, <https://www.uncdf.org/article/7768/the-financial-health-of-the-ageing-and-the-elderly-in-china>

¹¹³ Binance Square, "China Aims to Drive Digital Yuan Adoption with Hard Wallets – CBDC Targets Elderly and Children", Binance Square, 15 Juni 2023, <https://www.binance.com/en/feed/post/644764>

Graph 6. Indonesia’s Financial Literacy Index Based on Education Level



Source: OJK (2022)

Mapping issues based on societal characteristics becomes crucial. In the context of habits in Indonesia, where the use of physical currency still dominates daily transactions, this needs to be considered in formulating strategies to accelerate the adoption of Digital Rupiah. The cash-out feature becomes crucial to increase the interest of the public in adopting the Digital Rupiah. The rejection of CBDC in Nigeria can serve as a lesson for BI, especially showcasing the consequence of directly replacing the circulating physical currency entirely with Digital Rupiah.

A transition with clear milestones and psychological reactance considerations needs to be taken into account. Psychological factors will have a greater impact during the implementation in the retail market. This is because, in general, human habits and behaviors require more time to accept change. Meanwhile, Digital Rupiah has significant potential in the future, especially in the context of Indonesia, which still has minimal adoption of financial service products.

Box 3. Rejection of the E-Naira by the Nigerian populace

After the Central Bank of Nigeria's CBDC product, E-Naira, was launched in October 2021, it can be observed that the adoption rate of E-Naira remains very low. In November 2022, or one year after its launch, there were only 860 thousand retail E-Naira wallets, accounting for only 0.8% of all bank account holders in Nigeria. Meanwhile, the average transaction value of E-Naira per week was 923 million Naira, or only 0.0018% of the M3 circulation in the same period. One factor contributing to the low transaction value is that 98.5% of account owners are inactive, meaning they have never used it at all.¹¹⁴

Seeing suboptimal results, the Nigerian government decided to impose restrictions on cash withdrawals. The Central Bank of Nigeria initiated restrictions on cash withdrawals in December 2022 to the amount of 100,000 Naira (equivalent to US\$225) per week for individuals and 500,000 Naira (US\$225) per week for business accounts. This initiative is one step towards the government's vision of achieving a 100% cashless economy in Nigeria. Previously, the government also provided incentives such as easy registration without needing a bank account and discounts for using CBDC as a payment method for Keke Napep (taxis).

However, this move caused panic in society. The restrictions on cash withdrawals, coupled with the initiative to redesign the Naira, resulted in the further limitation of physical currency in the market. People found it difficult to obtain Naira banknotes from banks or ATMs. This led to significant unrest, with people taking to the streets to reject E-Naira. This rejection occurred because Nigerian society still heavily relies on physical currency for daily transactions. Additionally, there is a perception that E-Naira is a tool for the government to exercise excessive supervision over the population. This illustrates that transitioning to a cashless economy requires a clear set of indicators and a transitional period. Cultural aspects and societal habits are also crucial considerations during this transition to avoid disturbances that could trigger economic and social instability.

Recognizing its importance, Bank Indonesia has made financial education and literacy a key principle in the consumer protection framework.¹¹⁵ In this regard, Bank Indonesia emphasizes the socialization of consumer rights and obligations in transactions. This strategy is also expected to enhance awareness and understanding of financial products, thereby increasing the public's confidence and security in using financial products or services.

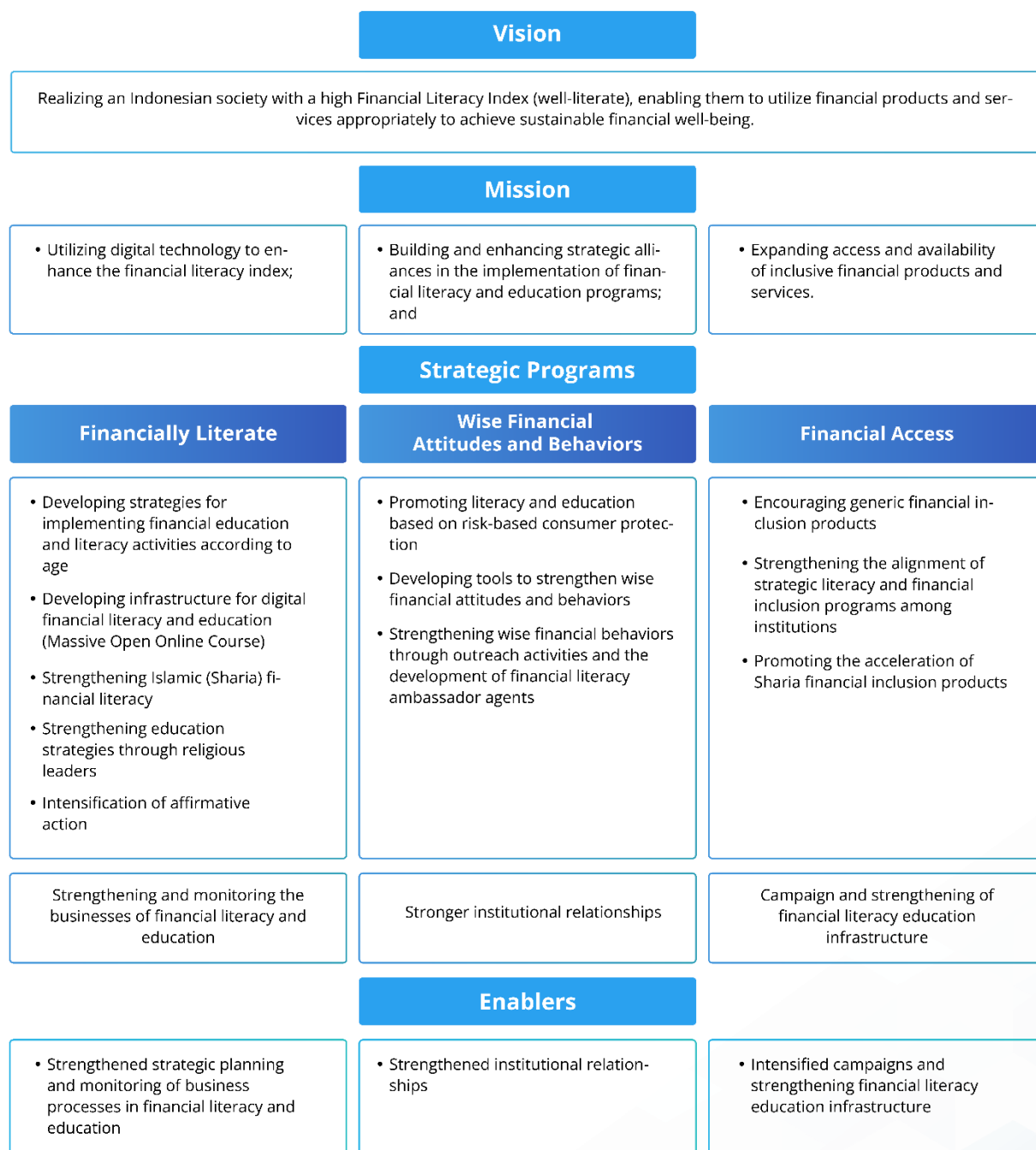
On the other hand, the National Financial Literacy Strategy of Indonesia for 2021-2025 by OJK (Financial Services Authority) has outlined strategic programs to create a society with a high financial literacy index to achieve sustainable prosperity. In one of its programs, OJK targets financial education and literacy strategies tailored to different age groups. In a concrete form, OJK has developed a series of financial literacy books, ranging from those intended for early childhood education (PAUD) to retirement. Additionally, education is also provided to priority communities

