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The Legal Analysis of Central Bank Digital Currency (CBDC) as a Kind of Money

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Abstract

Technological advancements are reshaping society and transforming the financial system. The rise of digital currencies issued by private entities has been an alarm for central banks to explore a central bank digital currency (CBDC), a digital version of cash issued by the central bank. More than 90% of central banks worldwide are undertaking research on CBDC, including the Bank of England and Bank Indonesia, and some countries have already adopted it as legal tender. CBDC marks a significant milestone in the innovation of money that potentially reshapes the future of the financial system.

The issuance of CBDC as a new form of money must be carefully examined from various dimensions, including a legal perspective, especially if it were adopted into the financial system and made available for public use. Acknowledging the emergence of a digital form of central bank money and its potential adoption in the future, this thesis aims to present novel legal concepts and arguments in relation to CBDC, seeking to make a meaningful contribution to the legal field and support its implementation. Moreover, this thesis attempts to fill the gaps in the existing legal literature and research related to money, digital money and CBDC.

The focus of this thesis is mainly on private law, including property law, areas that remain largely unexplored in previous literature. This thesis employs a doctrinal legal research methodology, analysing legal sources and materials to develop a legal analysis of CBDC mainly from the perspective of English Law. Given that money has universal concepts and characteristics for discharging debts, such legal analysis will also serve as a comparative foundation for the eventual introduction of CBDC in Indonesia, particularly for retail payments.

This thesis argues that existing money principles and theories in the English legal system remain applicable to CBDC, meaning that the issuance and adoption of CBDC can still be accommodated under these principles and theories. However, refinement of the existing legislation would be needed to accommodate the nature of CBDC as a new kind of money.

Regarding the issuance of money, this thesis shows that the state has the authority to proclaim a thing as money, regardless of its materials. This authority also extends to CBDC, which is classified as state-issued money. CBDC can also serve the same functions as traditional money, such as banknotes and coins, and can be declared legal tender, especially when it is designed for retail payment. However, in order for the general public to use this kind of money to discharge debts, it would need to be conferred a legal tender status by the legislation.

To protect the rights of the CBDC holders, including their privacy, the central bank must govern the system and technology employed in CBDC. The finality of settlement in the transactions must also be guaranteed by the central bank. This settlement is essential to confirm that the transaction is final, unconditional and irreversible. From the perspective of property law, individuals holding CBDC would generally hold proprietary rights that include the right to payment on central bank money in some other form, enforceable directly against

the central bank as the issuing party. They also have the right to services, enforceable against the distributing entities, such as commercial banks acting as intermediaries in the transaction.

Furthermore, the law must be capable of recognising and protecting the rights of the CBDC holders, especially when CBDCs are transferred from one party to another. In this context, the law must guarantee that the payee has the same proprietary rights as the payer had when the funds were under their control.

Lay Summary

This thesis explores Central Bank Digital Currency (CBDC) from a legal perspective. CBDC represents an innovation in money, introducing a fully digital form of cash that employs advanced technology while retaining functions similar to those of traditional cash. It is issued by the state through the central bank. CBDCs can be designed for large-value payments, available to financial institutions or designated parties, and for small-value payments, which will be accessible for all households.

CBDCs are expected to be adopted globally in the future as a means of payment, positioning them as the future of money. Many central banks, institutions and scholars have conducted studies, including pilot projects on CBDC. From these studies, CBDCs come in a variety of designs. It can be designed for both large and small value payments, and it can work with or without a network. CBDC can also be stored and processed through an account or a token. Nonetheless, extensive research and preparation, including legal aspects, are needed before introducing a CBDC to the public, given its involvement with public money.

To address such a need, this thesis analyses the legal aspects of CBDC, primarily from a private law perspective. It aims to provide an understanding of CBDC as a form of money and to address the legal concerns associated with it, especially those related to individuals' rights. Recommendations on the refinement of the law are also offered in this thesis.

In general, CBDC is a kind of money that can serve the traditional functions of money. Furthermore, the legislation must declare it as legal tender for the public to use as a means of payment. Since it is in a digital form, the transfer of CBDC will need to be conducted in a system. Related to this transfer, in principle, once CBDCs are transferred by the payer to the payee, it must be ensured that the payer's debts are settled, and the payee now has the right to use such CBDCs. Additionally, there must be individual rights embedded in CBDC. These cover the rights to payment from the central bank and the rights to obtain services from banks or entities that manage the media or devices for storing CBDC.

This thesis argues that law is crucial for CBDCs to exist in the financial system as a kind of money available for the general public. Such a law is important to safeguard the rights of individuals who hold CBDCs.

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All glory be to God.

Declaration

According to the Postgraduate Assessment Regulations for Research Degrees, Regulation 34, I hereby declare that this thesis has been composed solely by myself and that it has not been submitted, in whole or in part, in any previous application for a degree. The work contained in this thesis is entirely my own, except where stated otherwise by reference or acknowledgement.

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Edinburgh, 16 October 2025
Fransiska Ari Indrawati

Date of VIVA : 2 December 2025
Examiners : Prof. Sarah Green
Dr. Evgenia Ralli

Table of Abbreviations

API	application programming interface
BIS	Bank for International Settlements
BI-RTGS	Bank Indonesia Real Time Gross Settlement
BoE	Bank of England
CBDC	Central Bank Digital Currency
CBDCs	Central Bank Digital Currencies
CDD	customer due diligence
CHAPS	clearing house automated payment system
OPS Protocol	offline payment system protocol
DSC3	Digital Symmetric Core Currency Cryptography
DLT	Distributed Ledger Technology
FMI	financial market infrastructure
IMF	International Monetary Fund
ISO	International Organization for Standardization
KYC	Know Your Customer
PoS	Point-of-Sale
RTGS	Real Time Gross Settlement
NFC	near-field communication
NIRP	negative interest rate policies
UTXO	unspent transaction output
UKJT	UK Jurisdiction Taskforce
US	United States
UK	United Kingdom
UCC	Uniform Commercial Code
SIPS	systemically important payment systems
SOV	the Sovereign (Marshall Islands currency)

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art 23	4.82
art 33(2)	4.82
Law No. 23 of 1999 on Bank Indonesia as amended lastly by Law No. 4 of 2023 on Strengthening and Development of the Financial Sector. ("Bank Indonesia Law")	5.14
art 15	5.14
Law No. 28 of 2014 on Copyright	8.47
art 16	8.47
Law No. 27 of 2022 on Personal Data Protection	9.59
Bank Indonesia Regulation No. 17/3/PBI/2015 on Mandatory Use of Rupiah within the Territory of the Republic of Indonesia	4.81
Bank Indonesia Regulation No. 23/7/PBI/2021 on the Payment System Infrastructure Providers	5.57, 6.14
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CHAPTER 1

INTRODUCTION

I. Background

1.1. The evolution of money and its usage heavily depend on technological advancements. As the world enters an era of electronic monies and virtual economies, rapid innovations in new forms of money are changing society and transforming how the financial system works.[1]

1.2. The increasing prevalence of private virtual currency, the declining use of cash in daily transactions and the soaring adoption of digital payments have prompted central banks to research the possible implementation of government-issued digital currency or central bank digital currency (CBDC).

1.3. This thesis discusses CBDC from the perspective of money as a creation of the State through the central bank. The discussion will primarily draw on legal research, while sociological research is methodologically excluded from the thesis when discussing the concept and creation of money. The concept of money itself can be broad, as it can refer to money created by the central bank or commercial banks.[2] Cryptocurrencies, on the other hand, are considered more as speculative assets rather than money.[3] In a modern economy, money is largely created by commercial banks through the issuance of bank loans.[4] These loans correspond to bank deposits in the bank's accounts, therefore creating new money.[5] The higher these deposits, the more banks should hold adequate central bank money to meet the public's withdrawals or settle payments to other banks.[6] To control the creation of money in general, the central bank sets the interest rate in line with its monetary policy's objectives.

1.4. According to the Bank for International Settlements (BIS), at the end of 2023, 94% of the surveyed 86 central banks, including the Bank of England (BoE) and the Bank Indonesia,

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[1] Morten Bech and Rodney Garratt, 'Central Bank Cryptocurrencies' (2017) BIS Quarterly Review, 55 < https://www.bis.org/publ/qtrpdf/r_qt1709f.pdf > accessed 12 September 2025.
[2] Michael McLeay and others, 'Money creation in the modern economy' (2014) Quarterly Bulletin, 14 <https://www.bankofengland.co.uk/-/media/boe/files/quarterly-bulletin/2014/money-creation-in-the-modern-economy.pdf> accessed 12 September 2025.
[3] Grégory Claeys and others, 'Cryptocurrencies and monetary policy' (2018) Policy Contribution Issue No 10, 6 <https://www.bruegel.org/system/files/wp_attachments/PC-10_2018_2.pdf> accessed 12 September 2025.
[4] McLeay and others (n 2) 14.
[5] ibid.
[6] ibid.

were researching CBDC.[7] Among them, 30% focused only on retail CBDC, while 2% preferred wholesale CBDC.[8] Around 54% were experimenting with proofs of concept, and 31% were conducting pilot projects.[9] Additionally, fifteen CBDC projects involving cross-border payments were being conducted by central banks.[10] Given the widespread interest, CBDCs will be the next milestone in the evolution of money and fundamentally change the financial system, with many studies showing the potential benefits.

1.5. To date, several central banks have issued CBDC, which are the Bahamas with Sand Dollar or Digital Bahamian Dollar, Nigeria with e-Naira, and Jamaica with Jam-Dex.[11] In the United Kingdom (UK), the government and the BoE have not made a decision on issuing CBDC.[12] A thorough assessment and sequenced phases of work on CBDC would need to be conducted over several years. In Indonesia, Bank Indonesia plans to issue a CBDC called the Digital Rupiah.[13] The legal basis for the Digital Rupiah has been established through an amendment to the Indonesian Currency Law in 2023, with an effective date two years after its enactment. The initial implementation of the Digital Rupiah will be confined to wholesale payments, followed by retail payments. However, the launch of the Digital Rupiah for retail payments requires further research and detailed regulations before it is introduced to the general public. As the fourth most populous country in the world, with approximately 285 million inhabitants, the launch of the Digital Rupiah as a means of payment would be a game-changer for the Indonesian monetary and payment system. Therefore, the legal framework for the Digital Rupiah, including its implementing regulations, should be designed carefully.

1.6. Many central banks and institutions have conducted research and launched projects related to CBDC. This thesis selects several CBDC projects based on their focus and relevance to the discussion. These projects are more developed than others and thus serve as strong examples to analyse from a legal perspective. For example, Project Digital

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[7] Alberto Di Iorio and others, 'Embracing diversity, advancing together – results of the 2023 BIS survey on central bank digital currencies and crypto' (2024) BIS Papers No 147, 4 < https://www.bis.org/publ/bppdf/bispap147.pdf > accessed 12 September 2025.

[8] ibid.

[9] ibid.

[10] According to CBDC Trackers, there are fifteen CBDC Projects that also involves cross border Payment: Project Polaris, e-CNY, Project Dunbar, Project Icebreaker, Project Mariana, Project Mandala, Project Rosalind, Project Aurum, Project m-Bridge, Digital Euro, Project Sela, Project Agora, Venus Initiative, Project Helvetia, D-Cash 2.0. See Central Bank Digital Currency Tracker, <https://www.atlanticcouncil.org/cbdctracker/#:~:text=137%20countries%20%26%20currency%20unions%2C%20representing,pilot%20projects%20around%20the%20world> accessed 12 September 2025.

[11] See Sand Dollar <https://www.sanddollar.bs/> accessed 12 September 2025; See e-Naira, < https://www.enaira.gov.ng/ > accessed 12 September 2025; See Bank of Jamaica, *Jamaica's Central Bank Digital Currency (CBDC) – JAM DEX* <https://boj.org.jm/core-functions/currency/cbdc/> accessed 12 September 2025.

[12] John Glen, 'Central Bank Digital Currency: Statement made on 9 November 2021' (2021) UK Parliament < https://questions-statements.parliament.uk/written-statements/detail/2021-11-09/hcws381 > accessed 12 September 2025.

[13] Bank Indonesia, 'News Release: CBDC Role in Strengthening Implementation of Central Bank Mandate' (2022) Press Release No. 24/177/DKom <https://www.bi.go.id/en/publikasi/ruang-media/news-release/Pages/sp_2417722.aspx> accessed 12 September 2025; M Taufan Rengganis, 'Bank Indonesia Highlights Three Major Benefits of Digital Rupiah,' *Tempo.Co*, 2021, <https://en.tempo.co/read/1496802/bank-indonesia-highlights-three-major-benefits-of-digital-rupiah> accessed 12 September 2025.

Euro and the Project e-CNY are discussed in the context of wholesale and retail CBDCs. Project e-Krona and Project Polaris are considered key in the context of offline CBDC. This thesis explores several other CBDC projects whose arrangements and features are relevant to the discussion.

1.7. However, in general, most central banks are still in the phase of carefully designing CBDC aspects that require deliberate planning, including legal ones. Some central banks are still in the early stages of their preliminary exploration. China may be leading the way in developing and trialling CBDCs, driven by its motivation to promote financial inclusion and supported by its strong technological capabilities.[14]

II. Research Questions

1.8. This thesis addresses three main research questions regarding CBDC. First, can CBDC qualify as a form of money that can serve the functions of traditional money and as legal tender? As a new form of money, CBDC raises the fundamental question of whether it can be used as a means of payment. To answer this, the discussion will cover the history of money, the legal principles of money, the functions of money and the concept of legal tender. Relevant theories on money and central banking will be analysed to determine whether CBDC can be categorised as money in a form of central bank money. This analysis will also consider the legality of central banks issuing CBDC.

1.9. Second, if CBDCs were declared as money and given the status of legal tender, then how can legal certainty in CBDC transactions be ensured, including the protection of the rights of CBDC holders? This question is necessary to establish the legality of the issuance, distribution and transfer of CBDCs while protecting the rights of the public as CBDC holders. The discussion will address Distributed Ledger Technology (DLT) as a potential technology for CBDC transactions and its governance, legal principles and schemes in finality of settlement in CBDC transactions, and the rights of CBDC holders as both the payee and payer.

1.10. Third, what is the legal nature of a CBDC in the context of property, and what proprietary rights are associated with it? Determining whether a CBDC can be classified as property is crucial, especially given that a CBDC can exist in account-based and token-based forms. Legal discussion on this aspect would provide an understanding of the legal characteristics of CBDC and a basis to examine the scope of proprietary rights of the CBDC holders.

1.11. This thesis addresses the above research questions mainly from a legal. Those questions will be analysed using the existing legal principles of money, including the relevant regulatory framework, to see whether those remain applicable or require refinement. The first research question is fundamental to discussing whether a CBDC can be classified as money. Once this qualification is established, the next issue concerns the use of CBDC in transactions, including the underlying technology and the finality of

[14] Ross P Buckley and Heng Wang, 'China's Central Bank Digital Currency Will Transform the International Monetary and Financial System' (2022) < https://blogs.law.ox.ac.uk/oblb/blog-post/2022/11/chinas-central-bank-digital-currency-will-transform-international-monetary > accessed 12 September 2025.

settlement. The final question examines CBDC as a form of property. Collectively, the discussions on those questions ultimately aim to protect individual rights.

III. Significance of Research

1.12. Although various topics related to money and CBDC have been explored in the existing literature, the legal aspects of CBDC, particularly from a private law perspective, remain largely unexamined. This may be due to the wide range of possible CBDC designs and a variety of potential legal arrangements involving individuals' rights, which make legal analysis in this area particularly complex. If CBDCs were issued for public use, in Indonesia alone, they would be used by more than 280 million individuals whose rights should be protected. While CBDC would be the next milestone in the evolution of money, a thorough analysis of CBDC from a private law perspective, including property law, is needed.

1.13. This thesis aims to provide a comprehensive analysis of the legal aspects of CBDC as a kind of money, including its legal treatment, with a focus on protecting the rights of individuals as CBDC holders. The legal discussion offered in this thesis is expected to fill the gaps in the existing legal literature and research related to money, digital money, and CBDC.

1.14. The original ideas and legal arguments in this thesis aim to contribute meaningfully to the issuance of CBDC in the future in the UK, Indonesia and other countries with a similar interest in it. By concentrating on the private law aspects, an area which has generally been studied less fully, this thesis can provide valuable insights for regulators, legal scholars and the general public. In addition, the general reflections explored in this thesis will help to identify key legal aspects that are needed for the effective issuance and adoption of CBDC. Noting that Indonesia already has a legal basis to implement CBDC in its financial system, this thesis contributes to the issuance of CBDC in Indonesia by proposing a minimum scope of implementing regulations for such issuance.

IV. Methodology

1.15. The methodology of the thesis is a doctrinal legal study that undertakes a comprehensive legal analysis of CBDC as a form of money. This methodology concerns with the formulation of 'legal doctrines' by analysing legal rules case law, legislation, and statutes related to money, legal tender, digital money and the personal rights of money holders.[15] Historical analysis of money is also explored to understand the concept of state-issued money, its transition from tangible to intangible and the role of legislation from time to time. Discussions on several CBDC designs to which this legal analysis applies are also based on the most fully developed CBDC projects, as mentioned in paragraph 1.6.