¹¹⁴ Jookyung Ree, “Nigeria's E-Naira, One Year After”, *IMF Working Papers Vol. 2023, Issue. 104*, (2023), <https://www.elibrary.imf.org/view/journals/001/2023/104/article-A001-en.xml>

¹¹⁵ Bank Indonesia, “Edukasi dan Literasi Pelindungan Konsumen BI”, <https://www.bi.go.id/id/pelindungan-konsumen/edukasi-dan-literasi/default.aspx>.

such as women, housewives, farmers and fishermen, MSMEs, people with disabilities, residents in 3T (remote, underdeveloped, and frontier) areas, and others.¹¹⁶

Figure 8. Indonesia’s Financial Literacy Index by Financial Literacy Education Level 2021-2025



Source: OJK (2021)

Of course, this National Strategy deserves appreciation and collective support for the agenda of improving financial literacy in Indonesia. However, there needs to be a central goal between

¹¹⁶ OJK, "Strategi Nasional Literasi Keuangan Indonesia (SNLIK) 2021-2025", OJK, (2021), ojk.go.id/id/berita-dan-kegiatan/publikasi/Documents/Pages/Strategi-Nasional-Literasi-Kuangan-Indonesia-2021-2025/Strategi-Nasional-Literasi-Kuangan-Indonesia-2021-2025.pdf

program strategies, age-appropriate education, and skill enhancement objectives. The education strategy should be developed to reduce barriers to the financial ecosystem, so in addition to building programs for diverse needs, it is also necessary to develop programs with communication methods that are more accessible. In this regard, communication methods used by the target audience of the program should be considered. Thus, the goal of financial proficiency would be more achievable.

Furthermore, another aspect that needs to be emphasized is how the improvement of literacy should not solely be the responsibility of OJK, rather it should involve other stakeholders. Collaboration and coordination are necessary between OJK, BI, and the Government, as well as the relevant industries, academia, media, and communities. With the increasing involvement of resources, more programs can be developed, accelerating the improvement of financial literacy in society.

Finally, each existing or planned program should have milestones with specific timeline stages based on good and transparent indicators. This way, program supervision becomes easier, allowing for further evaluation. If initial milestones cannot be achieved, the program needs to be evaluated, and alternative programs need to be considered. Therefore, the direction of the program can always align with sustainable improvement in financial literacy on a societal level, which would be on par with the expected outcome of a National Strategy.

9

Risk Management, Challenges, and Mitigation

In the dynamic landscape of global finance, the emergence of a Central Bank Digital Currency (CBDC) marks a significant shift towards digitalization. In the second half of 2023, the momentum of CBDC is very strong, with 130 countries exploring this new form of digital currency, it encompasses 98% of the global GDP. Of that amount, 64 countries have continued to further critical development, including launching, trialing, or developing their CBDC.¹¹⁷

However, both developing and advanced economies are still lagging in the regulation development. Only 25% of the countries researched by the Atlantic Council¹¹⁸ have regulations regarding Anti Money Laundering Countering the Financing of Terrorism (AML-CFT), consumer protection, and permission in cryptocurrency. Not only that, only 16% of developing countries have the regulation. These regulations are very important in their roles in managing risks and challenges in the CBDC implementation.

Indonesia, along with this global trend, has begun its journey towards establishing its CBDC, that is, the Digital Rupiah, led by BI. This BI initiative known as Project Garuda, aims to develop three different phases of Digital Rupiah, each focused on a different implementation aspect, beginning with issuance testing, redemption, and interbank transfers.¹¹⁹

The exploration and development of CBDC worldwide brings valuable insight into Indonesia's journey. Primarily, the European Central Bank (ECB) just entered the preparation phase for the Euro digital, which focuses on building infrastructure, formulating regulations, and conducting extensive testing. This phase aims to create an offline digital currency system, a high level of privacy, and instant settlement, setting precedence for other economies, including Indonesia.¹²⁰

Indonesia's approach through the BI Project Garuda is hoped to align with the global movement towards a well-structured introduction of digital currency in several stages so that existing risks can be mitigated. The first stage of the Garuda Project emphasizes testing core functionality in a controlled environment, reflecting a cautious yet progressive approach to the integration of digital currency into the financial ecosystem. The functionality test also has to be able to identify and mitigate risks that emerge from the implementation of both wholesale Digital Rupiah and retail.

The Digital Rupiah approach should ideally mirror the global trend of meticulous research, stakeholder collaboration, and phased implementation, which is crucial for reducing risks associated with CBDC and ensuring successful integration into the existing financial system.

9.1. Risk Analysis and Mitigation for CBDC Infrastructure

The risk review for CBDC in the context of wholesale and retail includes a deep understanding of the challenges and potential of digital currency in many countries, including Indonesia. CBDC is an increasingly powerful innovation worldwide, driven by various motivations ranging from enhancing financial inclusion to modernizing payment systems. However, behind this transformative potential, some risks and challenges need to be considered.

¹¹⁷ [Central bank digital currency evolution in 2023: From investigation to preparation - Atlantic Council](#)

¹¹⁸ [Cryptocurrency Regulation Tracker - Atlantic Council](#)

¹¹⁹ [Bank Indonesia announces CBDC plan - Central Banking](#)

¹²⁰ [Central bank digital currency evolution in 2023: From investigation to preparation - Atlantic Council](#)

CBDC faces many risks, specifically in the context of wholesale and retail. These risks include transaction security, the potential for misuse in illegal activities such as money laundering and terrorism financing, and their impact on the stability of the financial system. To mitigate these risks, BI is planning the implementation of Digital Rupiah with a comprehensive regulatory and policy approach. This strategy includes participant regulation, mitigation of pro-cyclical effects of growth exceeding economic absorption during contraction cycles (procyclicality), operational risk management, consumer protection, and personal data protection, with a specific focus on commitment to APU-PPT.

The Security Framework and Risk Management ¹²¹ are key components in implementing a successful CBDC. To ensure robust security for CBDC, a comprehensive approach is required. This includes conducting a comprehensive risk assessment to identify potential vulnerabilities and threats that could jeopardize the integrity, confidentiality, and availability of the system. Prioritizing these aspects is crucial in maintaining trust in the digital currency.

One effective strategy is to leverage the existing security and operational framework for the current payment system. This proven framework can serve as a solid foundation for securing CBDC. By building upon best practices and experiences from this framework, central banks can facilitate the process of identifying and mitigating risks associated with the implementation of CBDC. This not only enhances the overall security posture but also ensures the sustainability and reliability of the digital currency system, ultimately building confidence among both users and stakeholders.

The international perspective towards the safety of CBDC like the Digital Rupiah is an important aspect that needs to be observed in the development and implementation of the digital currency. While CBDC has the potential to enhance existing payment infrastructure more efficiently, it needs to be acknowledged that the introduction of CBDC also brings new security risks. With the presence of CBDC, the attack surface becomes broader, necessitating stricter measures to protect this system from potential cyber threats.¹²² User trust (digital trust) in digital currencies such as Digital Rupiah is crucial, and to maintain this trust, developers must prioritize the security of the CBDC platform. Proactive measures need to be taken to prevent counterfeiting, fraud, and double spending that could compromise the integrity of the digital currency.

9.1.1. Strategy in CBDC Risk Mitigation

In the interview with BI, their strategy in addressing security risks of transactions and misuse of the Digital Rupiah, including money laundering and financing illegal activities, takes center stage. BI is committed to forming regulations and policies from multiple perspectives to support the design implementation of the Digital Rupiah. This effort is important to mitigate risks related to transaction security and the potential misuse of the Digital Rupiah for illegal activities.

A phased approach will also be implemented by BI, starting with the testing of issuance and interbank transfers, reflecting the global trend in careful and research-based implementation of CBDC.¹²³ This is a wise step, as it allows institutions like Bank Indonesia to understand the potential impact and risks before launching CBDC on a large scale, especially its impact on the Fintech

¹²¹ [The Fed - Security Considerations for a Central Bank Digital Currency \(federalreserve.gov\)](#)

¹²² [The Fed - Security Considerations for a Central Bank Digital Currency \(federalreserve.gov\)](#)

¹²³ [Bank Indonesia announces CBDC plan - Central Banking](#)

industry. However, important challenges that need to be addressed include transaction security, potential misuse of illegal activities such as money laundering and terrorism financing, and the impact on the stability of the financial system. Therefore, BI must design a comprehensive mitigation strategy.

According to BSSN, the implementation of the Digital Rupiah must be supported by a security system that can effectively reduce the risks of money laundering and financing illegal activities. Key security factors identified involve the transparent nature of blockchain, the inability to counterfeit digital currency, and sophisticated tracking technology. Security risks, including technological aspects, privacy, and potential attacks against users, become the main focus within the CBDC ecosystem. To overcome this risk, there needs to be a tight security policy, supervision of CBDC operations, and community education efforts. This approach mirrors serious attention towards security and data privacy, along with the social responsibility in implementing the Digital Rupiah, so that it is acceptable amongst the community.

Operational disruptions or fraudulent activities within the CBDC ecosystem must also be addressed firmly. Such incidents can undermine public trust in the digital currency and damage the central bank's reputation. The loss of this trust has the potential to negatively impact the central bank's ability to maintain monetary and financial stability in the country. Therefore, the central bank must develop a strong strategy to detect, prevent, and promptly and effectively handle similar incidents. By taking proactive measures to protect personal information and prevent fraudulent activities, the central bank can ensure sustainability and trust in its CBDC implementation.

9.1.2. Ensuring the Security of CBDC Technology Infrastructure

From the interview with BSSN, the security risk of CBDC is discussed from a more general point of view, including technology security, privacy, and attacks on users. This underscores the importance of maintaining the integrity and security of the technology infrastructure used in the implementation of CBDC. Additionally, the protection of personal data and efforts to prevent cyberattacks are also crucial factors in reducing security risks associated with CBDC.

Cybersecurity plays a crucial role in promoting the adoption of Digital Rupiah.¹²⁴ Similar to other Information Technology (IT) systems, the implementation of aligned security standards is key to maintaining the integrity, confidentiality, and availability of Digital Rupiah. Components such as identity and access management help ensure that only authorized entities can access and use Digital Rupiah, while incident management prepares responses to potential cyber threats that may arise. Meanwhile, development lifecycle management ensures that any changes or updates in this system continue to comply with the required security standards. By prioritizing cybersecurity in the development and usage of the Digital Rupiah, we can build a strong foundation for the secure and successful adoption of this digital currency.

Protection of sensitive personal information is a crucial element in the implementation of CBDC.¹²⁵ The security of users' personal data is the top priority, and adequate measures must be taken by the central bank to protect this information from potential threats and breaches. Furthermore, compliance with applicable privacy laws is a necessity in the management of CBDC. Strict

¹²⁴ [Indonesia's Digital Rupiah Game Plan: Everything You Need to Know - Fintech Singapore \(fintechnews.sg\)](https://www.fintechnews.sg/news/indonesia-digital-rupiah-game-plan-everything-you-need-to-know)

¹²⁵ [The Fed - Security Considerations for a Central Bank Digital Currency \(federalreserve.gov\)](https://www.federalreserve.gov/monetarypolicy/monetarypolicy.htm)

enforcement of privacy laws is a crucial step to ensure that personal data is not misused or accessed by unauthorized parties. A significant breach of privacy can cause serious consequences, including legal sanctions which will have the potential to harm the central bank and lose the public's trust in CBDC.

BSSN plans the implementation of security technology by ensuring the existence of strict regulations related to data privacy and the use of personal information in the context of Digital Rupiah. To maintain user security and privacy, BSSN emphasizes the need for compliance with the Personal Data Protection Law and conducts regular audits as an integral part of the security strategy. These steps show commitment to providing maximum protection for the public's private data and ensuring that the implementation of the Digital Rupiah is under clear and accountable regulatory control. By combining security technology, data privacy regulations, and rigorous audit practices, BSSN aims to create a secure, transparent Digital Rupiah ecosystem that aligns with high privacy standards.

9.1.3. Case Studies: Other Risks

Besides Indonesia, other countries have different approaches to implementing CBDC. For example, Argentina is developing its legal framework for its CBDC projects with a focus on economic and inflation issues.¹²⁶ This shows that Argentina sees CBDC as a tool to overcome its inflation.

On the other hand, Australia successfully completed trials of CBDC blockchain, highlighting the potential for CBDC to interoperate with various blockchain technologies.¹²⁷ In this pilot, the Reserve Bank of Australia collaborated with the private sector, namely Mastercard, to ensure the identification and mitigation of risks, particularly because the system was designed to interoperate with different blockchain technologies. However, full-scale development of CBDC in Australia still requires several more years. This indicates that Australia is carefully considering the technical challenges and infrastructure involved in launching CBDC.

Brazil faced privacy and infrastructure concerns in the development of DREX, intending to launch its CBDC across all financial services.¹²⁸ Their focus is on maintaining user privacy and ensuring reliable infrastructure. However, it is also important to mitigate the risk of CBDC misuse in illegal activities. Brazil plans to launch the first phase of DREX in 2024 and is gradually developing it for the entire financial services.

China has taken a step further in utilizing e-CNY in international trade, demonstrating the potential of CBDC in cross-border transactions. China's success in utilizing the CBDC in international trade shows the potential of the CBDC to replace fiat money in the context of international trade. In its implementation, China collaborated with the private sector, PetroChina to use digital yuan in crude oil trade.

India is also actively engaged in CBDC trials, with the Reserve Bank of India targeting the launch of CBDC in the interbank lending market. This indicates that India sees CBDC as a useful tool in developing their financial system. However, they also need to ensure that their CBDC is secure

¹²⁶ [Central bank digital currency evolution in 2023: From investigation to preparation - Atlantic Council](#)

¹²⁷ [Central bank digital currency evolution in 2023: From investigation to preparation - Atlantic Council](#)

¹²⁸ Ibid.

from security risks and misuse. Moreover, they are targeting one billion daily transactions by the end of 2023.