[15] Paul Chynoweth, 'Legal Research' in Andrew Knight and Les Ruddock (eds), *Advanced Research Methods in the Built Environment* (Willey Blackwell 2008) 29; Terry Hutchinson and Nigel Duncan, 'Defining and Describing What We Do: Doctrinal Legal Research' (2012) Deakin Law Review, 84 < https://ojs.deakin.edu.au/index.php/dlr/article/view/70/75 > accessed 12 September 2025.

1.16. During 2022 – 2025, the author also held several discussions with the representatives of Bank Indonesia, the Central Bank of Spain, the International Monetary Fund (IMF), BIS and a UK-based cryptography engineer. Discussions with those representatives have enabled the author to develop a strong understanding of the concepts and policies related to CBDC, as well as technical perspectives on relevant technology and systems.

1.17. Drawing on the analysis of the above sources, including the historical examination of money presented in this study, this thesis proposes a legal analysis of CBDC as a new form of money, along with legal principles and refinement of legislation that are needed to support the issuance and adoption of CBDC. The crux of the doctrinal method will be analysing the sources of law and legal principles that define the nature and parameters of the law.[16]

1.18. This thesis also contains a literature review of books and official documents related to money, CBDC, payment systems and their infrastructures from central banks such as the BoE and Bank Indonesia. General research and advisory documents, such as working papers and strategic documents published by international institutions like the BIS and the IMF, are also analysed.

1.19. Given that money has universal concepts and characteristics for discharging debts, its legal analysis should not vary substantially across jurisdictions. This thesis examines the legal perspective of CBDC under English law while also providing a comparative foundation for the eventual introduction of CBDC in Indonesia, particularly for retail payments. In the UK, the BoE has conducted extensive studies on its proposed CBDC, the Digital Pound, although a final decision on its issuance has not yet been made. Bank Indonesia is also actively conducting research on its CBDC, the Digital Rupiah, and has already established a legal basis for its issuance. Even so, the adoption of CBDC into the financial system, particularly for retail use, requires thorough legal research.

V. Structural Overview

1.20. This research covers five parts. First, it sets out a background of research in the thesis and provides an introduction on CBDC. Second, it explores the main theories, doctrines and concepts related to the functions, characteristics and creation of money. These include the commodity theory of money,[17] the theory of sovereign power over money,[18]

[16] ibid.

[17] The commodity theory of money investigated money as purely commodity origin and applies purchasing power in supply and demand. Also, this theory perceived that fiat money is not the essence of money as it cannot determine its value. See Arthur Nussbaum, *Money in the Law National and International: A Comparative Study in the Borderline of Law and Economics* (The Foundation Press Inc 1950) 22; See Howard S Ellis, *German Monetary Theory* (Harvard University Press 1934) 4.

[18] Theory of Sovereign Power over Money asserted the sovereignty power of the King or the State through its power to mint coins which also connected to the State Theory of Money that contended the power of the State to define money and its function within the State. This theory also relates to Monetary Sovereignty concept. See David Fox, 'Money, Law and Institutions', in S. Battilossi, Y. Cassis & K. Yago (eds), *Handbook of the History of Money and Currency* (Springer 2020) 161; See Rosa Lastra, *International Financial and Monetary Law* (Oxford University Press 2015) 2.16; See Georg Friedrich Knapp, *The State Theory of Money (*Abridged edition, London: the Royal Economic Society by Macmillan 1924) 24.

the state theory of money[19] and theories on legal tender.[20] They are essential; the legal analysis of CBDC as money should be based on them, even though the design and technology of CBDC may change.

1.21. Third, the thesis examines the concept of CBDC, including its designs, technology, and scheme or configuration, as well as finality of settlement in CBDC. Studies on the DLT[21] as a potential technology for CBDC, including its mechanisms and technicalities, serve as the basis for the subsequent legal analysis of the issuance, distribution and transfer of CBDC. Fourth, the thesis analyses the status of CBDC as property, one of the core aspects of its status in private law. Foundational principles in designing CBDC and concluding remarks of this thesis are covered in the fifth part.

1.22. The thesis consists of ten chapters. Starting with Chapter 3, the discussion in each chapter proposes legal principles and analyses to support the issuance and adoption of CBDC within the financial system.

1.23. Chapter 1 introduces the thesis, then Chapter 2 offers a general understanding of CBDC as a new form of central bank money, including its traits and technicalities. It forms the basis for the legal analysis of CBDC in the subsequent chapters. Chapter 2 explores a variety of CBDC designs, such as wholesale and retail, account-based and token-based systems, online and offline functionality, and their usage in domestic and cross-border transactions. This chapter also defines the scope and limitations of the legal discussions on CBDC in the thesis.

1.24. The main substantive part of the research begins in Chapter 3, which provides further detail on CBDC by tracing the history and development of money from ancient times to the digital era, including recent innovations in the financial system. This chapter primarily examines the general characteristics of CBDC in relation to its functions, materials, issuance, distribution and transfer mechanisms. It also compares these features with those of existing forms of money, highlighting that the characteristics of CBDC, to some extent, combine elements of cryptocurrencies, cash and commercial bank money.

1.25. Chapter 4 continues the legal analysis by examining fundamental theories of money and their relevance to CBDC. It considers how sovereign power over money, the state theory of money and theories on legal tender apply to CBDC. The chapter proposes that CBDC should be regarded as state-issued money capable of functioning as a means of

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[19] Knapp (n 18) 24.

[20] Legal tender concept may have several interpretations such as a specific thing with specific value that is proffered in payment and the quality of money given by the State on certain forms of the medium of exchange. As the status of legal tender given by the State, any refusal of such legal tender may expose the creditor to certain risks. See Simon Gleeson, *The Legal Concept of Money* (Oxford University Press 2018) 134; See David Fox, *Property Rights in Money* (UOP 2018) 1.90.

[21] See Raphael Auer and Rainer Böhme, 'The Technology of Retail Central Bank Digital Currency' (2020) BIS Quarterly Review <https://www.bis.org/publ/qtrpdf/r_qt2003j.pdf> accessed 12 September 2025; See Bank of Canada and others, 'Central Bank Digital Currency: operability' (2021) Report No. 2 < https://www.bis.org/publ/othp42_system_design.pdf > accessed 12 September 2025.

payment. However, it concludes that legislation is required for the state or central bank to confer the status of legal tender on CBDC.

1.26. Chapter 5 focuses on the possible technologies used by CBDC. It analyses the legal aspects of DLT, which many central banks are likely to adopt. The chapter further argues that the state or central bank should have full control over the creation of CBDC through the system. To ensure this control, a permissioned DLT or similar alternative would be preferred as long as it allows the state or central bank to maintain full oversight and control.

1.27. Following the discussion on DLT as a possible technology employed for CBDC, Chapter 6 seeks to explore the finality of settlement in CBDC transactions. Settlement finality is essential to give legal certainty to both the payee and the payer, ensuring that the payment is irrevocable and final. Thus, it eventually grants the payee a full and unconditional right to use the funds.

1.28. Chapters 7 and 8 analyse the proprietary rights for an account-based CBDC and a token-based CBDC, respectively. The rights in both CBDC designs comprise a mix of statutory and contractual rights that are enforceable against central banks and intermediary entities. Chapter 7 focuses on the proprietary rights in an account-based CBDC, where the existence of financial accounts is crucial to determining the rights of holders. These rights arise from contractual relationships with the intermediaries, which include the right to payment of central bank money in other forms, enforceable against either the central banks or intermediaries, and the right to services related to the accounts, which are enforceable against the entities managing those accounts. Chapter 8 examines the proprietary rights in a token-based CBDC system, which is more complex than an account-based one. It begins by discussing how a token-based CBDC fulfils the criteria of a digital object under English law, which is rivalrous and has an independent existence. The chapter argues that the right to receive payment from the central bank derives from statutory rights, and while the right to services stems from the contractual relationships between CBDC holders and the entities managing the medium for tokens.

1.29. Chapter 9 proposes four fundamental principles when designing CBDC if it were introduced to the public as a means of payment. This chapter synthesises the analysis in previous chapters to develop regulatory principles, aiming to protect the rights of CBDC holders, as follows. First, CDBC is a monetary instrument, and any policies issued by the related authority must prioritise and protect the public interest. Second, in line with the principle of economic freedom, CBDC holders should have autonomy and should not be restricted to using CBDC as a means of payment for any retail transaction they wish to use. Third, the main participants in the CBDC ecosystem, including central banks, intermediaries, and the public as end-users, must have clearly defined roles and responsibilities. Data protection and privacy should be considered when implementing CBDC. The Know-Your-Customer (KYC) procedures should be tailored to the specific CBDC design. Last, the CBDC system must be sustainable for the public as CBDC holders, addressing both environmental and security concerns.

1.30. Concluding remarks are given in Chapter 10 as the final chapter. These cover a summary of the thesis, recommendations related to the regulatory framework of CBDC and the need to increase literacy level on CBDC and involve private sectors in the issuance of CBDC. Since CBDC has various dimensions to explore, further legal research of CBDC from other legal branches is also needed in order to create a comprehensive legal analysis for CBDC.

CHAPTER 2

OVERVIEW OF CBDC

I. Introduction

2.1. As previously mentioned, this thesis investigates the legal aspects of CBDC as a kind of money mainly from the perspective of private law. It also explores the conceptual foundations, designs and potential underlying technologies of CBDCs. Attention is given to the rights of individuals in their capacity as CBDC holders, particularly in relation to holding and transacting with CBDC. However, before discussing the legal aspects of CBDC, it is essential to establish a general understanding of CBDC, which will be set in this chapter.

2.2. Like other forms of central bank money, CBDCs are direct liabilities of the central bank and can be used as a means of payment. Their designs vary depending on the technology employed and can serve different purposes, such as for wholesale or retail payment. However, given the features and characteristics of retail payment, retail CBDCs are the most suitable to be conferred the status of legal tender by legislation.

2.3. Depending on their accessibility and authentication methods, CBDCs can be operated on an account-based or token-based system. They may be designed for use in domestic and cross-border transactions and can be used with or without network connectivity (ie online or offline CBDC).

2.4. This chapter also establishes the focus of the thesis. The discussion primarily addresses concerns about the use of CBDC for retail payment domestically rather than for cross-

border transactions. As the effective implementation of CBDC requires a regulatory framework, this chapter also outlines the scope of the legal analysis relevant to that framework. While the discussion is conducted in terms of English law, it also offers foundational legal considerations for the issuance of CBDC in Indonesia.

II. Background for Conducting CBDC Research and Current State of CBDC

2.5. The decline in the use of cash in daily transactions, the rise in digital payments and the rapid growth of privately issued virtual currencies are key factors motivating central banks to explore and research CBDCs.[22]

A. Decline of the Use of Cash and Change in Payment Habits in Society

2.6. In general, societal payment behaviour has shifted from traditional methods toward online payments, largely driven by technological and social factors, as will be elaborated below. This shift has contributed, among other things, to a decline in cash use and, consequently, reduced access to central bank money. The impacts arising from these circumstances may be addressed through the issuance of CBDC as central bank money in digital version. The issuance of CBDC could enhance the accessibility to central bank money, particularly in countries with geographical challenges in distributing money, such as Indonesia, which comprises 17.000 islands. Digital central bank money could reduce the transportation cost for distributing money and, in doing so, improve the circulation of money.

2.7. Payment behaviour in society has undergone significant changes, shifting from traditional methods to digital payments, with the pandemic further accelerating the adoption of online payments.[23] During the pandemic, cash withdrawals dropped by 23%, which reflected the reduction in consumer cash usage due to decreased travel and commuting.[24]

2.8. In a 2020 European Central Bank survey, respondents stated their intent to use online payments and less cash due to hygiene concerns. These concerns led to a rapid increase in contactless payments, signalling a strong preference for avoiding cash or physical contact on the payment terminal or card.[25] People have also become discouraged from holding cash in large amounts due to the high costs associated with obtaining, storing and securing physical money.[26] For these reasons, the public's payment behaviour has shifted towards cashless payments. This shift has contributed to a decline in the use of cash, reducing the role of state-issued money as a means of payment to discharge debts.

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[22] Bank for International Settlements, 'BIS Annual Economic Report 2021' (2021) 67 <https://www.bis.org/publ/arpdf/ar2021e3.pdf> accessed 12 September 2025.

[23] European Central Bank, 'Study on the Payment Attitude of Consumers in the Euro Area' (2022) 12 < <https://www.ecb.europa.eu/stats/ecb_surveys/space/html/ecb.spacereport202212~783ffdf46e.en.html#toc9> accessed 12 September 20225.

[24] ibid 3.

[25] ibid 24.

[26] Monetary Authority of Singapore, 'A Retail Central Bank Digital Currency: Economic Considerations in Singapore Context' (2021) 30 < https://www.mas.gov.sg/-/media/mas/epg/monographs-or-information-paper/a-retail-cbdc---economic-considerations-in-the-singapore-context.pdf> accessed 12 September 2025.

2.9. The rapid growth of digital payments requires timely action from the government and the central bank to mitigate the negative impacts of the declining use of cash. CBDC may offer an effective way to address these challenges. Negative impacts include a growing reliance on privately issued money, which increases people's exposure to credit and liquidity risks.[27] In this context, a CBDC would provide a means of payment that is free from such risks.[28] Furthermore, the decline in the use of cash suggests that it may no longer be an effective backup payment method, particularly when a disruption occurs and a reliable payment option is needed.[29] The issuance of CBDC would also offer a viable public alternative with higher baseline standards for digital payments, while encouraging the private sector to drive innovation and technological advancements.[30]

B. The Rise of (Unregulated) Private Digital Currencies

2.10. Technological developments have driven interest in CBDC as an innovative means of payment. However, as a digital currency, it would provide an alternative payment option using state currency but digitally, thereby diminishing the competition from privately issued money. Its implementation would be governed and supported by a regulatory framework issued by the state that should be designed to consider the public interest. If it were designed as a legal tender, CBDC would offer a safer and more reliable payment option for consumers compared to cryptocurrencies.

2.11. The lack of a uniform regulatory framework for private virtual currency in developed countries shows that they are not prepared for the global phenomenon of cryptocurrency.[31] However, in July 2025, the United States (US) government launched the Genius Act that regulates stablecoins. This Act, aiming at protecting consumers, requires stablecoins to have 100% reserve backing with liquid assets and issuers to conduct monthly public disclosures.[32] Regarding cryptocurrency in some countries, such as Indonesia, they do not consider cryptocurrencies to be legal tender, even though some allow the usage of privately issued cryptocurrencies to pay for goods or services. Furthermore, a rapid increase in crimes involving the use of cryptocurrencies seems to suggest that these digital assets enable the emergence of a new global criminal community that transcends boundaries.[33]

2.12. Cryptocurrencies have certain characteristics that may pose risks to users. The risk of loss through 'ownership' of what may be the first true form of digital money would be

[27] ibid 11.
[28] ibid 21.
[29] ibid 12.
[30] ibid 23.
[31] D Towne Morton, 'The Future of Cryptocurrency: An Unregulated Instrument in an Increasingly Regulated Global Economy' (2020) *Loyola University Chicago International Law Review*: Vol. 16, 132 < https://lawecommons.luc.edu/cgi/viewcontent.cgi?article=1219&context=lucilr>
accessed 12 September 2025.
[32] The White House, 'Fact Sheet: President Donald J. Trump Signs Genius Act into Law' (2025) < https://www.whitehouse.gov/fact-sheets/2025/07/fact-sheet-president-donald-j-trump-signs-genius-act-into-law/ > accessed 12 September 2025; Guiding and Establishing Innovation for US Stablecoins (Genius) Act, Public Law 119-27, 119 Stat. 419 (2025).
[33] Morton (n 31).

challenging to protect against because, unlike theft of corporeal money, cyber-theft is an unbounded crime; there is no requirement of physical proximity between perpetrator and victim.[34] Cryptocurrencies are unregulated in many countries, and their holders do not benefit from the legal protection associated with regulated instruments.

C. Current State of CBDC

2.13. Several CBDC projects have been identified for legal analysis based on their depth and relevance to this research discussion. For example, when analysing the features of wholesale and retail CBDCs, Project Digital Euro and Project e-CNY are foremost in mind. In the context of offline CBDC, Project e-Krona and Project Polaris serve as key projects. Other CBDC projects are also explored in the thesis, where their features are relevant to the discussion.

2.14. As mentioned in the previous chapter, three central banks have fully issued CBDCs: the Bahamas (Sand Dollar or Digital Bahamian Dollar), Nigeria (e-Naira) and Jamaica (Jam-Dex).[35] Cambodia has also launched its national payment system app called Bakong which functions more like a mobile payment and banking app, allowing users to transfer money to any party using an individual's account registered within the app.[36] Although Bakong can be considered an account-based CBDC, the central bank did not make any reference to the concept of CBDC. The Marshall Islands have also introduced their national currency, the Sovereign (SOV), through the Declaration and Sovereign Issuance Act 2018.[37] However, according to BIS, SOV does not qualify as a CBDC because it does not fulfil the function of money: it is neither a central bank liability nor convertible at par with other kinds of central bank money.[38]

2.15. In the UK, the BoE's investigation into the Digital Pound is still in the design phase; no decision has been made as to whether to issue such money.[39] This phase of the project aims to lay a solid foundation for the next stages. However, such a decision should be made in the building phase, starting from 2025 or 2026, after conducting a pilot project.

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[34] Kelvin F K Low and Ernie Teo, 'Chapter 10 – Legal Risks of Owning Cryptocurrencies' In David Lee Kuo Chuen and Robert Deng (eds), *Handbook of Blockchain, Digital Finance, and Inclusion* (Volume 1, Academic Press, 2018) 242 < https://doi.org/10.1016/B978-0-12-810441-5.00010-5 > accessed 12 September 2025.

[35] See Sand Dollar < https://www.sanddollar.bs/>, eNaira <https://www.enaira.gov.ng/ > and Bank of Jamaica, *Jamaica's Central Bank Digital Currency (CBDC) – JAM DEX*, < https://boj.org.jm/core-functions/currency/cbdc/> accessed 12 September 2022.

[36] The Next Generation Mobile Payments and Banking < https://bakong.nbc.gov.kh/en/ > accessed 12 September 2025.

[37] See Republic of the Marshall Islands, the Declaration and Issuance of the Sovereign Currency Act 2018 < https://sfb-tech.com/wp-content/uploads/2024/10/law.pdf > accessed 20 August 2025.

[38] International Monetary Fund, 'Republic of the Marshall Islands: Selected Issues' (2018) IMF Country Report No. 18/271, 10 < https://www.imf.org/en/Publications/CR/Issues/2018/09/10/Republic-of-the-Marshall-Islands-Selected-Issues-46217 > accessed 12 September 2025.

[39] Bank of England, 'Progress Update: The Digital Pound and The Payments Landscape' (2025) https://www.bankofengland.co.uk/report/2025/digital-pound-progress-update accessed 25 July 2025.

2.16. Meanwhile, Bank Indonesia plans to issue Indonesian CBDCs, known as the Digital Rupiah, in wholesale and retail forms through an integrated system.[40] The initial stage began with the experiment on the wholesale CBDC. In 2024, Bank Indonesia completed the proof of concept for the wholesale CBDC. Testing was conducted to assess DLT as a potential technology for CBDC.[41] This CBDC will proceed across several phases until 2030, where the last stage will focus on cross-border CBDC.[42] This wholesale CBDC project will serve as a foundation for the future implementation of retail CBDCs.[43]

2.17. Most central banks continue to carefully design and plan their CBDC, including legal aspects, while the remaining central banks are at various stages in their exploration of CBDCs. China may be leading the way in developing and trialling CBDCs, driven by its motivation, among others, to promote financial inclusion and backed by its strong technological capabilities.[44] The second-largest CBDC project is India's rupee, which is developing retail and wholesale payments, including offline functionality.[45]

III. Concept of CBDC as Money

A. CBDC as a Digital Form of Central Bank Money

1. CBDC is Central Bank Money

2.18. The definition of traditional money must be explored to determine whether CBDC can be considered money. English law does not provide any legal definition for 'money'.[46] However, several definitions of money can be found in English law and in other countries, as follows:[47]

- The court in *Moss v Hancock*[48] viewed money as '[a thing] that which passes freely from hand to hand throughout the community in final discharge of debts and full payment for commodity, being accepted equally without reference to the character or credit of the person who offers it and without the intention of the person who

[40] Bank Indonesia, 'Project Garuda: Navigating the Architecture of Digital Rupiah' (2022) 19 < https://www.bi.go.id/en/rupiah/digital-rupiah/Documents/White-Paper-CBDC-2022_en.pdf> accessed 12 September 2025.
[41] Bank Indonesia, 'Proof of Concept: Wholesale Rupiah Digital Cash Ledger' (2024) 2 < https://www.bi.go.id/en/rupiah/digital-rupiah/Documents/Laporan_POC_Proyek_Garuda_EN.pdf > accessed 12 September 2025.
[42] Bank Indonesia, 'Indonesia Payment System Blueprint 2030 – Bank Indonesia: Accelerating Digital National Economy for Future Generation' (2024) 74, < https://www.bi.go.id/en/publikasi/kajian/Documents/Blueprint-Sistem-Pembayaran-Indonesia-2030-EN.pdf> accessed 12 September 2025.
[43] Bank Indonesia, 'Project Garuda: Navigating the Architecture of Digital Rupiah' (n 40) 19.
[44] Buckley and Wang (n 14).
[45] See Central Bank Digital Currency Trackers, 'Key Findings' <https://www.atlanticcouncil.org/cbdctracker/#:~:text=137%20countries%20%26%20currency%20unions%2C%20representing,pilot%20projects%20around%20the%20world> accessed 12 September 2025.
[46] Gleeson (n 20) 116.
[47] Charles Proctor, *Mann and Proctor on the Law of Money* (8th edn, Oxford University Press 2022), para 1.11-12.
[48] *Moss v Hancock* [1899] 2 QB 111, at 116.

receives it to consume it or apply it to any other use than in turn to tender it to others in discharge of debts or payment for commodity';

- The Supreme Court of Canada described money as 'any medium, which, by practice, fulfils the function of money which everyone will accept in payment of a debt is money in the ordinary sense of the words, even though it may not be legal tender'; and

Knapp clearly defined money as a means of payment where: '*money always signifies a chartal means of payment. Every means of payment we call money. The definition of money is therefore a chartal means of payment*.'[49]

2.19. Money also has various meanings in different contexts. For example, bank deposits may be categorised as money to the economist, but in private law analysis, they may be viewed as a debt or an obligation for the bank to repay.[50] Therefore, the law should be able to provide a framework within which money plays a role and its use has determined legal consequences.[51]

2.20. In Indonesia, the definition of money is found in the Indonesian Currency Law, which regulates currency as money issued by the state and defines money as a legal tender or a legal payment instrument.[52] This law, however, only regulates specific forms of money that are declared as legal tender. From the concept of money discussed above, money can be understood as any kind of medium that discharges debts, makes payments or settles any financial obligation. Furthermore, the state can declare whether such money is legal tender. Once money is declared as legal tender, then a creditor is obligated to accept it if tendered by a debtor to repay its debt.[53] This obligation on the creditor can be created only by law.[54]

2.21. The concept of CBDC is fundamentally similar to traditional central bank money, with the primary distinction being the digital element. CBDC is 'a new form of money, issued digitally by the central bank and intended to serve as legal tender' and which is distinct from other forms of money typically issued by a central bank (ie banknotes and traditional reserve accounts maintained by banks with the central bank).[55] BIS also defines CBDC as an electronic central bank liability, denominated in an existing (legally recognised) unit of account, which serves both as a means of payment and as a store of value, namely digital money of legal tender that is available for the general public.[56]

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[49] Knapp (n 18) 38.
[50] Proctor, *Mann and Proctor on the Law of Money* (n 47) Para 1.08.
[51] ibid.
[52] See Indonesian Currency Law, art 1 paras 1 and 2.
[53] Nussbaum (n 17) 45-46.
[54] ibid.
[55] Tommaso Mancini-Grifolli and others, 'Casting Light on Central Bank Digital Currency' (2018) (IMF Staff Discussion Note), 7 < https://www.imf.org/en/Publications/Staff-Discussion-Notes/Issues/2018/11/13/Casting-Light-on-Central-Bank-Digital-Currencies-46233 > accessed 12 September 2025.
[56] Bank for International Settlements, 'Central Bank Digital Currencies' (2018), 3 <https://www.bis.org/cpmi/publ/d174.pdf> accessed 12 September 2025.

2.22. The BoE and the Bank Indonesia introduced similar concepts for CBDCs. The BoE describes a digital pound as a digital banknote that would be used for everyday payments, both in person and online, which would be a direct claim on the central bank.[57] Like banknotes or other central bank money, a digital pound would not bear any interest, meaning that it would not be designed for investment or saving.[58] In the case of Indonesia, the Digital Rupiah would be designed for wholesale and retail payments.[59] For retail CBDCs, similar to the digital pound, they would serve as a means of payment.[60]

2.23. Several central banks, along with the BIS, have established foundational principles for creating CBDCs. These include ensuring that CBDCs must not undermine financial and monetary stability, that they coexist with and complement existing forms of money, and that they foster innovation and efficiency.[61] Additionally, much of the literature emphasises that CBDCs should also be convertible into other forms of central bank money at par value.[62]

2.24. From the above definitions and concepts of CBDC, it can be argued that CBDC would have a similar concept to traditional money available to the public, with the distinguishing characteristic lying in its form or materiality. If it were intended to be for public use, then just like traditional money, CBDC must be declared as legal tender by the state through legislation.

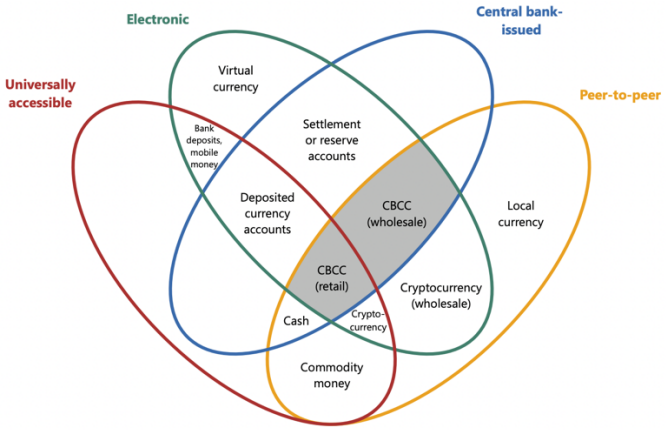
2.25. Whether a CBDC can fulfil the criteria as money or not depends on its design, as such a design may have different characteristics. In addition, Gutknecht and others have analysed ideal criteria for a monetary object to be equivalent to traditional money: possessing smoothness (security in balance with effectiveness), inclusivity, privacy, and it should be risk-free and uniform in terms of value.[63] Related to privacy, Gutknecht and others explained that the protection of privacy in dealings is crucial in a monetary object, but it should also consider the legal prevention of money laundering. Further theories, relevant laws, and cases discussing money and CBDC, their function, and their status as legal tender will be explored in a later chapter.[64]

2.26. Regarding the design of CBDC, in 2017, Bech and Garratt introduced the 'money flower' concept, encompassing both wholesale and retail applications, by combining the

[57] Bank of England and HM Treasury, 'Digital Pound: A New Form of Money for Households and businesses?' (2023) 13 < https://www.bankofengland.co.uk/-/media/boe/files/paper/2023/the-digital-pound-consultation-working-paper.pdf> accessed 12 September 2025; Bank of Indonesia, 'Project Garuda: Navigating the Architecture of Digital Rupiah' (n 40) 12.
[58] Bank of Indonesia, 'Project Garuda: Navigating the Architecture of Digital Rupiah' (n 40) 12.
[59] ibid.
[60] ibid.
[61] Bank of Canada and others, 'Central Bank Digital Currencies: Foundational Principles and Core Features,' (2020) Report No 1, 10 < https://www.bis.org/publ/othp33.pdf> accessed 12 September 2025.
[62] ibid.
[63] Corinne Zellweger-Gutknecht and others, 'Digital Euro, Monetary Objects, and Price Stability: A Legal Analysis' (2021) 7 Journal of Financial Regulation, 293–294 < https://doi.org/10.1093/jfr/fjab009 > accessed 12 September 2025.
[64] See Chapter 4.

taxonomies of cryptocurrencies, virtual money and existing central bank money, as illustrated in Figure 1.

Figure 1. Money Flower



(Source: Bech and Garratt, 2017)

Applying the money flower concept to CBDC, there are four fundamental elements when creating a CBDC: (1) it must be universally accessible, meaning that the general public may have access to CBDC just like traditional central bank money; (2) the central bank must issue it; (3) it should exist in an electronic form similar to the form of cryptocurrency; and (4) it may have peer-to-peer features allowing transactions with a certain degree of anonymity like cash.[65]

2.27. In addition to these taxonomies, the BIS outlined the possible key design features of CBDC to consider in its issuance. These cover the availability, anonymity, transfer mechanism, interest-bearing character and limitation of thresholds of CBDC. These features will also determine how a CBDC may function as a means of payment and a store of value, and its implications for payment, monetary policy and financial stability.[66] To give a deeper understanding of the nature of CBDC, the discussion below compares the concept of CBDC with that of cryptocurrency as privately issued digital money.

2. Differences Between CBDCs and Cryptocurrencies

2.28. While both CBDCs and cryptocurrencies share the characteristics of being digital in form, the key distinction between them lies in their issuers, where CBDCs are issued by the state or central bank in accordance with the relevant regulatory framework, while cryptocurrencies, such as Bitcoin and Ethereum, are created by private entities. In contrast, cryptocurrencies often lack a legal foundation, where, in many jurisdictions such as China, Vietnam and India, the public is not even encouraged to buy or transact

[65] Bech and Garratt (n 1) 60.
[66] Bank for International Settlements, 'Central Bank Digital Currencies' (n 56) 5.

with them.[67] As the issuer of CBDC, the central bank should maintain its level of independence, as this is essential to ensuring that its monetary policy decisions remain free from political interference. Such independence is usually clearly stated in the relevant law.[68] This law also plays a crucial role in determining the functions of the central bank in issuing money and, furthermore, designing money to meet the central bank's purposes. The independence of the central bank is important, as it is one of the factors that influence the motivation to issue CBDCs, their design, and the intended use of CBDCs as part of monetary policy, including the decision on the suitable technology for CBDCs.[69]

2.29. Since cryptocurrencies operate independently of the state, they are not backed by the state or central bank. The issuance of cryptocurrency, such as Bitcoin, is controlled by nodes and not backed by real assets. For stablecoins, they are issued by a private entity and often backed by traditional assets such as US Dollars and commodities, to support a stable value. In contrast with cryptocurrencies, when the central bank creates central bank money, the liability side of the central bank is increased, and therefore, it will be balanced by an equal increase on the central bank's assets, such as foreign exchange reserves, including gold, bonds and central bank operations.[70] Similar to traditional central bank money, CBDC would be 'backed' by the same central bank assets to cover its liabilities. The risks for cryptocurrency holders should be greater than those of holders of central bank money, as there is a limited possibility of the central bank going bankrupt and being unable to guarantee payment from central bank money.[71]

2.30. From the perspective of traditional money functions, cryptocurrencies are often criticised for their inability to serve as a reliable store of value due to their unpredictable exchange values and volatile nature.[72] Their limitation and inelasticity of supply also lead

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[67] See Chloe Orji, 'Bitcoin ban: These are the countries where crypto is restricted or illegal' (2021) < https://www.euronews.com/next/2022/08/25/bitcoin-ban-these-are-the-countries-where-crypto-is-restricted-or-illegal2 > accessed 12 September 2025.

[68] Mario I Blejer and Paul Wachtel, 'A Fresh Look at Central Bank Independence' (2020) Cato Journal, Vol.40, No.1, 7-8 < https://www.lse.ac.uk/iga/assets/documents/research-and-publications/Rockefeller-Project/Paul-Wachtel-Mario-Blejer-A-fresh-look-at-central-bank-independence.pdf > accessed 22 December 2025.

[69] Adrian Tobias, 'Central Bank Independence and the Development of Payment and CBDCs' (2023) < https://www.imf.org/en/news/articles/2023/01/10/sp-central-bank-independence-development-payments-and-cbdc?cid=em-COM-123-45998 > accessed 22 December 2025.

[70] Garreth Rule, 'Understanding the central bank balance sheet' (2015) Centre for Central Banking Studies, 11-12 < https://www.bankofengland.co.uk/-/media/boe/files/ccbs/resources/understanding-the-central-bank-balance-sheet.pdf > accessed 12 September 2025.

[71] Stephen Ceccheti, 'Fiscal consequences of central bank loses' (2024) < https://cepr.org/voxeu/columns/fiscal-consequences-central-bank-losses> accessed 22 December 2025; Romain Veyrune, 'Assessments can help clarify the appropriate capitalization to best ensure a sound institutional financial position' (2025) < https://www.imf.org/en/blogs/articles/2025/09/19/stress-tests-can-help-determine-how-much-capital-central-banks-need> accessed 22 December 2025.

[72] See Yale Insights, 'El Salvador Adopted Bitcoin as an Official Currency; Salvadorans Mostly Shrugged' (2024) <https://insights.som.yale.edu/insights/el-salvador-adopted-bitcoin-as-an-official-currency-salvadorans-mostly-shrugged> accessed 12 September 2025; BBC, 'Bitcoin Becomes Official Currency in Central African Republic' (2022) < https://www.bbc.co.uk/news/world-africa-61248809> accessed 12 September 2025; and CNBC, 'Central African Republic Becomes Second Country to Adopt Bitcoin as Legal Tender' (2022) < https://www.cnbc.com/2022/04/28/central-african-republic-adopts-bitcoin-as-legal-tender.html > accessed 12 September 2025.

many to regard them as speculative assets rather than actual money.[73] Consequently, it cannot function as a workable means of payment. Furthermore, cryptocurrencies can be considered a commodity, rather than money, because they have real value derived from the costs of their production in the form of using the power of computers.[74] However, they could still work in practice as a means of payment if they were stable in value, and furthermore, they will only have a status as legal tender if the law confers it on them.

2.31. At the moment, only El Salvador and the Central African Republic have officially declared cryptocurrencies, such as Bitcoin, as their legal tender. Besides having the US dollar as its legal tender since 2001, El Salvador also enacted the Bitcoin Law in 2021 to declare Bitcoin as an unrestricted legal tender to be used in any transactions within El Salvador. El Salvador believes that Bitcoin can respond to free-market criteria, which can increase national wealth for the public's benefit and promote the economic growth of the nation.[75] Denominations of prices of goods and services are still in US dollars, and people can convert them to Bitcoin units if they want to pay with Bitcoin.