9.1.4. Collaboration with relevant parties and other countries

Looking ahead, the global CBDC landscape will continue to be diverse and evolving. Each country will adapt its approach based on specific economic, technological, and regulatory considerations. The success of CBDC implementation will heavily depend on how countries address challenges related to security, privacy, and the impact on financial stability. Therefore, collaboration and information exchange will be key factors in mitigating risks and achieving success in adopting CBDC. BI should always ensure active participation from relevant stakeholders, from the government, regulator, private sector, and even non-governmental institutions such as research institutions and academics. In addition, reflecting on other countries, active discussions between countries that are also exploring CBDC are needed to ensure the exchange of information and discussion related to their obstacles. Indonesia, through Digital Rupiah, is involved in this global movement and needs to ensure that careful and well-planned mitigation measures are implemented to minimize the risks associated with this digital currency.

The development of Digital Rupiah in Indonesia must be careful in striking a balance between the opportunities offered by digital transformation and the challenges in ensuring security, user trust, and system resilience. Learning from international examples and implementing a strict security and risk management framework will be the key to successfully addressing the risks associated with the implementation of CBDC.

One crucial aspect of ensuring CBDC security is international collaboration and the exchange of information on best practices in cybersecurity. As CBDC can be used across borders, cooperation among countries in establishing strong security standards and protocols becomes highly important. In addition, regulations supporting responsible innovation and regular audits need to be implemented to ensure compliance with established security standards. By taking these steps, digital currencies like Digital Rupiah can develop securely and provide significant economic benefits while maintaining integrity and trust in the payment system.

9.2. Comprehensive Risk Analysis for Financial System Stability

9.2.1. Liquidity Risk

Digital Rupiah, especially in retail form, has the potential to transform the financial landscape of Indonesia. However, it should be noted that a large-scale conversion of public savings into Digital Rupiah can have a significant impact on the stability of the financial system. One main risk is the decline in stable and low-cost funding sources for banks, which can impede their ability to extend credit.

In facing these challenges, the implementation planning of the Digital Rupiah must consider careful mitigation strategies. BI has identified two key mechanisms, tiering and capping, which will be integrated into the Digital Rupiah design. This mechanism is aimed at managing exposure, primarily in critical situations.

First and foremost, capping involves limiting the amount of Digital Rupiah that can be owned by specific individuals or entities. This can prevent excessive accumulation and potential disruptions

in the banking system. By setting a maximum ownership limit, the risk of liquidity imbalance can be controlled. This is in line with several countries that have already implemented CBDC with ownership limits.

Meanwhile, tiering involves establishing different levels of exposure for holders of Digital Rupiah, depending on the type and volume of accounts. This provides flexibility in managing risks, ensuring that account holders with higher values will be subject to stricter requirements, while those with lower-value accounts will have greater exposure limits.

The importance of these tiering mechanisms is that they can be used to prioritize individual accounts in specific categories, such as MSME participants or individuals with lower income levels. This will allow them to have more access to Digital Rupiah, which is crucial for facilitating daily transactions.

In the interview, BI highlighted the importance of Digital Rupiah as a tool that can strengthen banking liquidity. BI plans to implement tiering and capping mechanisms in the design of Digital Rupiah as a step to manage exposure. According to them, this step can help prevent excessive accumulation and potential disruptions in the banking system. Thus, Digital Rupiah is expected to support banking liquidity stability.

Additionally, BI also emphasizes that careful planning and testing phases will be integral parts of the Digital Rupiah implementation. This will help identify potential issues and ensure that the Digital Rupiah system can operate smoothly, avoiding situations that could disrupt the stability of the financial system. By combining careful mitigation strategies, strict supervision, and appropriate regulations, Indonesia can reap the full benefits of Digital Rupiah innovation while maintaining the integrity of the country's financial system.

However, it is important to emphasize that the implementation of tiering and capping mechanisms must be done wisely and based on thorough risk analysis. This is done to avoid potential vulnerabilities that could disrupt the stability of the financial system, including the risk of a bank run that may occur if there is a massive withdrawal of Digital Rupiah in a short period.

9.2.2. Inflation Risk and Unauthorized Use

BSSN highlights the importance of limiting Digital Rupiah printing to prevent inflation potential and unauthorized use. They emphasize the need for appropriate regulations to oversee the use of Digital Rupiah and ensure that it remains a legitimate and trustworthy means of payment.

Other than that, BI's active role in supervising and arranging the implementation of Digital Rupiah is very important. The central bank has to make sure that all banks and organizations involved in the ecosystem of Digital Rupiah comply with the established guidelines, primarily in the existing risk mitigation, which is the mandate of several government entities.

With mature mitigation strategies and strict supervision by Bank Indonesia, Indonesia can harness the full potential of Digital Rupiah innovation without sacrificing the crucial stability of the financial system. This will be a significant step in facing the challenges and opportunities presented by the increasingly evolving era of the digital economy. Furthermore, the interview result with BI and BSSN shows that they are strongly committed to ensuring the success of Digital Rupiah

implementation through a mature strategy to mitigate risks and ensure the security and integrity of Indonesia's financial system.

9.2.3. Cross-border Transaction Risks

Digital Rupiah, as a progressive step in adapting Indonesia's financial system to the digital era, is focused on improving transaction efficiency and global accessibility. By designing it to facilitate both domestic and international transactions, the goal is to reduce transaction costs while improving the speed and transparency of using this digital currency. A comprehensive analysis of this initiative reflects efforts to manage financial risks in the international markets. The approach, which includes safeguarding monetary sovereignty and ensuring the effectiveness of the central bank's mandate, is a key strategy to secure financial stability in the face of global challenges. Thus, Digital Rupiah not only serves as a sophisticated payment tool but also as a strategic instrument in maintaining national economic sustainability amid changing dynamics in the global financial landscape.

9.3. Mechanisms for Monitoring and Continuous Feedback

In pioneering the implementation of CBDC, it is important to establish mechanisms for continuous monitoring and feedback to ensure that the process not only runs smoothly but also mitigates risks and ensures the participation of all stakeholders, including the Fintech industry. The regulators such as BI need to lead an initiative with transparency and commitment, presenting a framework that supports innovation, and addressing challenges that may arise over time. Several mechanisms involving stakeholders and the Fintech industry can be engaged in monitoring and providing feedback on the preparation and implementation of CBDC.

9.3.1. Involvement of Relevant Parties in the Policy-Making Process

- **Open Dialogue:** Through open dialogue, Bank Indonesia can gain direct insights from the Fintech industry, understand the challenges faced, and respond promptly, creating a collaborative environment that supports innovation.
- **Shared Commitment:** Active engagement and shared commitment build trust among stakeholders, creating a strong foundation for CBDC implementation and enhancing regulatory certainty.
- **Monitoring and Regulatory Compliance:** Continuously monitoring regulations allows Bank Indonesia to respond quickly to market dynamics, creating the necessary flexibility without compromising security and compliance. A clear regulatory framework, along with the engagement of the Fintech industry, can help improve compliance in the Fintech industry, reduce the risk of illegal activities, and provide a strong legal foundation for stakeholders.
- **Public Education:** The education campaign helps reduce the uncertainty of the public, creating public trust towards CBDC, and providing them with a better understanding of the potential benefit acquired from this technology.
- **Survey and Public Consultation:** This includes the public in the decision-making process through survey and consultation providing the feeling of ownership, increasing the public acceptance towards CBDC, and assisting in understanding the needs of users. Furthermore, surveys and public consultations provide a forum for the public to voice their concerns and aspirations, creating a chance to adjust and increase sustainability.