3. CBDC in a Theory of Supply of Money

2.32. The issuance and circulation of money, including CBDC, as a means of payment, fall within the authority of a central bank as a monetary authority. Adopting CBDC into the financial system with attractive features could boost demand for central bank money, thus strengthening monetary policy transmission through various channels.[76]

2.33. Every unit of CBDC that the central bank issues counts as central bank liability, and to balance its balance sheets, it has to have an equal number of assets, which supports the effective implementation of monetary policy.[77] The issuance of CBDC would also affect the money supply, which may be crucial to the economy and monetary stability, depending on the level of adoption of CBDC as a means of payment.

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[73] Gregory Claeys and Maria Demertzis, 'The Next Generation of Digital Currencies in Search of Stability' (2019) European Parliament - Monetary Dialogue Papers, 9 < https://www.europarl.europa.eu/cmsdata/207654/14.%20PE%20642.359%20Bruegel%20publication-original.pdf > accessed 12 September 2025.

[74] O S Bolotaeva and others, 'The Legal Nature of Cryptocurrency' (2019) IOP Conference Series: Earth and Environmental Science, 2 < https://iopscience.iop.org/article/10.1088/1755-1315/272/3/032166/pdf > accessed 12 September 2025.

[75] See Bitcoin Law of El Salvador, Decree No. 57 of 2021 (Decreto No. 57) <https://www.jurisprudencia.gob.sv/DocumentosBoveda/D/2/2020-2029/2021/06/E75F3.PDF> accessed 12 September 2025 and its unofficial translation <https://goldservice.com.sv/en/bitcoin-law-of-el-salvador> accessed 12 September 2025.

[76] Mitali Das and others, 'Implications of Central Bank Digital Currencies for Monetary Policy Transmission' (2023) Fintech Notes No 2023/010, 18 <https://www.imf.org/en/Publications/fintech-notes/Issues/2023/09/15/Implications-of-Central-Bank-Digital-Currencies-for-Monetary-Policy-Transmission-538517 > accessed 12 September 2025.

[77] Ulrich Bindseil and others, 'The impact of central bank digital currency on central bank profitability, risk-taking and capital' (2024) ECB Occasional Paper Series No 360, 26 < https://www.ecb.europa.eu/pub/pdf/scpops/ecb.op360~35915b25bd.en.pdf > accessed 12 September 2025.

2.34. The adoption of CBDC into the financial system must be carefully calculated from a monetary perspective. In general, as far as the money supply is concerned, the adoption of CBDC as a means of payment will change the public portfolio of holdings in cash and deposits.[78] These changes may affect money velocity, disintermediate bank deposits, and increase volatility in commercial bank reserves held at the central bank.[79] The central bank has the exclusive authority to issue banknotes and coins, with volumes and values of the money determined annually.[80] If changes in money supply are significant, the credit and interest rate channels for monetary policy transmission may not function optimally, hindering the central bank's capacity to forecast reserves and conduct effective open market operations, which may result in weakening the effectiveness of money and inflation targeting regimes.[81]

2.35. The issuance of CBDC to the financial system must consider various factors, such as its impact on the money supply. Changes in the money supply can influence the risk of inflation or deflation, which can affect public welfare. In an inflationary environment, for example, the rising prices reduce the purchasing power of consumers and also the purchasing power of those paying fixed interest rates,[82] causing slower economic growth.

B. Possible Designs of CBDC

2.36. CBDCs have different designs depending on their purpose, accessibility, authentication methods, system usage and transaction scope. They can be used for wholesale or retail purposes, utilising account-based or token-based systems, online or offline systems, and domestic or cross-border payments. However, if CBDCs were proclaimed as legal tender, then the CBDCs that would most closely resemble the features and characteristics of cash are retail CBDCs, utilising a token-based system in an offline environment.

2.37. Each CBDC design will be analysed and explained in the following paragraphs. However, as this thesis aims to discuss CBDCs and the individual rights associated with them, the scope of discussion mainly focuses on retail CBDCs.

1. Wholesale and Retail CBDC

2.38. CBDCs can be designed for either large-scale payments or retail payments. The concepts of CBDC, both wholesale and retail, are expected to fulfil the fundamental functions of money, as a medium of exchange, a unit of account and a store of value.[83] Based on a

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[78] Inutu Lukonga, 'Monetary Policy Implications of Central Bank Digital Currencies: Perspectives on Jurisdictions with Conventional and Islamic Banking Systems' (2023) IMF Working Papers WP/23/60, 5 < https://doi.org/10.5089/9798400236532.001 > accessed 12 September 2025.

[79] ibid.

[80] Lastra (n 18) 2.16.

[81] Lukonga (n 78) 5.

[82] Ceyda Oner, 'Inflation: Prices on the Rise' 30 < https://www.imf.org/en/Publications/fandd/issues/Series/Back-to-Basics/Inflation#:~:text=In%20an%20inflationary%20environment%2C%20unevenly,payers%20of%20fixed%20interest%20rates > accessed 12 September 2025.

[83] Aristotle, 'Politics' in J. Barnes (ed), *The Complete Works of Aristotle* (Princeton University Press 1984).

study by BIS and the Centre for Latin American Monetary Studies, wholesale CBDC is limited only to large-value transactions and accessible only to particular firms, such as financial institutions,[84] while retail CBDC is designed for small-value transactions and accessible to all households, including the general public.[85]

2.39. Based on the concepts explained above, wholesale CBDC can only be used to discharge debts with certain parameters and limitations, and therefore, it could only carry a limited legal tender status if it were declared as a means of payment. It cannot be used for payment of debts below the minimum threshold, making it less ideal as a general legal tender, which is supposed to be able to settle debts of any amount.

2.40. Unlike wholesale CBDC, retail CBDC would offer cash-like convenience for the public. It is also intended to be regarded as a method of payment for any amount in both private and public transactions. Further explanation of designs for retail CBDC is as follows.

2. Various Designs of Retail CBDC

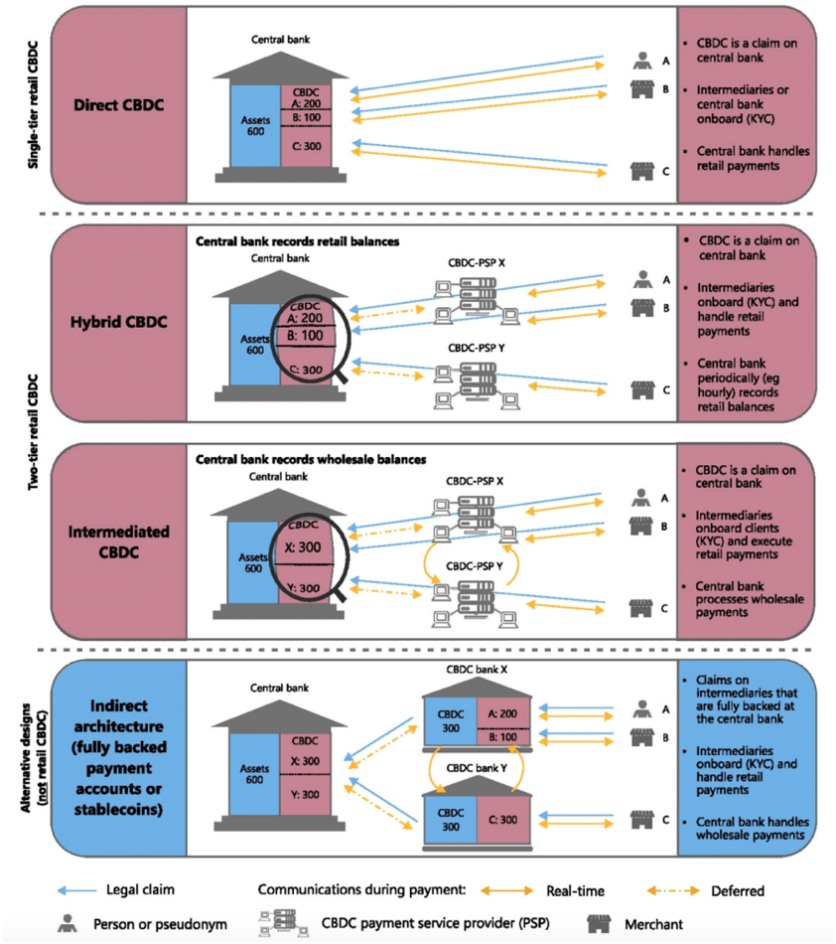
2.41. Various designs of CBDC have been explored for retail payment, including direct CBDC, hybrid CBDC, intermediated CBDC and indirect architectures known as synthetic CBDC, as illustrated in Figure 2.[86]

[84] Bank of Canada and others, 'Cross-Border Interbank Payments and Settlements: Emerging Opportunities for Digital Transformation' (2018) 28 < https://www.mas.gov.sg/-/media/MAS/ProjectUbin/Cross-Border-Interbank-Payments-and-Settlements.pdf > accessed 12 September 2025.

[85] Bank for International Settlements (n 66) 13, and Center for Latin American Monetary Studies, 'Key Aspects around Central Bank Digital Currencies Policy Report' (2019) CEMLA Fintech Forum, 7 <https://www.cemla.org/fintech/docs/2019-06-KeyAspectsAroundBankDigitalCurrencies.pdf> accessed 12 September 2025.

[86] BIS Innovation Hub and Hong Kong Monetary Authority, 'Project Aurum: A Prototype for Two-Tier Central Bank Digital Currency (CBDC)' (2022) 5 < https://www.bis.org/publ/othp57.pdf > accessed 12 September 2025.

Figure 2. Various Designs of Retail CBDC



(Source: Auer and Bohme, 2020; BISIH, 2022)

2.42. For the purpose of examining proprietary rights in CBDC, various designs of retail CBDC illustrated in Figure 2 can be further classified based on (1) the accessibility and authentication method, determining whether CBDC operates on an account-based or token-based system, and (2) the nature of the claim, assessing whether CBDC constitutes a claim against the central bank or commercial bank. Additionally, considering the network connectivity in a token-based CBDC for retail payment, this type of CBDC can be categorised as either online or offline, a classification that is applicable across all architectures shown in Figure 2.

2.43. In direct CBDC, the retail payments or claims are directly managed by the central bank, whereas in intermediated and hybrid CBDC, the claims are enforced through intermediaries.[87] For an intermediated model, or a two-tier model, the CBDCs are distributed by the central bank to the end-users with direct claims on the central bank, but it only records the wholesale balances.[88] Meanwhile, in the hybrid model, the central bank periodically records retail balances.[89]

[87] Auer and Böhme, 'The Technology of Retail Central Bank Digital Currency' (n 21) 89-90.
[88] ibid.
[89] ibid.

2.44. Indirect architecture is an alternative model for retail CBDC, where the central bank issues wholesale CBDC to intermediaries who then issue a claim or 'CBDC' to their consumers, where each claim is backed by a CBDC holding at the central bank.[90] If these claims cannot be enforced against the central bank, it implies that the central bank does not have liabilities on this CBDC. As a result, one may argue that this type of CBDC essentially lacks some key features of central bank money and, therefore, this type of CBDC cannot be considered central bank money but rather as a form of commercial bank money.[91] While this critique is true, this type of CBDC can still be used as a means of payment. A CBDC issued in this way is sometimes called a 'synthetic CBDC'.

a. Account-Based and Token-Based CBDC

2.45. There are also two possible variants for retail CBDC: token-based retail CDBC and account-based retail CBDC.[92] The token-based system allows CBDC to be accessed by individual users and is based on password-like digital signatures with private-public key cryptography. With this approach, token-based retail CBDC can enable anonymity in payments since personal identification would not be required. There is no verification needed for payment using token-based retail CBDC. Meanwhile, in order to be able to use account-based retail CBDC, the user or holder should create an account in the central bank, either directly with the central bank or through the commercial bank as an intermediary. A verification of the user's identity would be needed before CBDC is used. The verification stage is compulsory to identify the holder to authorise the transactions using CBDC.

2.46. The token-based retail CBDC may enable anonymity in payment, just like cash. The transfer mechanism or payment using retail CBDC for both types, just like other money in digital forms, involves an adjustment of the balances of the payer and payee.[93] Nonetheless, both types of retail CBDC would still require an adjustment in their ledgers. A verification process might be an essential element in deciding which type of CBDC is suitable for legal tender. Compared with the nature of physical cash, a token-based retail CBDC most likely falls within the classification of cash because it would not require any verification to be processed for payment. As with a payment of physical cash, the transfer is deemed complete between the payer and payee, as no further settlement is required by the issuer. Just like cash, token-based retail CBDC can be designed as a bearer instrument and support offline transactions.[94] It is also freely transferable without requiring any verification from the authority. In contrast, account-based retail CBDC would need a verification process to authenticate the identity of the holder before

[90] BIS Innovation Hub and Hong Kong Monetary Authority (n 86) 4-5.
[91] Bank of Canada and others, 'Central Bank Digital Currencies: Foundational Principles and Core Features' (n 61) 4.
[92] See Bank for International Settlements, 'Central Bank Digital Currencies' (n 56) 6; Bank for International Settlement (n 22) 72; and Auer and Böhme, 'The Technology of Retail Central Bank Digital Currency' (n 21) 19.
[93] Bank of Canada and others, 'Central Bank Digital Currency: System Design and Interoperability' (n 21) 4.
[94] ibid.

a CBDC transaction can take place.[95] Presumably, the transfer between the payer and payee needs to be recorded in the central ledger of the issuer.

2.47. A token-based retail CBDC can also be designed to be non-traceable or anonymous so that payments would operate like cash money, which is relatively untraceable.[96] It would become challenging to identify the former owner of specific money when the money is mixed, and thus, the legal title to the money is generally extinguished when it is mixed.[97]

2.48. From the analysis above, token-based retail CBDC most closely resembles the features and characteristics of conventional cash that is used as legal tender. As such, this type of CBDC is the most likely to be recognised as a monetary means of payment available to the general public. Legislation may also confer the status of legal tender on CBDC.

b. Online and Offline CBDC

2.49. CBDCs, including token-based CBDCs for retail purposes, can be configured for online or offline payment. The primary difference between these models lies in their dependence on internet connectivity. The underlying technological infrastructures and mechanisms for supporting offline CBDC transactions notably differ from those utilised in online transactions. As a result, the elements determining settlement finality in offline transactions may differ from those in online payments.

2.50. There are a variety of designs of CBDC for offline payment, such as fully offline, intermittently offline and a staged offline. These variations depend on whether they are fully connected to the internet, which, in turn, would determine the timing of the final settlement of the transactions. Further explanation of offline CBDC is given in the next chapter.[98]

2.51. This thesis addresses both online and offline CBDCs. However, any discussion regarding offline CBDCs will be explicitly indicated.

c. Domestic and Cross-border CBDC

2.52. From the scope of transactions, CBDCs can be designed for domestic and cross-border transactions.[99] If a CBDC were designed for domestic use only, then its use would be limited to the jurisdiction in which it is issued. However, if a CBDC was designed for cross-border transactions, then it could be used for payments in other jurisdictions depending on the arrangement between those jurisdictions.

[95] Charles M Kahn, 'How Are Payment Accounts Special' (2016) 5 < https://chicagopaymentssymposium.org/wp-content/uploads/2016/10/kahn-how-are-payments-special.pdf > accessed 12 September 2025.
[96] Fox, *Property Rights in Money* (n 20) para. 1.61.
[97] ibid.
[98] See Chapter 6.
[99] Bank for International Settlements, 'Central Bank Digital Currencies' (n 56) 7 and 17.

2.53. Many central banks are investigating the possibility of issuing CBDCs for cross-border payments, especially for public use.[100] Project Icebreaker, for example, has shown that cross-border CBDCs can create an effective rate in transaction between jurisdictions.[101] However, the effectiveness of cross-border CBDC payments depends, among other things, on the existence of regulatory frameworks that are either harmonised or compatible across jurisdictions.

2.54. The scope of discussion of CBDCs in this thesis is limited to domestic use only. Cross-border CBDCs are excluded from discussion, as it would require a comprehensive legal analysis across multiple jurisdictions, including the harmonisation of relevant legal frameworks. Critically, the other jurisdictions might also need to recognise the CBDC as an effective means of payment to discharge debts.

C. CBDC as a Direct Liability of the Central Bank

2.55. As mentioned earlier, if CBDCs were issued by the central bank, they would be a direct liability of the central bank, just like any other form of central bank money. From an accounting perspective, this liability would be reflected on the central bank's balance sheet, and the CBDCs would be recorded in a manner analogous to that of physical banknotes. As central bank money, including CBDC, is recorded as liabilities in the balance sheet of the central bank, they are not, per se, a legal liability and therefore, they should not be considered as debt owed by the central bank.[102] They should be described as *sui generis* hybrid financial instruments or social equity that can facilitate financial and real economy transactions and facilitate economic policy.[103] Thus, central bank money as well as CBDC should be treated as a public good.[104]

2.56. This accounting treatment highlights the comparable status of CBDCs and banknotes within the central bank's financial statement, which will be the scope of discussion in this section.

2.57. In a retail CBDC model with a two-tier architecture, commercial banks act as intermediaries between the central bank and CBDC holders. A simple scenario for the issuance of CBDC and records in the balance sheet of the household, commercial bank, and central bank can be illustrated in Figure 3.[105]

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[100] Examples of these projects are e-CNY Project and Project Icebreaker.

[101] Bank of Israel and others, 'Project Icebreaker: Breaking new paths in cross-border retail CBDC payments' (2023) 18 < https://www.bis.org/publ/othp61.pdf > accessed 12 September 2025.

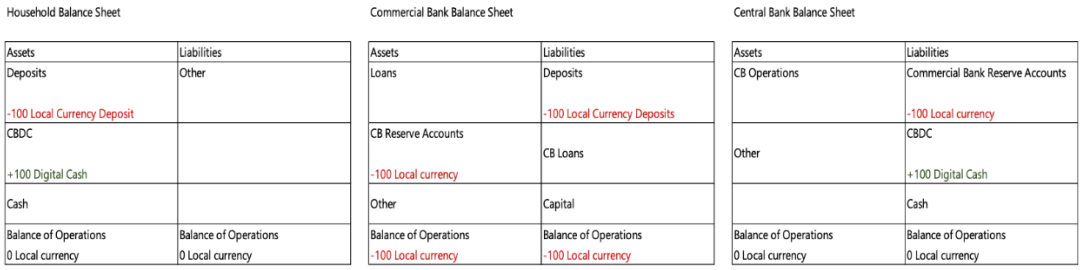
[102] Michael Kumhof and others, 'Central Bank Money: Liability, Asset, or Equity of the Nation?' (2020) Cornell Law School Research Paper No 20 – 46, 18 and 25-26 < https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3730608 > accessed 12 September 2025.

[103] ibid.

[104] ibid.

[105] Lukonga (n 78) 15.

Figure 3. Illustration in Balance Sheets



Household Balance Sheet

Assets	Liabilities
Deposits -100 Local Currency Deposit	Other
CBDC +100 Digital Cash	
Cash	
Balance of Operations 0 Local currency	Balance of Operations 0 Local currency

Commercial Bank Balance Sheet

Assets	Liabilities
Loans	Deposits -100 Local Currency Deposits
CB Reserve Accounts -100 Local currency	CB Loans
Other	Capital
Balance of Operations -100 Local currency	Balance of Operations -100 Local currency

Central Bank Balance Sheet

Assets	Liabilities
CB Operations	Commercial Bank Reserve Accounts -100 Local currency
Other	CBDC +100 Digital Cash
	Cash
Balance of Operations 0 Local currency	Balance of Operations 0 Local currency

(Source: Lukonga, 2023)

In Figure 3, reserves, cash, government cash and CBDC would be recorded as liabilities on the central bank's balance sheet, while treasury bonds would be recorded as assets.[106] When an individual requests CBDC from the intermediaries, they transfer funds to their bank accounts to acquire CBDC.[107] The bank then acquires CBDC from the central bank by exchanging funds from its reserves. Meanwhile, the bank's liabilities declined as its customer had already used his money for CBDC. In this scenario, the total value of the central bank's liabilities should remain the same as the reserves decrease while CBDC increases by the same amount.[108]

2.58. Regardless of its design, CBDC may be recorded as part of the currency in circulation as it can be substituted with cash, but it will still be recorded as a liability on the right side of the central bank's balance sheet.[109] Even if CBDC were substituted with cash or bank deposits, the total liabilities of the central bank would remain unchanged unless there is a new issuance of money in circulation or a new issuance of CBDC.

2.59. In the composition of the balance sheet of the BoE, for instance, its main liabilities cover (1) banknotes that are in circulation, including those held in the commercial banks and their automatic teller machines, and held by the public, and (2) commercial bank reserves cover balances that banks hold in an account at the central bank.[110] The introduction of CBDC to the financial system should cause changes in the balance sheet of the central bank, where a new component of CBDC will be added as liabilities.

2.60. When the central bank records CBDC as a component of liabilities on the right side of the balance sheet, this means the central bank acknowledges CBDC as an obligation to the CBDC holders, who can exchange their CBDC for other forms of central bank money or bank deposits through mechanisms determined by the central bank. Furthermore, it is unlikely that the central bank maintains a list of CBDC holders. In the two-tier

[106] Christopher Gust and others, 'The Effects of CBDC on the Federal Reserve's Balance Sheet' (2023) Finance and Economics Discussion Series 2023-068, 9 <https://doi.org/10.17016/FEDS.2023.068> accessed 12 September 2025; see also Adrian Armas and Manmohan Singh, 'Digital Money and Central Banks Balance Sheet' (2022) Working Paper No. 2022/206, 22 < https://www.imf.org/en/Publications/WP/Issues/2022/10/28/Digital-Money-and-Central-Banks-Balance-Sheet-524987 > accessed 12 September 2025.

[107] Gust and others (n 106) 9; See Lukonga (n 78) 15.

[108] ibid.

[109] Armas and Singh (n 106) 22.

[110] Rule (n 70) 9-10.

architecture, managing this should be the responsibility of commercial banks as intermediaries.

D. CBDC Is Not Programmable Money

2.61. In principle, no law, regulation or policy issued by the state or the central bank would restrict or interfere with individuals' rights in any way, including rights related to their money. They should not control or restrict the use of money, including CBDCs, solely to specific types of transactions through programming the CBDC. The issuance of laws or regulations related to CBDCs and the adoption of CBDC in any jurisdiction must respect personal rights as protected under existing laws related to personal rights or property. Furthermore, the creation of any policy related to CBDC should be in harmony with other laws.

2.62. In the UK, concerns were raised that CBDC might be issued as programmable money, which was misinterpreted as potentially prohibiting individuals from conducting personal transactions. A petition was submitted to the government to prevent the implementation of CBDCs, as it was feared that the government would control their use, thereby reducing the public's freedom to use them.[111]

2.63. Responding to the petition in the UK, the HM Treasury stated that the government would not have the capability to program CBDC, nor does it have plans to do so or restrict how money is spent,[112] thus it would not violate rights and freedoms outlined under the Human Rights Act.[113] In Indonesia, regulations or policies should consider personal interests[114] and be in harmony with the relevant laws,[115] such as the Human Rights Law, where personal properties are protected under this law.[116]

2.64. A transaction is considered programmable when it occurs automatically upon fulfilment of a specified set of conditions, which is no different from the technical controls that already exist.[117] When responding to the above petition, the HM Treasury explained that the application of programmability in the financial system is not an entirely new concept, as similar functionality can be found in existing features like standing orders in bank accounts that allow users to deduct their money according to their own set of rules.[118] This is known as programmable payment.[119]

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[111] Petition – UK Government and Parliament, 'Prevent the Introduction of Any "Programmable" CBDC in the UK' (2023) < https://petition.parliament.uk/petitions/624159 > accessed 12 September 2025.

[112] ibid; See 'Riots Erupt in Nigerian Cities as Bank Policy Leads to Scarcity of Cash' (2023) < https://www.theguardian.com/world/2023/feb/15/angry-protests-erupt-across-nigeria-against-scarcity-of-cash > accessed 12 September 2025.

[113] Petition – UK Government and Parliament (n 111); See Human Rights Act, arts 8 and 14.

[114] See Law No. 12 of 2011 on the Establishment of Laws and Regulations, art 6 (j).

[115] ibid art 6 (b).

[116] See Law No. 39 of 1999 on Human Rights, art 39.

[117] See Petition – UK Government and Parliament (n 111).

[118] ibid.

[119] EDPS TechDispatch, 'Central Bank Digital Currency' (2023) < https://edps.europa.eu/system/files/2023-03/23-03-29_techdispatch_cbdc_en.pdf > accessed 12 September 2025.

2.65. However, if CBDC is interpreted as programmable money, programmability can be set to CBDC by the authority if it is designed specifically for conditional payments using smart contracts. For instance, CBDC could be programmed only for spending in government household relief subsidies,[120] and it can also have a maximum transfer limit of CBDC between parties to avoid double-spending and enforce anti-money laundering measures.[121] This setting would depend on the design of CBDC and how the approach is taken by the authority in adopting CBDC.

IV. Advantages of the Issuance of CBDC

A. Advantages for the Economy

2.66. Studies show there are many advantages of issuing CBDC by the central bank. CBDC could promote the uniformity of money as it can be exchanged for other forms of money at par value and at all times, thereby supporting a stable and efficient monetary system.[122] The issuance of CBDCs is also expected to preserve the role of public money as the anchor of the monetary and financial system due to their availability in the digital economy era.[123] Furthermore, the availability of digital forms of central bank money also means extending access to central bank money, thereby facilitating broader economic participation.[124]

2.67. CBDCs have the potential to promote financial inclusion, particularly to economically vulnerable households and communities.[125] People living in remote areas often face challenges in accessing financial services, as many commercial banks or other private financial institutions may find it unprofitable to operate in these areas.[126] By introducing CBDCs, the state will play a direct role in expanding financial access through systems or platforms to reach the broader economy, including those in underserved locations. This rationale has been acknowledged in China, where the CBDC system is designed to support unbanked populations in rural areas to receive basic financial services and, thus,

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[120] Gabriel Soderberg and others, 'How Should Central Banks Explore Central Bank Digital Currency?: A Dynamic Decision-Making Framework' (2023) International Monetary Fund Note/2023/008, 22 < https://www.imf.org/en/Publications/fintech-notes/Issues/2023/09/08/How-Should-Central-Banks-Explore-Central-Bank-Digital-Currency-538504 > accessed 12 September 2025.

[121] European Central Bank, 'Exploring Anonymity in Central Bank Digital Currencies' (2019) 5-6 < https://www.ecb.europa.eu/press/intro/publications/pdf/ecb.mipinfocus191217.en.pdf > accessed 12 September 2025.

[122] Bank of England, 'Progress Update: The Digital Pound and The Payments Landscape' (n 39).

[123] ibid.

[124] Bank of England, 'Progress Update: The Digital Pound and The Payments Landscape' (n 39); The Federal Reserve System, 'Money and Payments: The US Dollar in the Age of Digital Transformation' (2022) 16 < https://www.federalreserve.gov/publications/files/money-and-payments-20220120.pdf > accessed 12 September 2025; The People's Bank of China, 'Progress of Research and Development of E-CNY in China' (2021) 4-5 < http://www.pbc.gov.cn/en/3688110/3688172/4157443/4293696/2021071614584691871.pdf > accessed 12 September 2025.

[125] ibid.

[126] Raphael Auer and others, 'Central bank digital currencies: a new tool in the financial inclusion toolkit' (2022) FSI Insights on policy implementation No. 41 < https://www.bis.org/fsi/publ/insights41.pdf> accessed 12 September 2025.

eliminate the need to travel to commercial banks.[127] Moreover, CBDC services could potentially be offered at no cost, as the central bank may cover operational costs through its seigniorage income.[128]

B. Advantages of Issuing CBDC as Legal Tender

2.68. In addition to the above advantages, there are advantages of issuing CBDC as legal tender, such as restoring the traditional function of legal tender, serving as an alternative mode of payment, and providing a cheaper, faster and more secure means of payment compared to existing forms. These advantages are detailed below.

2.69. First, CBDC would restore the function of legal tender in the digital era. Presently, the payment or discharging of debts is mostly conducted through deposits or commercial bank money, even privately issued digital currency, instead of state-issued money as legal tender. These cause the declining use of cash, which also means that the function of state-issued money as legal tender to discharge debts is also decreasing. Another concern is that both private and foreign digital money could displace state-issued currency and may threaten the central bank's task of creating effective monetary policy.[129] If many people adopt CBDC for payments or discharging debts, then a greater amount of virtual legal tender money will be used. Consequently, a greater possibility for the central bank to achieve an effective monetary policy. Thus, the function of state-issued money to discharge debts and serve as a legal tender should be given to CBDC to perform effectively as a monetary tool.

2.70. Second, CBDC, as central bank money, could serve as an alternative mode for digital payments to the public. With the existence of digital central bank money in the financial system, CBDC could diversify the range of digital payment options where cash could not be used.[130] If CBDC were designed for offline payment, then it could also serve as a useful contingency if there is an electricity outage.

2.71. Last, as an alternative mode for digital payment available to the public, CBDC also offers faster, more secure and cheaper payment than existing forms of money, including cash and commercial bank money. Since CBDC is digital state-issued money that will be processed through the system provided by the central bank, it is expected that the process of 'delivery' of money from the payer to the payee can be conducted in a timely manner or perhaps faster than the payment process of commercial bank money.[131] CBDC can be treated as digital cash, which can be transferred on an automated system, similar to commercial bank money. The technology might enable it to be transferred

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[127] People's Bank of China (n 124) 5.

[128] Auer and others, 'Central bank digital currencies: a new tool in the financial inclusion toolkit' (n 126) 17.

[129] Skylar Brooks, 'Revisiting the Monetary Sovereignty Rationale for CBDC' (2021) Staff Discussion Paper Bank of Canada, 1 < https://doi.org/10.34989/sdp-2021-17 > accessed 12 September 2025.

[130] Bank of England, 'Central Bank Digital Currency: Opportunities, Challenges and Design' (2020) Discussion Paper, 16 <https://www.bankofengland.co.uk/paper/2020/central-bank-digital-currency-opportunities-challenges-and-design-discussion-paper> accessed 12 September 2025.

[131] World Bank Group, 'Central Bank Digital Currency: Technical Background Note' (2021) 1 < https://documents1.worldbank.org/curated/en/603451638869243764/pdf/Central-Bank-Digital-Currency-Background-Technical-Note.pdf > accessed 12 September 2025.

faster than cash or commercial bank money at a lower cost – or even for free – especially for small transactions.[132] CBDC promotes more secure payments because the central bank is involved in the transaction process, either directly or indirectly. Moreover, during a crisis, holders of commercial bank money and cryptocurrencies may be exposed to insolvency risks feared by the issuers. Therefore, since there is a low probability for the central bank to be exposed to insolvency risks, and thus, CBDC, similar to fiat money, promotes a secure feature compared to privately issued money.[133]

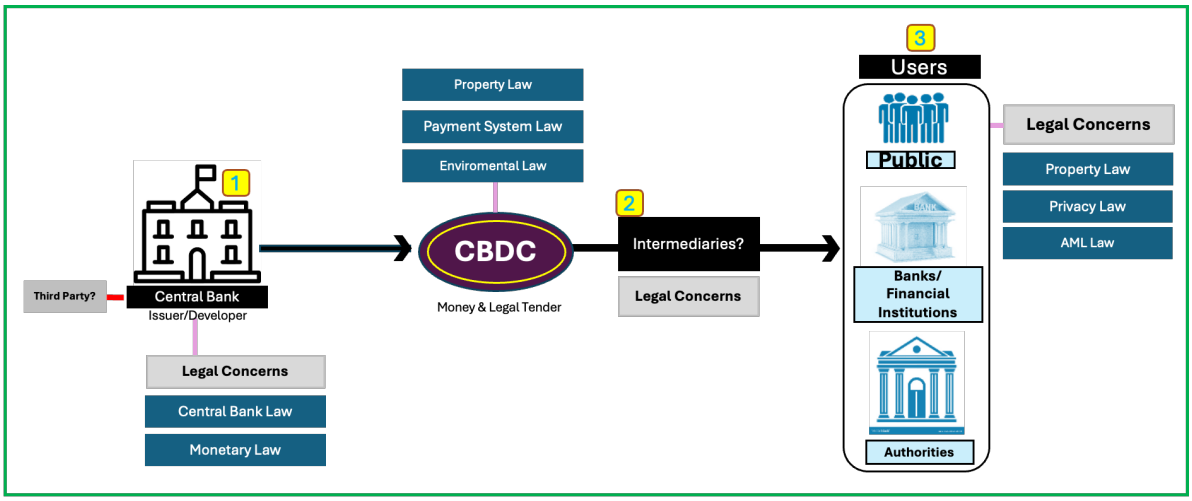
2.72. In addition to those arguments, CBDC might also offer an ideal kind of legal tender because it combines the features of cash and commercial bank money, as will be discussed in a later chapter.[134]

V. A Regulatory Framework to Support the Issuance of CBDC

2.73. CBDC has many dimensions to explore and analyse, particularly from a legal perspective. A comprehensive regulatory framework must be established to support the legality of adopting CBDC into the financial system. Such a framework is grounded in extensive legal research conducted prior to the issuance of CBDC.

2.74. This thesis aims to recommend the minimum scope of the regulatory framework for CBDC. This framework outlines the roles and responsibilities of the relevant parties in these transactions, namely the central bank as the issuer of CBDC, banks as intermediaries and CBDC holders. It also discusses the legal nature of CBDC as a form of money, as illustrated in Figure 4.

Figure 4. Identification of Legal Aspects in the Issuance of CBDC



(Source: Author)

[132] Ashley Lannquist and Brandon Tan, 'Central Bank Digital Currency's Role in Promoting Financial Inclusion' (2023) 14 < https://www.elibrary.imf.org/view/journals/063/2023/011/article-A001-en.xml > accessed 12 September 2025.
[133] ibid 2.
[134] See Chapter 3.