9.3.2. Testing and Continuous Collaboration

- **Security and Performance Testing:** Regular testing ensures that CBDC can respond to evolving security threats, maintain user trust, and avoid potential risks of data leaks or cyber-attacks.
- **Transaction Monitoring:** An efficient transaction monitoring system helps detect suspicious transaction patterns, strengthens system integrity, and assures that CBDC is used for legitimate purposes.
- **Collaboration Forum:** Establishing a collaborative forum encourages innovation and the development of joint solutions, creating an ecosystem that supports the growth of financial technology and delivers more efficient solutions for CBDC users.
- **Incentive for Innovation:** Providing incentives for innovation stimulates the participation of the Fintech industry, creating a competitive atmosphere that encourages companies to contribute to the success of CBDC.

9.3.3. Routine Evaluation Mechanisms and Feedback

- **Customer Service Center:** An efficient customer service center reflects Bank Indonesia's commitment to promptly address user issues, enhancing public trust in CBDC as a reliable payment tool.
- **Independent Audit:** Independent audits provide an objective view of CBDC performance, ensuring that its operations adhere to high standards and instill confidence among stakeholders.
- **Performance Evaluation:** Periodic performance evaluations provide in-depth insights into the impact of CBDC on the economy and society, enabling necessary strategy adjustments to enhance its benefits.
- **Technology Monitoring:** Keeping track of technological advancements ensures that the CBDC infrastructure remains relevant and reliable, creating a robust foundation for market needs, growth, and adaptation.

10

Implementation Guide: Adoption and Collaboration with Stakeholders

Although the implementation of Digital Rupiah has not yet reached the trial phase, BI provides a rough estimate of the stages of Digital Rupiah implementation as described in Figure 10 below. This segment is intended to provide an overview of the Digital Rupiah implementation, including the scope of each implementation phase, BI's strategies for Digital Rupiah to be accepted by the public, and BI's collaboration with stakeholders in implementing Digital Rupiah.

10.1. Phased Rollout

Figure 9. Digital Rupiah Roadmap

W-Digital Rupiah Cash Ledger	W-Digital Rupiah Cash & Securities Ledger	Integrated end to end W-Digital Rupiah to R-Digital Rupiah	
<p><i>Issuance & Redemption</i> <i>Interbank fund transfer</i></p>	<p><i>Interbank money market</i> <i>Monetary Operation</i> <i>Connection to CCP</i></p>	<p><i>Distribution, Collection & P2P</i> <i>R-CBDC wholesaler to peritel</i> <i>R-CBDC direct from Bank Sentral</i></p>	Use Case
Digital Rupiah	Digital Rupiah Digital Securities BI	Digital Rupiah Digital Securities BI Digital Securities non BI	Digital Asset
W- CBDC platform BI digital rupiah 3i Converter with RTGS	W- CBDC platform BI digital rupiah & digital securities 3i Converter with FMI (Multimatching, CCP) Standar 3i untuk BI-APS BI-RTGS Gen3 dan BI-SSSS Gen3	W- CBDC platform BI for other use case Standar 3i for all FMI (seamless connection) R-CBDC Platform 2 tier & 1 tier BI DLT Gateway	Infrastructure
Wholesaler designated to sharing made with BI (No Node)	Wholesaler designated to sharing node with BI (No node) or using validating & non validating nodes	Wholesaler and/or retailer prepares mechanism distribution to retail user Preparation of 3i standard for other FMI Infrastructure	Industry
Intermediate State	Intermediate	End State	

Source: White Paper Project Garuda

10.1.1. First Stage (immediate)

The first stage of the phased rollout of Digital Rupiah implementation will commence with a trial of transactions among wholesale market participants, issuance, and destruction of w-Rupiah. These three aspects serve as an ideal starting point for the initial trial of Digital Rupiah because 1) they have minimal impact on both consumers and the real industry, 2) the complexity of inter-bank transactions is relatively low, and 3) the need for a comparison between the effectiveness and efficiency of blockchain technology and DLT infrastructure compared to conventional infrastructure must be verified before other processes can begin.

Interbank transactions with w-Rupiah are quite simple and intuitive, but the definition of issuance and destruction of w-Rupiah will involve the conversion process between the central bank's current account and Digital w-Rupiah. Unlike typical centralized technologies, every change in circulating Digital Rupiah within the DLT ecosystem needs validation from each validator. At this stage, system optimization will be implemented to ensure that the speed and security of w-Rupiah are not inferior to the previous system.

This phase will conclude with a trial implementation of integration, interoperability, and interconnection (3i) functions between the w-Rupiah infrastructure and BI-RTGS. If these functions operate correctly, the validation and interbank fund transfer processes on the platform will no longer be restricted to Digital Rupiah. Once these functions are operational, each node will be authorized to independently use the blockchain infrastructure provided by Bank Indonesia.

10.1.2. Second Stage (intermediate)

The success of the first stage will be continued into the second stage with trials in financial market transactions such as delivery-versus-payment (DvP) and settlement transactions in the Central Counter Party (CCP). This phase's linkage space is chosen because transactions in the money market are more complex than interbank transactions, but the impact on consumers and the real market is still limited.

The transition period between the first and second stages will be utilized to provide wholesale participants with the opportunity to develop self-sufficiency in managing nodes, both in terms of human resource preparation and hardware readiness. Node preparation will depend on the transactional needs of each wholesale market participant.

In parallel with the trials in the financial market, tokenization functions will also begin to be applied to several securities. Tokenization, in this context, involves creating digital representatives for securities (doppelgangers) and the ongoing development of securities with native or hybrid tokens, securities issued simultaneously or without physical documents.

Transactions in this stage of DvP also do not encompass every transaction type. The limited trial phase involves the inclusion of digital assets in the form of cash tokens or digital securities based on w-Rupiah. Digital securities in this context are also restricted to those issued with a securities account in the Bank Indonesia Scripless Securities Settlement System (BI-SSSS) infrastructure, while cash tokens only involve the issuance of Digital Rupiah involving current accounts in the BI-RTGS infrastructure. The expected outcome of this stage is the acceleration of the settlement process through the integration of digital securities and w-Rupiah without the burden of transfer processes or physical proof processes.

The acceleration of the settlement process will also be supported by trials connecting with CCP. Some clearing settlement transactions, such as interest rate and standardized exchange derivatives, for example, domestic non-deliverable forward (DNDF) transactions, will be traded through a trading platform using w-Rupiah. In adopting this trading platform, the role of the CCP will also be directed to participate as a member of the w-Rupiah platform. With this use case, the w-Rupiah platform will be seamlessly connected in a 3i manner with the Bank Indonesia Electronic Trading Platform (BI-ETP), BI-RTGS, and BI-SSSS.

10.1.3. Third Stage (End State)

The third stage is the final trial phase before the Digital Rupiah meets the public and is used as a medium of exchange. Therefore, this stage will encompass an end-to-end integration process between w-Rupiah and r-Rupiah, from the DLT system to the conventional system. The development of interoperability functions between DLT and BI-RTGS will play a significant role in this stage.

Before r-Rupiah is used by the public, the peer-to-peer (P2P) transfer function of r-Rupiah and the conversion process between w-Rupiah and r-Rupiah need to be perfected. In the P2P context, the conducted trials will involve transfer mechanisms between consumer digital wallets. At this stage, it is expected that collaboration will be established between the central bank and various payment system stakeholders to develop intuitive and convenient mechanisms for users.