2.75. Figure 4 identifies key legal aspects in the issuance of CBDC, which will be addressed in this thesis. In detail, these aspects include (1) the central bank's authority and responsibilities to issue CBDC as a means of payment and legal tender,[135] (2) the roles and responsibilities of intermediaries in facilitating CBDC transactions,[136] and (3) the rights and responsibilities of users or CBDC holders encompassing general public, banks and other institutions, as parties that can hold and transact CBDC.[137] In addition to the authority and responsibilities of the relevant party, the discussion will address the legal aspects of CBDC as a digital form of central bank money.[138] This discussion includes an analysis of the underlying technology and its processes to understand the legality of mechanisms for acquiring and transacting CBDC and to determine how settlement finality in CBDC transactions can be achieved with various CBDC designs.[139]

2.76. The discussion related to the central bank's aspects will cover the central bank's mandates, liabilities, mechanisms for issuing CBDC, whether to involve third parties in the technology and relevant central bank regulations that are impacted by CBDC adoption.[140] Regarding intermediaries, their responsibilities should include ensuring data protection and facilitating settlement finality in CBDC transactions.[141]

2.77. For CBDC holders, particularly individuals, the regulatory framework should at least address the personal rights as holders of CBDC in a property context, the legal arrangements with intermediaries and the issuing authority, and the liabilities related to CBDC.[142] These three elements will be examined in connection with the establishment of a regulatory framework for CBDC, which is linked to the scope of central bank law, monetary law, property law and consumer law.

2.78. Additionally, the regulatory framework related to the issuance of a CBDC will consider concerns from the perspectives of anti-money laundering law and privacy law, as CBDC transactions would relate to the privacy of the general public and risks exposed to them.[143] As the process of CBDC involves technological infrastructure, such as cloud storage, this thesis also addresses environmental concerns.[144]

VI. Conclusions

2.79. CBDC is a digital form of central bank money that is expected to serve the same functions as traditional money. A CBDC may have a variety of designs that can influence how it performs as a means of payment to discharge debts.

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[135] See Chapter 3, 4 and 9.
[136] See Chapter 4 and 9.
[137] See Chapter 9.
[138] See Chapter 3.
[139] See Chapter 4, 5 and 6.
[140] See Chapter 3.
[141] See Chapter 5, 6 and 9.
[142] See Chapter 7 and 8.
[143] See Chapter 9.
[144] See Chapter 9.

2.80. From those various possible designs of CBDC, a token-based CBDC for retail payment in an offline system would most closely resemble the features and characteristics of banknotes as traditional central bank money. This type of CBDC can be designed as a bearer instrument and does not need a verification process to authenticate the identity of the holder before a CBDC transaction can take place.

2.81. A comprehensive regulatory framework is needed to support the effective adoption of CBDC into the financial system. Such a framework should at least address legal concerns related to the parties involved in the CBDC ecosystem and CBDC as a digital form of central bank money.

CHAPTER 3

FUNCTIONS AND CHARACTERISTICS OF CBDC AS MONEY

I. Introduction

3.1. In the previous chapter, the concept of CBDC was presented in the new taxonomy of money called the 'money flower', introduced by Bech and Garratt.[145] This taxonomy introduces four fundamental attributes of CBDC: it is issued by the central bank, universally accessible, in a digital form and can be used in peer-to-peer mechanisms.[146] These basic characteristics of CBDC will be analysed further in this chapter to distinguish it from traditional money. Other key design features that further define CBDC as a new form of money include its availability, anonymity, transfer mechanism and interest-bearing characteristics,[147] which will be discussed in this chapter.

3.2. This chapter examines the general characteristics of CBDC, which are associated with its functions, materials, issuance, distribution and transfer mechanisms. These characteristics are essential for understanding CBDC as a digital form of central bank money before proceeding to a more complex analysis of CBDC. The analyses in this chapter also cover the traits of existing forms of money, such as cash and commercial bank money, which show their differences from CBDC.

[145] See para 2.26.
[146] Bech and Garratt (n 1) 60.
[147] See Bank for International Settlements, 'Central Bank Digital Currencies' (n 56).

3.3. This chapter mainly argues that CBDC shares similar characteristics with existing forms of money, such as cash and commercial bank money. The characteristics of CBDC are essentially a combination of features from other types of money. The unique characteristics of CBDC may pose challenges to its adoption into the financial system, especially from a legal perspective, and thus, the state or the central bank, as the issuer, must prepare a strong legal conception of CBDC that serves as the foundation for its legal interpretation and understanding.

3.4. This chapter begins by elaborating on the evolution of various forms of money from the ancient era to the digital age, illustrating how conceptions and forms of money have gradually changed over time. It then explores the functions of traditional money in CBDC before analysing its characteristics by comparing those of existing forms of money, including cash, commercial bank money and cryptocurrency.

II. History of Money

3.5. This section lays out the evolution of money within Western legal systems by briefly touching on the barter system before discussing commodity money and various tangible forms of money. The analysis in this section shows that all kinds of money, especially state-issued money, including legal tender money, were initially tangible objects. Over time, money has evolved from tangible to intangible; metal or physical elements are no longer the components necessary for the recognition of monetary status. In the modern era, money has transitioned into intangible forms yet continues to serve its function as money. CBDC represents the latest form of state-issued money in an intangible form in today's world, intended to serve the same functions as traditional central bank money. Although its form has undergone considerable changes over time, the fundamental function of money has remained unchanged: to settle debts arising from commercial transactions, contracts or other monetary obligations.

3.6. Before money was introduced, society relied heavily on the use of metals, commodities and other tangible objects as media of exchange. As society evolved, the authority to issue money rested with the king, who held the highest authority in society. This authority also allowed him to declare the function of such money to discharge debts, regardless of its material substance, through legal ordinance. In the modern era, this authority has been shifted to the supreme monetary authority in a state.

A. From Barter System to Coins

3.7. The barter system is the oldest form of commerce. It emerged long before the idea of a universal medium of exchange. In a barter system, parties directly exchange goods and services of similar value strictly without using money as a means of payment.[148] To barter, the parties had to agree on the value of the exchange, covering what goods and services to trade. However, finding goods or services with the same value to trade was challenging as there was no common measure of value among the goods or services bartered. Even

[148] Glyn Davies, *A History of Money: From Ancient Times to Present Day* (3rd edn, University of Wales Press 2002) 9.

determining the value could cause difficulties for some parties, not to mention the cost of transportation required to deliver such goods or services. Nonetheless, the inefficiency of bartering prompted individuals to gradually develop the concept of money as a medium of exchange.

3.8. Aristotle, the ancient Greek philosopher whose insights on money may be the basis of analysis in the field of money,[149] believed that money evolved through the barter system, where such use was invented out of necessity.[150] He wrote: 'For not all of the things that are required by nature are easy to transport; and so, for use in exchanges, they agreed among themselves to give and take something of a sort that, being itself one of the useful items, was easy to handle for the needs of life, such as iron or silver or anything else like that.'[151]

3.9. Acknowledging the limitations of the barter system, early civilisations started using certain commodities as their standard medium of exchange.[152] During the Bronze Age, societies had metals or specified grain as a standard of payment. They opted for commodities like salt, cattle and grain, as these commodities offered greater flexibility and reliability in transactions. Ultimately, their value in payment transactions derived from the fact that they could be used. Nevertheless, the availability of these commodities was limited, making them difficult to use as a sustainable medium of exchange.

3.10. In addition to commercial transactions, money has long been used to settle monetary obligations. All these transactions suppose that a monetary unit exists in terms of which the debt can be denominated. But the transaction is settled by direct barter or by using some commodity that was useful by itself. Early law in the middle of the seventh century in Greece set the term for the local magistrate to impose fines or payment compensation for suffered damage.[153] The law did not specify through in what medium the payment was to be made,[154] but it can be reasonably interpreted that people could pay with any medium of equal worth as stated by the law, such as a certain amount of grain or grapes.[155]

3.11. Moving to the pre-coinage era, all metals were considered precious and widely served as a medium of exchange and unit of account. Items such as axes, spears, knives, swords, hoes, and spades made of copper, bronze, and iron were commonly used.[156] Even after more advanced European societies adopted coins, crudely made iron sword blades continued to be used as money.[157]

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[149] J Schumpeter, *History of Economic Analysis* (London: Allen and Unwin 1959) 63; See Aristotle's thoughts as translated by Schaps, see D M Schaps, *The Invention of Coinage and Monetization of Ancient Greece* (University of Michigan Press 2004) 5.
[150] Schaps (n 149) 5.
[151] ibid.
[152] Ibid 34.
[153] E D Heymans, *The Origins of Money in the Mediterranean World* (Cambridge University Press 2021) 196.
[154] ibid.
[155] ibid 198.
[156] Davies (n 148) 46.
[157] ibid.

3.12. Gold and silver were considered the ideal media of exchange mainly due to their universally recognised value. Unlike grains or commodities, these are non-perishable, easily divisible and less prone to major market fluctuations.[158] However, the sources or supplies of these media of exchange were often unreliable, forcing society to find alternative ways to fulfil their needs for a consistent and dependable supply.[159]

B. The Authority to Issue Money

3.13. The idea of money serving as a universal medium of exchange may have begun with the invention of coinage.[160] These coins, which Greeks referred to as 'nomismata' or 'customary things', were not only physical objects but also represented a person's wealth, both in the sense of being valuable assets themselves and as a means of valuing other assets they might have owned.[161] In the Western legal systems, the power to mint coins was recognised as the special privilege of the king. The prerogative right to strike coins (*ius cudendae monetae*) was recognised as an aspect of the sovereignty of the king, reflecting his position as the highest authority within the kingdom or jurisdiction.[162] Besides minting coins, this authority was eventually recognised as covering all aspects of money circulation, including the issuance of banknotes, as shown in *Emperor of Austria v Day and Kossuth*.[163] This highest authority to create money was later transformed in the modern era into the state's power to control the issuance and circulation of money within its jurisdiction.

3.14. The invention of minting and printing machines in the modern monetary age expanded the forms of money to include paper.[164] The earliest known paper money was invented in China around 118 BC, with the first official paper notes, issued by the emperor, appearing in 1160 AD. However, people temporarily abandoned paper money when there were periods of inflation due to the over-issue of paper money.[165] Later, in 1440, the invention of the modern press in Germany marked a significant development in mass printing.[166] By the mid-17th century, printed banknotes had become a popular medium of exchange in Britain.[167]

3.15. Today, in the UK, the BoE's power to issue banknotes is granted under the Bank Charter Act 1844.[168] Money is a tool for monetary policy, and the BoE, as the UK's monetary authority, is empowered to oversee the national monetary system under the Bank of England Act 1998.[169] Legal tender in the UK, particularly in the form of coins, is regulated under the Coinage Act 1971, as amended by the Currency Act 1983. Under this Act, gold

[158] Schaps (n 149) 8.
[159] Davies (n 148) 293.
[160] Schaps (n 149) 5.
[161] ibid 16.
[162] Fox, 'Money, Law and Institutions' (n 18) 161.
[163] *The Emperor of Austria v Day and Kossuth* (1861) 3 De G.F. & J. 217.
[164] Davies (n 148) 176.
[165] ibid.
[166] ibid 178.
[167] ibid 286.
[168] Bank Charter Act 1844, s 32.
[169] Bank of England Act 1998, s 11.

coins with specific dimensions are declared legal tender for payment of any amount.[170] This Act also specifies the measurements of coins of cupronickel, silver, and bronze and any other coins produced in the future. For banknotes, the status of banknotes as legal tender in England, Wales, Scotland and Northern Ireland is provided under the Currency and Bank Notes Act 1954 as amended by the Currency Act 1983. If the UK decides to issue CBDC, this legislation must be reviewed and amended to support its issuance.[171]

3.16. Article 23D of the Indonesian Constitution of 1945 mandated the establishment of Bank Indonesia as the central bank of Indonesia. Under the Indonesian Currency Law, Bank Indonesia is an independent central bank that is authorised to issue and declare money as legal tender.[172] An amendment to the Indonesian Currency Law in 2023 expanded the scope of legal tender to include a digital form of money known as the Digital Rupiah.[173] Under the Indonesian Currency Law, the issuance and distribution of the Digital Rupiah fall solely under the authority of Bank Indonesia, but the planning for its issuance must first be coordinated with the Ministry of Finance.[174]

3.17. Coordination with the Ministry of Finance may be stated in an agreement or regulation that outlines the amount of Digital Rupiah that will be issued, considering the inflation rate and economic conditions. This agreement can mirror the existing agreement with the Ministry of Finance that rules the coordination for planning the issuance of physical currency as stated in Memorandum of Understanding between Bank Indonesia and Ministry of Finance dated 26 June 2012.

3.18. Regulations on Digital Rupiah should cover, among others, the issuance, distribution and redemption of Digital Rupiah. The issuance, distribution and redemption of Digital Rupiah, especially for account-based design, may consider the scheme explained in paragraphs 7.36-7.42 and 7.51-7.56.

C. Virtual Currency in the Digital Era

3.19. The digital era may be defined as one with a high use of technology that can heavily impact the economy and society.[175] Early in this era, the use of private virtual currency such as Bitcoin and Ethereum, also known as cryptocurrency, became popular. The Financial Action Task Force defines cryptocurrency or virtual currency as 'a digital representation of value that can be digitally traded and functions as (i) a medium of exchange and/or (ii) a unit of account and/or (iii) a store of value, but does not have legal tender status (ie when tendered to a creditor, is a valid and legal offer of payment) in any jurisdiction.'[176]

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[170] Coinage Act 1971, s 2.
[171] See Bank of England, 'Progress Update: The Digital Pound and The Payments Landscape' (n 39).
[172] See Indonesian Currency Law, art 11(3).
[173] ibid art 14A.
[174] ibid.
[175] Jill Sheperd, 'What Is Digital Era?' in Georgios Doukidis, Nikolaos Mylonopoulos, and Nancy Pouloudi (eds), *Social and Economic Transformation in the Digital Era* (IGI Global 2004).
[176] Financial Action Task Force, 'Virtual Currencies: Key Definitions and Potential AML/CTF Risks' (2014) 4 < https://www.fatf-gafi.org/en/publications/methodsandtrends/documents/virtual-currency-definitions-aml-cft-risk.html > accessed 12 September 2025.

3.20. Unlike traditional money ('fiat money'), cryptocurrency has no physical form. No regulatory body or institution can guarantee its claims because it is privately issued. The mechanisms for issuing and transferring this currency rely on a sophisticated system that synchronises the ledgers of the payer and the payee. The state has the authority to declare any kind of money as its means of payment and confer it a status as legal tender. Currently, only two countries – El Salvador and the Central African Republic – have proclaimed Bitcoin as their legal tender via legislation.[177]

3.21. CBDC can be seen as the latest development in the evolution of virtual currencies. It is considered a new form of digital money issued by the central bank and intended to function alongside other kinds of traditional money. It would be open to being declared legal tender by the law. CBDC has distinctive characteristics that differentiate it from other forms of central bank money (ie banknotes and traditional reserve accounts held by banks with the central bank).[178] Further elaboration on the validity of the digital nature of CBDC is provided in the next paragraphs.

III. CBDC as De-physicalised Cash

3.22. While the form of money has significantly changed over time, its function has remained the same. Recognising there is no physical component in CBDC, this section further analyses the validity of the digital component of CBDC as state-issued money under the theories of money. It also assesses the roles of legislation in affirming this validity.

3.23. The discussion begins by examining the doctrines of *metallism* and *nominalism* to understand the evolving perspectives on how money can be detached from metal and any tangible elements. This transformation in the forms of money has been supported by changes in legislation, as evidenced by historical legal records related to the materiality of money dating back to as early as 300 AD. The analysis suggests that the forms of money over time have always been supported by the legislation that affirms the validity of such money to be used as a means of payment. Applying this to CBDC, a fully digital state-issued money with no physical component, the legislation would be essential for the state to proclaim CBDC as a means of payment, regardless of its materials.

A. Perspectives in *Metallism* and *Nominalism* Doctrines

3.24. The doctrines of *metallism* and *nominalism* explain different approaches to the physical forms of money and its values. In *metallism* doctrine, the value of money comes from the metal element contained in such money while *nominalism* doctrine believes that money has intrinsic value that does not rely on the value of its material, including metal.[179] Under the *metallism* doctrine, money terms such as 'pound' and 'mark' derived from the names of weights. As a branch of commodity theory, the doctrine of *metallism* supposed that the value of money as a medium of exchange derived from its

[177] See Bitcoin Law of El Salvador (n 72).
[178] See Grifolli and others (n 55) 7.
[179] Nussbaum (n 17) 2; Ellis (n 17) 5 and 91; Knapp (n 18) 38.

bullion or metal content, and therefore, it had an absolute value.[180] The examples of money from the *metallism* era include coins made from brass, bronze, and copper with specific sizes and weights. Although some coins directly derive their value from the metal they are made from, others serve as tokens that have intrinsic value. In any case, these were physical money that could be clearly seen and touched as a tangible object, as they had metal elements in them.

3.25. The era of *metallism* showed that state-issued money, which functioned as legal tender, had always been a tangible object or in physical form. This type of money is considered a movable form of corporeal property in terms of property law categories. Property law regulates certain rights and characteristics of money.

3.26. Eventually, coined metal was given and received regardless of its weight but in reliance on the stamp. The concept of money changed, and the monetary unit became detached from its physical base. This is when the *metallic* doctrine transitioned to the *nominalistic* doctrine, a conception which separates money from the metallic element. The nominalism of the monetary object differs from that of monetary obligations, where the latter holds that a debt should be repaid as agreed, regardless of changes in the intrinsic value of money, as will be explained in the next paragraphs.

3.27. There was, however, a special case of exchange commodities with metal content that could be used as a means of payment, which Knapp, a German economist, referred to as *autometallism*.[181] He explained the distinguishing characteristics of money that can be used both as a means of payment and a medium of exchange, determined by the weight of their metal components (eg copper, silver or gold).[182] These characteristics identify them as legally authorised means of payment, carrying the units of value corresponding to their power to discharge debts and acquire value in exchange due to their metal elements.

3.28. The *nominalism* idea developed by Knapp disconnects money from the metallic element. According to Knapp, money and other forms of payment, such as tickets, stamps and tokens, do not have intrinsic value, but they can still derive their function of discharging debts from legal ordinances.[183] However, even with this understanding of nominalism, state-issued money was still issued in the form of physical currency, even though the value might not be explicitly stated on it. Ellis also explained the nominalism concept in money, in which its value was relative and operated through a unique medium of exchange.[184] Under this idea, money can consist of a 'thing' that does not have intrinsic value, but it still can fulfil its function as money. Regarding the value of money, although it has a nominal value, it does not possess intrinsic value. Its worth is determined by the supply and demand of money, as it also depends on its status as a legal tender.

[180] Nussbaum (n 17) 2; and Ellis (n 17) 5 and 91.
[181] Knapp (n 18) 4-5.
[182] ibid.
[183] ibid 38.
[184] Ellis (n 17) 5.

3.29. The nominalism doctrine introduced a 'token' or a 'symbol' as a medium of exchange.[185] The case of *Gilbert v Brett*,[186] commonly known as the *Case of Mixt Monies*, confirmed the nominalist conception of money in English common law. The modern significance of the case is that the state has the sovereign power to debase the fineness of the coinage, reduce its weight or proclaim a new legal value on money.[187] The case shows that the primary value of money was determined by law and that money debts had to be discharged at their nominal value. It underscored that the value of money does not stem from the intrinsic worth of the metal content it may have.[188] The forms of money currently in use, such as banknotes and coins, are also examples of money created by law. Their values are not based on the materials used to create them but rather on the nominal value defined by the law. This view could also be extended to CBDC. When the law declares the value of CBDC and its function, it should be legally valid as money, although it does not contain any physical material or metal content. Knapp contemplated that the law could give the power to discharge debts to token pieces of metal. CBDC is a logical extension of the same basic idea. It is consistent with Knapp's theory that the law can ascribe the same power to discharge debts to entirely dematerialised tokens.

B. Legal Records of the Materiality of Money

3.30. Legal records tracing the evolution of money globally, covering the *metallism* and *nominalism* eras since as early as 300 AD, highlight the continuing impact of legislation proclaiming money as a means of payment. Historically, these laws recognised various metals as money, and they continue to serve as the legal foundation in determining digital money as a legal tender. It also reflects the ideas of sovereignty held by the highest authority, which amounts to a legally unbounded power. This section provides examples of legislation affirming the validity of such money as a means of payment from an early age, a role it still fulfils today, while the concept of sovereignty is discussed in the following chapter.

3.31. A rescript of Roman Emperor Constantine, at the earliest in 326 AD, ruled that minting coins was the sole right of the sovereign. Although the material of the coin was not explained in detail, the rescript showed that money at that time was in the form of metal since the rescript referred to the counterfeiting and adulterating of the metal content of the coinage. Later, in the medieval era, the anonymous *Tractatus Nove Monete* of 1286, following Edward I's re-coinage in 1279 in England, stated that a statute was needed to determine the proportion of alloy, the weight and the number of coins.[189] The closest specification of coins that have been found was the sterling penny at 32 grains of corn.[190]

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[185] Nussbaum (n 17) 14-17.
[186] *Gilbert v Brett* (1604) Davis 18.
[187] David Fox, 'The Enforcement of Nominal Values to Money in the Medieval and Early Modern Common Law' in David Fox and Wolfgang Ernst (eds), *Money in the Western Legal Tradition: Middle Ages to Bretton Woods* (Oxford Academic 2016) 204.
[188] David Fox, 'The Case of Mixt Monies (1604)' in David Fox and Wolfgang Ernst (eds), *Money in the Western Legal Tradition: Middle Ages to Bretton Woods* (Oxford Academic 2016), 229.
[189] Fox, 'The Enforcement of Nominal Values to Money in the Medieval and Early Modern Common Law' (n 187) 205.
[190] ibid 206.

The *Tractatus* also stated that the coins should be created by order or under special instruction of the prince and proclaimed for public use.[191]

3.32. In 1343, clear legal records governing Edward III's first issue of penny coins were promulgated and continued until the end of Elizabeth I's reign in 1603.[192] A series of silver and gold coins with reduced weight was authorised in the 1351 mint indenture of Edward III. During this period, a variety of forms of coins evolved from metal to silver and gold. In fact, in the 16th century, the creation of money followed a certain weight and metal content.[193] In *Case of Mixt Moneys*, the characteristics of money were determined by its weight, fineness and impression of the coinage as determined by the state.[194]

3.33. In the UK, a new form of money in the form of BoE notes, which were originally issued as a private currency, was recognised as money in 1758 by Lord Mansfield in *Miller v Race*.[195] In this case, paper money was recognised as having the power to discharge debts and was issued in prescribed forms. An English law in 1774 regulated that silver coins should be legal tender up to 25 GBP and above this value, and should be weighed at *5 s. 2d an ounce*.[196] As a comparison, in the US, the legal tender by weight was applied to gold and silver coins by Congress in 1792.

3.34. Another legal case in the 19th century in England, *Emperor of Austria,*[197] acknowledged the sovereignty power over money and the materiality of money in the form of paper or notes.[198] In *Emperor of Austria*, the Court of Appeal in Chancery prohibited the printing of Hungarian banknotes in England by a person who was also a Hungarian refugee, and the circulation of such notes in Hungary.[199]The English court ruled that the manufacturing notes to become money or means of payment in Hungary should be an exclusive right of the emperor or the state and therefore, the activities conducted by the defendant in England should be terminated.[200] The court also stated that the right of the Austrian emperor was to control the circulation of money in his jurisdiction and to issue notes, aligned with the notion of *ius cudendae monetae,* which is attached to the supreme power in every territory or state.[201] Such right also covers issuing precious

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[191] ibid 204.
[192] Fox, 'The Enforcement of Nominal Values to Money in the Medieval and Early Modern Common Law' (n 187) 203.
[193] Nussbaum (n 17) 10.
[194] Fox, 'The Enforcement of Nominal Values to Money in the Medieval and Early Modern Common Law' (n 187) 205.
[195] Nussbaum (n 17) 9.
[196] The definition of an upper legal tender value on a silver coin in the UK in the 18th century was stated in the 1774 the statute 14 George III c.42 which reads as follows:
'That no Tender in the Payment of Money made in the Silver Coin of this Realm of any Sum exceeding the Sum of Twenty Five Pounds… shall be reputed in Law or allowed to be a Legal Tender. for more than according to its Value by Weight… and no Person to whom such Tender shall be made shall be any ways bound thereby; any Law, Statute or Usage to the contrary notwithstanding.'
[197] *Emperor of Austria* (n 163).
[198] ibid.
[199] *Emperor of Austria* (n 163) 233 (See also Fox, 'Money, Law and Institutions' (n 18) 168)
[200] ibid 217.
[201] ibid.

metals and any instruments made to represent varying amounts in value of gold and silver.[202]

3.35. Furthermore, Germany and the US progressed in money regulation by declaring money as legal tender through legislative actions. Under German law in 1921, the money consisted of every medium of payment whose value was acknowledged by the government (or its authorised agent) and was circulated publicly as a legal tender. Under this theory, money was not categorised by its materials but by its acknowledgement from the state.[203] The US also regulated all coins and paper money as legal tender, including gold coins, as stated in the Legal Tender Act of 1933. The UK enacted its legal tender regulation in 1971, where gold coins as legal tender could be used for payment of any amount. It also regulated other specific coins as legal tender, such as cupronickel, silver and bronze, that could be used for a certain amount of payment.[204]

3.36. In the digital era, virtual currency has been proclaimed the legal tender, as evidenced by the legislation of several countries. For example, El Salvador passed a Bitcoin Law that regulates Bitcoin as an unrestricted legal tender to be used in any transactions in El Salvador. In Indonesia, the Indonesian CBDC, known as the Rupiah Digital, is a valid legal tender within the jurisdiction alongside banknotes and coins.[205]

IV. Traditional Functions of Money in CBDC

3.37. This section analyses the traditional functions of money in CBDC. The context of the discussion focuses on the functions of money as an institution, distinct from its status as legal tender to discharge debts. The latter topic and its analysis related to CBDC will be covered in the next chapter.

3.38. The functions of money can be seen from various perspectives, but in principle, money serves three traditional functions: a medium of exchange, a unit of account and a store of value. More specifically, money serves as a means of payment that facilitates the discharge of debts. The analysis of traditional functions of money within CBDC is crucial for understanding the purpose and use of CBDC, especially in comparison to traditional forms of money, as it would impact the effectiveness of the adoption of CBDC in the financial system in comparison to traditional money.

3.39. The analysis suggests that although CBDC is a digital form of central bank money, it serves these traditional functions of money just like the other forms of central bank money, such as banknotes and coins. Beyond these core functions, money can also hold ornamental and ceremonial value. While CBDC could fulfil this function, certain conditions must be met.

[202] ibid.
[203] ibid 9.
[204] See Section 2 of the Coinage Act 1971.
[205] Article 14A of Currency Law as amended by the Strengthening and Development of the Financial Sector Law.

A. Medium of Exchange

3.40. For an object to be considered money, it must be able to function as a medium of exchange. This is the primary function of money in commercial activities.[206] It is indeed the essential character of money that can give security to every consumer and merchant in transactions.[207] CBDC is intended to provide a costless medium of exchange and a secure store of value, where its interest rate could be used as a tool for monetary policy.[208] An analysis of CBDC as a medium of exchange is elaborated below.

1. Theories on Medium of Exchange

3.41. Much has been written about the concept of a medium of exchange, as seen in the works of Menger and Jevons, who explain the theory that money evolved as a medium of exchange to overcome the barriers to bartering.[209] They also recognised the broader functions of money as a common medium of exchange and as a denominator of value and standard for deferred payments.[210] Fox argued that, in the modern era, a medium of exchange refers to a money asset used in transactions to purchase goods or settle obligations.[211] Other scholars describe it as a medium of exchange from an economic perspective as the set of assets in an economy that are regularly exchanged for goods and services.[212] From this definition, a medium of exchange is essentially an asset that has been transformed into a form that can be exchanged for goods and services (ie this 'form' must be generally accepted in such transactions).

3.42. In a barter economy, the highly saleable commodity was considered a medium of exchange, which ultimately evolved into money.[213] Related to the 'saleableness' of commodities, Menger argued that some of the criteria of money as a medium of exchange were based on the 'saleableness' of metals because they are precious materials and appear in history.[214] According to Menger, universally recognised use value explains the evolution of the medium through its high exchange value. Precious metals should serve as an example of these saleable criteria rather than rigid criteria for a medium of exchange.

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[206] *Emery Bird Thayer Dry Goods Co v Williams* 107 F2d 965 (1938).
[207] *United States v Arjona* 120 US 479 (1887), 484.
[208] Michael D Bordo and Andrew T Levin, 'Central Bank Digital Currency and the Future of Monetary Policy' (2017) NBER Working Paper Series No. 23711, 4 <https://www.nber.org/papers/w23711.pdf> accessed 12 September 2025.
[209] Fox, *Property Rights in Money* (n 20) para 1.21; See K Menger, *On the Origins of Money* (1892) 2 Economic Journal 253; See WS Jevons, *Money and the Mechanisms of Exchange* (London, 1875) 8-9.
[210] Nussbaum (n 17) 11.
[211] Fox, *Property Rights in Money* (n 20) para 1.20.
[212] Bill Z Yang, 'What Is (Not) Money? Medium Of Exchange ≠ Means Of Payment' (2007) The American Economist 51, no. 2 (2007), 101 <http://www.jstor.org/stable/40657688> accessed 12 September 2025.
[213] Fox, *Property Rights in Money* (n 20) para 1.20.
[214] Menger (n 209) 239–55.

2. Metals Characteristics in CBDC

3.43. Metals often show the qualities that make them most suitable for use as money. Some of their characteristics translate into essential qualities for money, such as uniformity, portability, durability and divisibility,[215] all of which are also present in a CBDC. To highlight their uniformity, CBDCs owned by individuals are issued by the central bank, meaning they have the same unit of account and are processed through a system supervised or monitored by the central bank. However, they may be stored in different media chosen by the individuals, such as on offline media and smartphones. The divisibility of CBDC allows it to be broken down into small units without compromising its function as a bearer of monetary value, making it suitable for both large and small transactions.[216] CBDC is also portable, as it can be electronically stored on a device or medium. When not in use, the device or medium retains the value of CBDC until the next transaction. CBDC demonstrates durability, as it does not expire, diminish or shrink like some forms of commodity money.

3.44. The quality and size of metals used to be critical factors for money or objects to be regarded as a medium of exchange, as demonstrated in *Ling Su Fan v United States*.[217] In this case, the quality of coins would be an attribute of law aside from their value.[218] This case illustrated how the denomination, specific weight and metal components of coins were valid money proclaimed by law, designating them as the authorised medium of exchange in circulation.[219] Certificates of indebtedness were also issued as a specific measure to maintain the parity of these coins.[220] The case highlights the historical importance of quality, size and metal content in determining what constitutes money. There will be no measurement of size or weight in the case of a CBDC, as it is a digital object. CDBC would need to be in the legally prescribed digital form if it were to function as recognised digital money. The quality of its 'materials' may be reflected in the unique serial numbers officially issued by the central banks as the CBDC issuer.[221] Applications installed on consumer devices should be able to verify these numbers to confirm the authenticity of the CBDC. Just like with banknotes, central banks must be able to generate unique serial numbers for CBDC with distinct and verifiable patterns.

3. CBDC Constitutes a Valid Medium of Exchange

3.45. With the evolution of money and the development of technology, the material composition of money should no longer be the primary consideration in constituting money as a medium of exchange. CBDC should still be considered a valid medium of exchange regardless of its materials. Knapp provided a more flexible view of the material

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[215] See Philip Bagus, 'The Quality of Money' (2009) The Quarterly Journal of Austrian Economics 12 No 4, 24-26.
[216] Patrick Schueffel, 'Can CBDC Mimic Cash? A Deep Dive into the Digital Euro Case' (2025) Journal of Risk and Financial Management, 18(7), 394, 12 < https://www.mdpi.com/1911-8074/18/7/394 > accessed 22 December 2025.
[217] *Ling Su Fan v United States* 218 US 302 (1910).
[218] ibid 23.
[219] ibid 22; See also *Emery Bird Thayer Dry Goods Co v Williams* 107 F2d 965 (1938).
[220] *Ling Su Fan* (n 217) 22.
[221] BIS Innovation Hub and Swiss National Bank, 'Project Tourbillon: Exploring privacy, security and scalability for CBDCs' (2023) Final Report, 11 < https://www.bis.org/publ/othp80.pdf> accessed 12 September 2025.

composition, asserting that the idea of money as a means of payment should not be restricted to any particular materials, even though certain materials eventually evolved into key components that constitute money.[222] He called it a 'morphic proclamatory', status where metallic components are not considered for the validity of money. As long as the token takes the legally prescribed digital form, there is no reason it cannot discharge debts. This theory is crucial for the public's adoption of CBDC as a medium of exchange because it has no physical component. Menger highlighted public acceptance of money, including CBDC, as another factor that makes it an effective medium of exchange. He explained that the less saleable commodities or goods might be used as a medium of exchange if accepted by the market.[223]

3.46. Overall, money, as a medium of exchange, must have the capacity to be traded or exchanged for goods and services and accepted in the economy. CBDC should have the same value as other forms of central bank money and its acceptance as a medium of exchange should be guaranteed under the law.[224] However, the level of acceptance might vary from country to country, depending on factors such as consumer expectations and the availability of payment options.[225]

4. CBDC as a Medium of Exchange to Discharge Debts

3.47. The concept of money as a means of payment has a more specific meaning than that of a medium of exchange. It not only allows the payer to obtain something in return but also discharges a debt. In other words, money can alter the legal relationship between parties as well as obtain goods or services. If CBDC were to be introduced as a form of money, it would also serve as a means of payment, just like banknotes and coins. However, this function should be conferred by law on CBDC so that it can discharge debts or settle any monetary obligation. The ability of CBDC to discharge debts will be elaborated in detail in the next chapter in the context of CBDC as legal tender.

3.48. Knapp also discussed the function of money as a means of payment and argued that 'money always signifies a chartal means of payment. Every means of payment we call money. The definition of money is, therefore, a chartal means of payment'.[226] According to Knapp, since debts are expressed in units of value, they can be discharged through payment.[227] Furthermore, Knapp defines money as a means of payment that can discharge debts. A means of payment can be defined as a generally accepted institutional arrangement or method that facilitates the delivery of money from one person to another.[228] A debt is discharged when the payer delivers the means of payment to the payee.