In addition to the developments at the retail level, the third stage will also continue to expand the functions of w-Rupiah to include the issuance of non-bank BI digital securities, both in the form of hybrid tokens and native tokens, as a manifestation of the Garuda Project's goal to develop digital monetary operations (OM). With this digital OM, the impact of OM on the money market and foreign exchange market is expected to be deepened and made more effective.

On the other hand, the digitization of OM will require more technology than the implementation of digital representatives of securities in the second stage. To use digital OM in the foreign exchange market, the w-Rupiah DLT needs to be developed into a DLT gateway capable of performing interoperability functions even with DLT platforms outside of the central bank.

10.1.4. Feasibility Framework

To ensure that the Digital Rupiah can be well integrated into Indonesia's economy, BI will use a feasibility framework in each stage. The Feasibility framework consists of four criteria, that is:

1. Relevance: Do the advantages that arise from the trial process remain relevant for the development of the financial sector in Indonesia?
2. Urgency: Do the benefits that arise from the trial process address an urgent issue?
3. Readiness: Are the administrators and players in the financial sector ready to implement the activities in the trial?
4. Impact: What is the magnitude of the impact of the trial results?

10.2. Collaboration and Stakeholder Engagement

The Garuda Project is a national initiative. This means that BI will collaborate with other institutions to ensure the smooth transition of this Indonesian payment system revolution, from the transition period to full operation. As outlined in the framework for the supervision and financial authority of Digital Rupiah, Bank Indonesia will collaborate with other financial sector regulatory authorities in the development of Digital Rupiah.

At the same time, financial sector players and other stakeholders need to be involved in the implementation process of Digital Rupiah. Without collaboration and synergy between the authority framework of the Garuda Project and stakeholders, there is a risk that Digital Rupiah cannot be seamlessly integrated into the national payment system.

10.2.1. Consultative paper

At the time of writing this Outlook, Bank Indonesia is preparing to enter the first stage (immediate) of the phased adoption of the Garuda Project. The participation and involvement of stakeholders are crucial elements in determining the success of this initial stage. Therefore, throughout 2022, Bank Indonesia engaged various players in the financial and Fintech industries through focus

group discussions (FGD) and other public collaboration platforms. The results of this public involvement are summarized and presented in the Consultative Paper available on the Bank Indonesia website.

The Public Consultation of the Consultative Paper includes 35 questions based on the primary concerns of the involved stakeholders. Broadly, the Consultative Paper covers the functionality of Digital Rupiah, BI's general considerations in the development of Digital Rupiah, and how Digital Rupiah can ensure transaction settlement finality. Following the issuance of the Consultative Paper, Bank Indonesia opened a platform to receive additional input from the public via email from January 31, 2023, to July 15, 2023.

10.2.2. Insights from the Consultative Paper

The first stage consists of trials at the wholesale level, specifically for interbank transactions. As this stage does not yet interact with the Fintech industry or consumers, the input that the public can provide is limited. This difficulty is reflected in the small response from the public during the 6-month public consultation period after the issuance of the Consultative Paper. Most industry players still feel unprepared to provide input.

The coverage of the White Paper: Digital Rupiah and the Consultative Paper is still quite broad. The detailed scope and technological structure are still under consideration. This makes stakeholders, both industry players and technology experts, find it challenging to provide input.

For example, one of the questions in the Consultative Paper asks the public to provide their ideal distribution of resilience, speed, efficiency, and scalability. This question is related to the reality of choosing blockchain protocols, where there always needs to be prioritized elements and some must be deprioritized. A structure that is both fast and secure will encounter scalability issues due to using hardware or software standards that are too high. On the other hand, a secure and easily developed structure will not be able to achieve optimal speed.

Answers to questions like that are challenging to provide without more details about the technology used by Digital Rupiah. This difficulty can be a lesson for future public consultation schemes. Therefore, various stakeholders hope for the release of technical white papers before opening a public consultation platform.

11

Comparative Analysis: Global CBDC Case Study

Indonesia is not the first country to issue CBDC. Some other countries, such as China and India, have already entered the testing phase or are already using CBDC as their means of exchange. This chapter is intended to present case studies of CBDC in other countries and some proposals from BI to mitigate issues that have arisen in other nations.

11.1. Case Study: Privacy Concerns

Nigeria launched its CBDC, e-Naira, on October 25, 2021. However, the usage of e-Naira among the public is significantly below the government's projections. According to a report from the IMF, the average e-Naira transactions only reach 14,000 per week, and the usage rate is only 1.5% of the total CBDC wallets.¹²⁹

Several academic studies have been conducted to find reasons for the low adoption rate of e-Naira. The findings from various studies state that the Nigerian public does not feel comfortable using e-Naira due to excessively strict monitoring systems.

Crypto-based currencies such as Bitcoin, which are frequently used for illegal activities, prompted the Central Bank of Nigeria (CBN) to take measures to ensure that financial crimes cannot be conducted using e-Naira. However, the integrated Anti-Money Laundering (AML) measures in e-Naira are perceived by users as a privacy violation. Government agencies use the e-Naira to monitor the balances and transactions of the public and then use that information to predict the risk level of each e-Naira user. Despite e-Naira utilizing decentralized technology, its implementation has paradoxically led to the centralization of governmental authority, which is detrimental to the public.

E-Naira was supposed to be built on the principles of openness and transparency, but in reality, each blockchain node is operated privately, and the details of the CBN audit process are not shared with the public at all. Therefore, the scope of oversight of e-Naira is only known to the CBN. Additionally, the identity verification steps make the adoption of e-Naira overly difficult, leading individuals to choose to continue using cash.

11.1.1. Proposed Solutions: Privacy Enhancing Technology (PET) and Tiering and Capping System

One of BI's proposals is to implement Privacy Enhancing Technology (PET) in Digital Rupiah. PET is one implementation of cryptographic technology that encrypts each transaction. This means that banks managing accounts or Bank Indonesia as the network administrator cannot see how Digital Rupiah is being used.

The implementation of PET in Digital Rupiah is still being discussed internally. However, to completely avoid cases like those in Nigeria, Bank Indonesia must be transparent about the scope and framework of the PET used. For example, if the number of transactions is encrypted by PET but the transaction direction and the parties involved can still be seen by the network administrator, then the privacy of Digital Rupiah users is still violated.

To fully make the public feel comfortable, a platform with a level of privacy equivalent to cash transactions needs to be provided. Therefore, BI proposes to also implement an identity-based

¹²⁹ TechCabal.com “Nigeria's eNaira: High on blockchain, low on adoption” Juli 13, 2023 <https://tinyurl.com/4pk8cpx7>

tiering and capping system. In this system, Digital Rupiah transactions exceeding a certain amount will require equivalent personal data. For example, Digital Rupiah users need to provide their Identity Card (KTP) and Tax ID (NPWP) numbers to conduct transactions exceeding IDR 20 million, similar to the case with the lowest-level debit cards. However, a tier that does not require any form of identity proof at all should be provided to ensure the inclusivity and comfort of Digital Rupiah users. This tier is an option without any burden, whether administrative or privacy-related, aimed at accommodating vulnerable segments of the population.

11.2. Case Study: Challenges of Features

CBDC is a national-scale project that demands significant resource allocation. Therefore, the biggest question is 'whether the benefits of CBDC justify the demands of its implementation?'

An example case is in India, where the trial period of e-Rupee starting from December 2022 received much criticism from its participants. According to wholesale trial participants, the e-Rupee was deemed inefficient and lacked functionality compared to the previous interbank system in India. Similar complaints were reflected in consumer trials, where consumers stated a preference for using India's Unified Payment Interface (UPI), an instant and real-time consumer payment system that allows users to transfer money between banks without disclosing account information. The existence of better alternatives already adopted by retailers makes it challenging for the e-Rupee to penetrate the retail market.¹³⁰

11.2.1. Proposal of solutions: Features of Digital Rupiah

To ensure that the adoption of the Digital Rupiah will provide added value to Indonesian society, w-Rupiah and r-Rupiah will be accompanied by outstanding features. From the wallet administration perspective, Digital Rupiah will provide identity services, allowing users who lose their devices or keys to regain access to their accounts. "Moreover, each Digital Rupiah itself will also be accompanied by the following features:

1. Programmability: The digital currency's ability to integrate programs into payments
2. Composability: The ability to combine multiple operations/transactions into a single operation/transaction.
3. Tokenization: The ability to use Digital Rupiah as a token representing securities, securities, or other financial assets

These three features provide Digital Rupiah with the capability to create smart contracts or processes that will run automatically. An example of the implementation of a smart contract in the finance sector based on DLT is automatic interest payments. Furthermore, an example of implementing smart contracts for the Fintech industry is the automatic application of discounts on a QR transaction without the need for an internet connection.

The third feature, tokenization, is an added value of Digital Rupiah to the financial asset market. By creating a Digital Rupiah token that will represent a financial asset, the efficiency of financial asset trading can be enhanced as assets can be traded through digital transactions. With smart

¹³⁰ EconomicTimes.com "India's digital rupee fails to excite interest, bankers say" Dec 2, 2022 <https://tinyurl.com/yr7adu7r>

contracts, the discount payment of bonds or securities can occur automatically and without the need for physical verification.

11.3. Advancements in Cross-Border CBDC

Over the past three years, various CBDC projects such as Project Dunbar in Singapore and the Digital Euro Project at the European Central Bank (ECB), and Bank Indonesia itself have collaborated under the BIS to materialize cross-border CBDC. The cross-border CBDC project has been underway since the release of the roadmap by the Committee on Payments and Market Infrastructure (CPMI) under the Financial Stability Board in 2020.¹³¹

CBDC projects tend to begin with implementations in domestic markets. This is because the complexity of developing CBDC at the domestic level is much easier than implementation at the cross-border level, as cross-border CBDC must have scalable capabilities capable of accommodating CBDC protocols from various countries. Preparing and developing infrastructure capable of achieving this level of stability is very challenging. At least, some of the CBDC projects currently under development are already considering the inclusion of other countries' CBDC protocols. Among these projects are the Jura project from China, the Dunbar project from Singapore, the mBridge project from Hong Kong, the Icebreaker project from Sweden, Norway, and Israel, and the Mariana project from the European Union, Singapore, and China.¹³²

Table 3. Cross-Border CBDC Projects BIS Innovation Hub

	Jura	Dunbar	mBridge	Icebreaker	Mariana
BISIH centres	CH	SG	HK	SE	EU, SG, CH
Central banks	BdF, SNB	MAS, SARB, RBA, BNM	HKMA, BoT, PBoC, CBUAE	CBs of SE, NO and IS	BdF, MAS, SNB
Output	Prototype	Prototype	Pilot	PoC	PoC
Type of CBDC	Wholesale, Intraday	Wholesale, O/N w/o interest	Wholesale, Intraday & O/N	Retail	Wholesale
Currencies	EUR, CHF	AUD, MYR, SGD, SAR	HKD, CNY, THB, AED	ILS, NOK, SEK	EUR, SGD, CHF
Transaction type	Real value	Simulated	Real value	Simulated	Simulated
Interoperability model	Common plat. w subnetworks	Common platform	Common platform	Hub and spoke	Common platform for FX
DLT	Corda	Corda, Quorum	mBridge Ledger	Corda, Hyperledger Besu, Ethereum Quorum	Ethereum
Operator	Private	Central banks	Central banks	Central banks	Central banks

¹³¹ BIS.org “Options for access to and interoperability of CBDCs for cross-border payments” July 2022 <http://tinyurl.com/yarwecj6>

¹³² BIS.org “Lessons learnt on CBDCs” July 2023, <http://tinyurl.com/4zyzcwkn>

Extra use cases	PvP, DvP, offshore	PvP, offshore	PvP	PvPvP	FX trading, PvP
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The Jura, Dunbar, and mBridge projects have successfully established a wholesale CBDC system network capable of conducting cross-border transactions. However, the success relies on the fact that all three wholesale CBDCs use the same blockchain protocol. At present, there is still no use case to integrate two DLT platforms with different blockchain protocols to enable cross-border transactions.

12

Conclusion and Recommendations

12.1. Conclusion

The Digital Rupiah design provided by Project Garuda already has a strong foundation for further development. The framework and implementation roadmap within the Digital Rupiah design has successfully reflected the two principles promised by the Project Garuda working group, namely the “do no harm” and coexistence principles.

On the other hand, although the design has established a clear framework for target outcomes to ensure successful implementation, the technical aspects of the implementation have yet to be disclosed. Without an explanation of these technical aspects, certain projections become challenging to make, especially projections regarding comparisons with current technologies and the feasibility of the proposed decentralized infrastructure.

In addition, success with both principles does not guarantee the achievement of Project Garuda's three goals. The first goal, ensuring the sovereignty of the Indonesian currency and preventing the emergence of shadow banking, depends on the level of adoption of Digital Rupiah by both the public and the industry players. The Project Garuda working group has prepared several strategies and standout features to promote adoption, but the level of public adoption cannot be guaranteed at this stage.

The second goal, the transformation of the Indonesian payment system to enhance financial inclusion and accommodate the rising demand for decentralized financial services, is closely related to the first goal. To avoid public defection from the national currency to crypto-based currencies, as seen in Nigeria, Project Garuda plans to provide standout features that will make it more attractive for adoption. One feature that will have a significant impact on the inclusion capacity of Digital Rupiah, especially in remote and underdeveloped areas (3T), is the offline digital transaction feature. By leveraging DLT and smart contract functions, Digital Rupiah users will be able to conduct digital transactions even without an internet connection.

The third goal from Project Garuda, preparing low-cost cross-border payment infrastructure, is a more challenging objective to achieve. Based on other countries' experience, the CBDC projects have succeeded in implementing the infrastructure for cross-border transactions using the same blockchain protocols. At this time, there is still no use case for integrating two DLT platforms with different blockchain protocols.

12.2. Recommendations to the regulator

Overall, Project Garuda is ready to begin its next phase, however, there are still several core issues that need to be resolved. One of the major issues is the prospect of Digital Rupiah's ability to integrate with cross-border CBDC infrastructure. The development of CBDC technology needs to be carried out in collaboration with multilateral initiatives, such as BIS.

Meanwhile, the immediate issue related to participants' readiness for the trial phase, both in terms of human resource readiness and liquidity readiness. At the same time, the speed of each stage of the Digital Rupiah rollout also needs to be adjusted to the liquidity needs of the relevant market. At the same time, the speed of each stage of the Digital Rupiah rollout also needs to be adjusted to the liquidity needs of the relevant market. In the immediate trial phase, a too-rapid transition

poses the risk of triggering liquidity congestion in financial institutions that are in the process of adopting Digital Rupiah.

Entities participating in the adoption of Digital Rupiah, both in the trial phase and in the full implementation stage, should not be disadvantaged compared to continuing business as usual. Wholesale participants assigned as validator nodes will have to bear the burden of validation processes, while retail participants connected to the Digital Rupiah network will have to bear the burden of virtual account rental and other expenses related to the conversion between w-Rupiah and r-Rupiah. If participants on either tier are disadvantaged, they will need to be compensated.

In addition to compensation, it is also important to ensure that parties that have already contributed significantly and invested heavily in Indonesia's digital economy, such as Fintech players, remain involved in the stages of Digital Rupiah development. Fintech players are likely to bear the most direct impact by Digital Rupiah policies alongside consumers. Therefore, it is crucial to continue involving Fintech players in the development process, from conceptualization to implementation and finalization.

Channels for receiving feedback on Digital Rupiah from consumers and the industry also need to be maintained after Digital Rupiah is launched and operational. This will ensure that any issues arising after the implementation of the Digital Rupiah are captured as quickly as possible and solutions are promptly identified. Furthermore, these channels are also useful for BI as the administrator of Digital Rupiah, allowing it to communicate and coordinate any adjustments to Digital Rupiah that have already circulated in the market.

13

Glosarium Terminologi

Glosarium Terminologi

A	
Adoption uptake	Significant increase in adoption rate. In the context of CBDC, uptake is an increase beyond a certain intensity that marks the potential for widespread use of CBDC in society.
B	
Bank Run	The phenomenon in which customers withdraw their deposits from banks en masse. This phenomenon occurs when customer confidence in banking institutions drops drastically.
Bankable	A community or category of individuals that can receive or register for banking services.
Blockchain	A system composed of blocks, or encrypted units. In the context of CBDC, a block represents a transaction.
C	
Cashless society	A Society or Community that no longer uses cash for transactions.
Centralized Ledger	The system in which the ledger of the financial sector is stored by a central institution.
Cloud Services	Storage services that do not use a single physical server. This storage uses a network of devices that backup the data simultaneously, leaving almost no single point of failure, although damage to one device may leave some parts of the storage inaccessible.
Cold wallet	The storage of a bank or payment service provider’s cash data offline for security purposes. With the existence of a cold wallet, failures in digital or online transactions can be reconciled with data in the cold wallet.
Confidential Transactions	The financial oversight approach ensures a portion of each transaction remains confidential and inaccessible to supervisors.
Crypto-collateralized	The process of securing the value of an asset with cryptocurrency.
Cyber Attack	Intentional disruption of a digital network by a party from outside the network.

D	
Data Granular	The most fundamental category of data that cannot be derived or further divided into other categories.
Data retention capacity	The capacity of a device to store information, measured in units of time.
Depository	An institution that provides asset storage services.
Digital Financial Economy	The measure and proportion of digital transactions within an economy.
Digitalization	The process of transferring storage, management, or processing of data from physical intermediaries to digital intermediaries.
Disintermediation	The process of the disappearance of the role of a category of financial institution from the settlement of payment services.
Distributed Ledger Technology (DLT)	Documentation technology for transactions in which each connected device holds a ledger for each transaction in the network.
Do No Harm policy	An approach or principle that prioritizes minimal impact when implementing a new product or instrument.
E	
Elimination/Redemption	The process of destroying or eliminating units of Rupiah currency.
F	
Fiat-collaterized	The process of securing the value of an asset with fiat currency.
I	
Interoperability	The ability of an object to be used in two different systems without the need for a conversion process. In the context of CBDC, interoperability means that CBDC can be used in the legacy interbank system and the w-Rupiah system without the need for conversion, although it may still incur a cost.
K	
Khazanah (minting) Rupiah	The process of creating or issuing rupiah currency.
L	
Low cost stable funding	A funding source standard that charges a small fee or no fee. This standard also comes with the expectation that the fee is stable and will not change.

M	
Macroprudensial	A specific approach to policy that is countercyclical in nature. Policy instruments under this approach tend to take the form of processes that do not impact or is affected by the business cycle.
Market Fragmentation	The process of a market’s division. In the context of CBDC, fragmentation is the emergence of a part of the market that can no longer transact directly with other parts of the market.
Monetary Operations	Monetary policy actions that aim to achieve stability in the financial system.
N	
Node	A unit of account or input point in a blockchain network. A transaction on a blockchain requires at least two nodes.
P	
Permissioned DLT	A category of DLT systems where the validator positions are assigned by the network administrator.
Piloting	The pilot phase of a project aims to determine the feasibility of the project.
Processing power	The capacity of a device to run computing processes.
Procyclicality	A phenomenon where an incident of economic growth in a period cannot be supported sustainably by the period of contraction cycle that follows.
Proof of authority (PoA)	A validator qualification system that is based on the status of the institution that will be used as a validator. This system tends to have an administrator who selects each validator one by one.
Proof of concept	The initial concept of a project or development of a system or product.
Proof of work (PoW)	A validator qualification system that is based on the encryption capacity or computing power of the party who will become a validator. The validator selection process in this system tends to be automated. Anyone who demonstrates device capabilities above a certain limit will be automatically appointed as a validator.
Prototyping	The first release of a system or product in development. In this context, a prototype is a version of the first Digital Rupiah that will still be developed further.

R	
Remittance	A service that sends cash across national borders.
S	
Sandboxing	The pilot phase of a project where the project subject is exposed to external factors in a controlled environment. The purpose of this stage is to explore the resilience of the project to external factors.
Scalability	The feasibility or difficulty of a system to be expanded. Scalability can be considered low if expansion requires large investment costs.
Security	A category of investments that can be traded. A security may consist of debt, futures, securities, or derivatives of other securities.
Settlement finality	Absolute certainty in the completion of a transaction.
Shadow banking	A category of financial institutions or intermediaries that cannot be supervised and are completely unaffected by monetary policy.
Shadow currency	A currency that can neither be monitored by a central bank nor be influenced by monetary policy.
Single point of failure (SPOF)	An identification of risk whereby a system may fail when a problem arises at a singular point or party.
Single-tier retail CBDC	Digital Money that is distributed directly by the central bank and can be used by consumers.
Socialization	The process of internalizing a new phenomena or object into people's daily lives.
Stablecoin	A crypto asset with guaranteed stability because its value is based on a stable asset.
T	
Tiering and capping	A risk management system where customer have transaction limit based on their trust level level, the higher their trust level, the higher their limit. In this context, one of the methods for the customer to increase their trust level is by validating their identity or subjecting themselves to higher scrutiny.
Tokenization	The process of converting an asset, whether physical or non-physical, into a crypto asset that is calculated in units of tokens.

V	
Validation Process	The confirmation process of a blockchain transaction, accompanied by encryption, and the recording of the transaction in the network’s ledger. A critical stage in the completion of a blockchain transaction
Validator	Performers of validation duties within the blockchain network.
Z	
Zero-knowledge proofs	A supervisory protocol that maintains the confidentiality of customer transactions. This protocol encrypts part of the transaction data so that the supervisor can only confirm that a transaction between 2 parties actually occurred or not.