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[222] Knapp (n 18) 25.
[223] Menger (n 209) 248-249.
[224] See paras 2.23, 2.66, and 3.56.
[225] Alejandro Zamora-Peres and others, 'Ensuring adoption of central bank digital currencies – an easy task or a Gordian knot?' (2022) Occasional Paper Series No 307, 5 < https://www.ecb.europa.eu/pub/pdf/scpops/ecb.op307~c85ee17bc5.en.pdf > accessed 12 September 2025.
[226] Knapp (n 18) 38.
[227] ibid 11.
[228] ibid.

3.49. The law should confer the power on CBDC as central bank money to discharge debts regardless of their form or material. History has taught humankind that law is an essential tool for the state in declaring what forms or materials of money can be used to serve as a chartal means of payment.[229] If the law states that a CBDC, as a digital form of money, can serve as a means of payment, it can be used legally to discharge debts. Related to this function, Knapp also argued that the state could declare money as a chartal means of payment through legislation that identifies the material and form of the money, including the power to discharge debts.[230]

B. Unit of Account

3.50. The unit of account in CBDC would use the same unit of account as other regular forms of money. However, the unit of account in a CBDC would be represented in a different medium, such as the balance stated in a digital wallet on a smartphone, card or other device.

3.51. Money serves as a standard measure for the value of goods and services traded or exchanged in an economy. This measure is reflected in the price of goods or services, which are expressed in monetary terms, acting as a common measure of value in the economy. This price simplifies transactions in the economy by indicating the value of a good or service. By contrast, the main difficulty in a barter system is in deciding the rate at which an exchange has to be carried out. For example, without resorting to a market, it is impossible to know whether two grams of salt equals four grams of tobacco. Furthermore, prices are stated in terms of units of account or national currencies, such as the pound sterling, euros and US dollars.

3.52. The central bank issues CBDC as another form of central bank money. From a legalistic approach, Knapp stated that a proclamation of an object as money is needed to determine the validity of money as a unit of value.[231] Retail CBDC, which would be designed to satisfy the retail payments for households and businesses, would exist alongside other forms of central bank money (ie cash and bank deposits),[232] as stated in the legislation. Therefore, the denomination of retail CBDC available for the public would also follow the denomination of current forms of central bank money or domestic currency.[233] In the UK, if a CBDC were to be introduced as a form of money, it would be denominated in pounds sterling, just like cash.[234] In this context, a CBDC would have the same value as physical notes or coins that can be used to discharge debts or pay for retail transactions.

3.53. Given its digital form, CBDC would not be expressed in the same standardised quantities as banknotes or coins. There might not be a denomination for each CBDC issued due to

[229] See paras 3.30-3.36.
[230] Knapp (n 18) 39.
[231] ibid.
[232] Bank of England, 'Central Bank Digital Currency: Opportunities, Challenges and Design' (n 130) 5.
[233] Bank for International Settlement - Committee on Payments and Market Infrastructures, 'Central Bank Digital Currencies' (2018) < https://www.bis.org/cpmi/publ/d174.pdf > accessed 12 September 2025.
[234] Bank of England, 'Central Bank Digital Currency: Opportunities, Challenges and Design' (n 130) 5.

their digital nature. It would be created unit by unit rather than in aggregated units, like 5 GBP or 10 GBP banknotes. However, individuals may check their CBDC balances or accounts that are stored in their digital wallet installed on a smartphone or through a card or other related devices.[235]

C. Store of Value

3.54. When the state or the central bank determines the status of CBDC as a means of payment through legislation, CBDC will be the lawful means of payment, regardless of its materials, appearance and purchasing power. As a lawful means of payment, CBDC would serve the same value-storing function as cash. A CBDC will be displayed on the device or medium that stores it, and it may not display a nominal value when being transacted, unlike banknotes or coins. Nonetheless, the value of a CBDC in payments will be the same as that of physical cash if it is intended to complement it.

3.55. Money should serve as a store of value that preserves purchasing power for future needs. It serves as a store of economic value.[236] For future use, the value of money should remain stable over time. If it is too volatile, then this currency may not function effectively as a unit of account.[237] When considering whether CBDC can function as a store of value, the answer would be the same as cash's capacity to serve such a function. This is its main advantage over many standard cryptocurrencies. In contrast to CBDC or other forms of central bank money, a privately issued virtual currency exhibits extreme volatility in value. It is true that some cryptocurrencies have increased in value, but they have also experienced substantial declines in a short period of time.[238]

3.56. Mann appeared to acknowledge this by saying that circulating money has minimal value, disregarding the value of material, purchasing power and external value. In other words, its only value is its ability to discharge debts at nominal rates. The minimal value may be interpreted as the face value that the money has when the state proclaims it. This proclamation is needed to confirm the face value of money and the acceptance of the money by the public.

D. Other Functions: Ceremonial and Collection

3.57. Another function of money is added by Einzig, suggesting that money can serve ornamental, ceremonial or collectable purposes that are not exchangeable with goods.[239] Although these additional functions of money have been more connected to the physicality of money, it is still possible for CBDC to fulfil such a function despite its

[235] Bank of Canada and others, 'Foundational Principles and Core Features' (n 61) 12.
[236] Fox, *Property Rights in Money* (n 20) para 1.27.
[237] M Doepke and M Schneider, 'Money as a unit of account' (2013) NBER Working Paper 19537, 5 <https://www.nber.org/papers/w19537> accessed 12 September 2025.
[238] Bank of England, 'What are cryptocurrencies (cryptoassets)?' < https://www.bankofengland.co.uk/explainers/what-are-cryptocurrencies> accessed on 12 September 2025.
[239] Paul Einzig, *Primitive Money: In Its Ethnological, Historical and Economic Aspects (*Eyre and Spottiswoode, London 1947) 376.

digital nature. However, certain conditions should be prepared by the central bank especially from the technological perspective.

3.58. People hold money for reasons other than discharging debts in monetary units, such as ceremonial purposes, as a medium of investment and for collection. Money used for these purposes may not be circulated publicly and may require certain methods to obtain them. Certain types of money, issued exclusively for ornamental and ceremonial functions, might not be exchanged for goods[240] or to discharge a debt.

3.59. In the UK, certain coins are minted exclusively for collection and investment. Although some of this money is considered legal British currency, such coins are not circulated to the public. However, they are still available for individual purchase, such as Royal Mint silver bullion coins.[241] In Indonesia, there are uncut versions of banknotes that are used for ceremonial and collection purposes.[242] These banknotes can still be used as a means of payment or as a valid form of payment for settling debts.[243] However, they cost more than the face value of such banknotes. Another example of money issued for an ornamental purpose can be seen in Kula on the Trobriand Islands, where shell ornaments, which were considered primitive money, were given as a symbol of friendship.[244]

3.60. From the examples of money given above, it can be said that up to now, the extra functionalities of money have been more connected to the physicality of money. Collectable money in the UK, for example, must have a standard design and certificate of authenticity.[245] It is possible that CBDC, as a digital form, might also be used for ceremonial purposes if it is created with certain serial numbers to celebrate certain dates or events. However, when creating a CBDC for ceremonial purposes or as collectable money, the central bank should anticipate challenges such as ensuring that such a CBDC is not circulated publicly or used for transactions and determining the appropriate medium to maintain its existence as an ornamental or collectable item.

V. Characteristics of CBDC

3.61. This section examines the characteristics of CBDCs based on their materials or components, legal liability and transfer mechanisms between transacting parties.

3.62. In addition to being fully digital – distinguishing it from traditional money – CBDC has a combination of characteristics between traditional money, like banknotes and coins, and commercial bank money. Just like other forms of central bank money, CBDC is a direct liability against the central bank as the issuer. However, since CBDC is digital state-issued

[240] ibid.
[241] The Royal Mint, 'Popular Bullion' <https://www.royalmint.com/invest/popular-bullion/> accessed 12 September 2025.
[242] Bank Indonesia, 'Definisi Uang Bersambung' < https://pintar.bi.go.id/Order/DefinisiUangBersambung> accessed 12 September 2025.
[243] ibid.
[244] Einzig (n 239).
[245] The Royal Mint, 'Guide to getting a fair price of a coin' < https://www.royalmint.com/stories/collect/guide-to-getting-a-fair-price-for-a-coin/> accessed 12 September 2025.

money, CBDC will operate through the system in a manner similar to commercial bank money or other digital money. It is expected that the 'delivery' process of money from the holder of CBDC to the recipient can be conducted in a timely manner and might involve the adjustment of the ledger, depending on the design.

A. Digital Component in CBDC

3.63. CBDC is purely digital and does not contain any metals or physical components. It contains data that is represented in an electronic medium as token-based or account-based. Nonetheless, as discussed earlier, it remains a valid form of money or means of payment as long as the state recognises it through legislation.

3.64. Fiat money has always been a tangible object which can be clearly seen and touched, such as banknotes and coins. One recognisable characteristic of fiat money is the ownership of cash, which is shown by the possession of holders of the money, and these holders can spend the money by transferring their possession of such money by a simple delivery to the counterpart.[246] As digital money, the ownership of CBDC would not involve physical possession of money, but the transfer of practical control over CBDC, particularly the CBDC token, would have the same function as the transfer of possession in relation to tangible cash. The CBDC can be accessed through the balance sheet, ledgers or systems available on the device. This is similar to commercial bank money, which, although intangible, can be verified through proof of funds or account balances.

Validity of Digital Component as Money

3.65. Analysing the digital nature of CBDC from the theories of money, it can be acknowledged that this digital nature is still a valid component of money since there is no limitation on the materials of money that can be used to determine such money as a means of payment. The general principles in the state theory of money, as proposed by Knapp did not limit the state's authority in determining the materials that can be determined as money; however, legal recognition through law gives validity to such money.[247]

3.66. Other payment media, such as tickets, stamps and tokens, do not have intrinsic value but can still have legal significance.[248] These payment media still allow the payment to occur, not because of the materials of such payment, but the debt-discharging power in those media, as long as they are recognised by the law. They can be identified legally as authorised means of payment and carry the units of value corresponding to their power to discharge debts. This is in line with Knapp's view that these objects are still means of payment because they are recognised as sign-bearing objects that have legal 'non-pensatory' means of payment.[249] Knapp also extended the concept of money to credit money due to its acceptability in private transactions.[250] He also asserted that if coins were to be totally diminished, meaning that the intrinsic metal content were taken away,

[246] Fox, *Property Rights in Money* (n 20) para 1.76.
[247] ibid 30.
[248] ibid 38.
[249] Knapp (n 18) 32.
[250] ibid 131.

the capacity to serve as a means of payment would still continue, meaning they would still have the chartal properties conferred by the state.[251]

3.67. All in all, Knapp's ideas would still be suitable for CBDC as digital money that does not contain any physical material, but would still be regarded as money that serves as a means of payment if a legal ordinance were to proclaim it as such.

3.68. Another interesting issue to discuss is related to the materials of money derived from digitised numbers. Innes claimed that the materials for state-issued money can be derived from digitised numbers at the central bank, and the reason why Innes insisted on including credit money as money is that the state has the authority to create such money.[252] However, Innes' theory specifically depended on a credit theory of money, and in this context, a CBDC may not necessarily involve debt or credit relations. However, this theory was fundamental in showing that money can be constituted from digitised numbers. If credit money can be considered state-issued money, then CBDC, as digital money issued by the central bank that is not related to debt or credit like commercial bank money, may have valid grounds to be proclaimed as state-issued money.

B. The Nature of Claims and Legal Liability of CBDC

3.69. CBDC would be issued as central bank money, and thus, it represents a direct liability of the central bank, which means that the payment on CBDC can be claimed directly from the central bank. In contrast to cash or other forms of central bank money, commercial bank money issued by commercial banks bears a direct liability to the bank itself. Compared to privately issued digital money or cryptocurrencies, they operate independently from the state, authority, or any institution. They are not recorded in any balance sheet. They are also not backed by the assets of the state or any institutions, meaning that this condition exposes the holders to risks, particularly if the issuer of cryptocurrencies faces collapse or bankruptcy.

3.70. To show that CBDC is a direct liability of the central bank, CBDC is recorded as a liability, which is on the right side of the balance sheet of the central bank, just like other forms of central bank money, banknotes, coins and central bank reserve accounts. The discussion on the balance sheet was discussed earlier in paragraphs 2.55-2.60.

C. Transfer Mechanism

3.71. In general, the transfer of CBDC from the holder to the recipient is conducted through a system, unlike cash. However, the details of the transfer mechanism in CBDC can vary depending on its design. For instance, the transfer mechanism or payment using retail CBDC for account-based and token-based systems may involve adjusting the balances of the payer and payee, similar to commercial bank money, and making corresponding

[251] ibid.
[252] L Randall Wray, 'From the State Theory of Money to Modern Money,' in David Fox and Wolfgang Ernst (eds), *Money in the Western Legal Tradition: Middle Ages to Bretton Woods* (Oxford Academic 2016), 637.

adjustments in the respective ledgers.[253] Furthermore, a verification process might also be needed to settle the payment. The transfer of legal title in CBDC should also occur when the settlement is final. A detailed discussion of CBDC transfer mechanisms and settlement finality will be provided in the following chapter.[254]

3.72. CBDC may have a peer-to-peer basis without the need for intermediaries or third parties to process such money, which could be a central bank, a commercial bank or a third-party agent.[255] This basis is most likely to be applied in a token-based system for offline CBDC. However, this mechanism can be challenging unless the technology can prevent double-spending problems.[256]

3.73. Compared to the delivery method of fiat money, the transfer of its legal title is done by simple delivery or physical transfer, regardless of the validity of any underlying legal transaction.[257] However, the delivery method of physical money can be burdensome, particularly for high-value payments. Rather than using cash as payment for debts, people tend to conduct payments using another form of money, such as commercial bank money, in which payment is conducted through a system. Payment using commercial bank money also avoids risks and costs related to payment by cash, arising, among others, from the transportation of money and physical delivery to the creditor.[258]

3.74. The transfer of commercial bank money, such as deposits, can be performed relatively easily since no physical delivery is required. This 'transfer' involves adjusting the debt liabilities of the parties' banks to the payer and recipient.[259] In other words, the transfer of commercial bank money for any kind of payment purposes means debiting the debtor's bank account and crediting the amount of the withdrawal to the creditor's account. According to Fox, the creation of the recipient's title on the money depends on the decision of the recipient's bank to assume a debt liability.[260] Furthermore, the determination of an accountability time point relies on banking practices and procedures.[261] In general, this time point or decision to assume a debt liability is executed in real-time as soon as the adjustment between debt liabilities is created.

3.75. Regarding the method of transfer of cryptocurrency, payment using cryptocurrency could occur instantly if the recipient's digital wallet provider is authorised to receive such a transfer, and the wallet holder can access their cryptocurrency without any

[253] Bank of Canada and others, 'Central Bank Digital Currency: System Design and Interoperability' (n 21) 4.
[254] See Chapter 6.
[255] Bank for International Settlement - Committee on Payments and Market Infrastructures, 'Central Bank Digital Currencies' (n 233) 6.
[256] Hanna Armelius and others, 'On the possibility of a cash-like CBDC' (2021) Sveriges Riksbank Staff Memo, 6 < https://www.riksbank.se/globalassets/media/rapporter/staff-memo/engelska/2021/on-the-possibility-of-a-cash-like-cbdc.pdf> accessed 12 September 2025.
[257] Fox, *Property Rights in Money* (n 20) para 1.61.
[258] Benjamin Geva, 'The Concept of Payment Mechanism' (1986) 24(1) Osgoode Hall Law Journal, 4.
[259] Fox, *Property Rights in Money* (n 20) para 1.100.
[260] ibid para 1.106.
[261] Geva, 'The Concept of Payment Mechanism' (n 258) 13-14.

hindrance.[262] The transfer is considered to happen when a receipt is recorded in their digital wallet.[263] The ledger adjustment between payee and payor occurs after such transfer.

VI. Conclusions

3.76. The form of money has evolved significantly over time. Traditionally, the state-issued money had always been a tangible object or contained metal, in line with the *metallism* doctrine. Then it shifted to the *nominalism* doctrine, where the physicality of money was no longer a determining factor. Despite these changes, the fundamental function of money has remained consistent, which is to settle debts arising from commercial transactions, contracts or other monetary obligations.

3.77. The characteristics of CBDC shows a combination of features from different forms of money. It marks an evolution in state-issued money where a pure digital form is offered as a component of this money. Nevertheless, its digital component does not undermine its validity as money, since no particular material of money determines its concept and function. As a kind of central bank money, CBDC consists in a direct liability of the central bank as the issuer, recorded in the central bank's balance sheet. Another distinguishing characteristic of CBDC is its delivery method, which can vary depending on its design but generally requires a technological system to enable the transfer of CBDC from one holder to another.

3.78. Despite its digital material, CBDC can serve the functions of traditional money as a medium of exchange, unit of account and store of value. It can also be used for other functions, such as for ceremonial or ornamental, if supported by the requisite technology.

[262] Christopher Hare, 'Cryptocurrencies and Banking Law: Are There Lessons to Learn?' in David Fox and Sarah Green (eds), *Cryptocurrencies in Public and Private Law* (Oxford University Press, 2019) para. 9.25.
[263] ibid.

CHAPTER 4

CBDC AS A STATE-ISSUED MONEY: STATE SOVEREIGNTY AND LEGAL TENDER STATUS

I. Introduction

4.1. CBDC may have a variety of designs, any of which may be developed in the future. As highlighted in the earlier chapter, while many theories, doctrines and characteristics related to money have evolved from ancient history to the modern era, they remain relevant in defining CBDC.

4.2. This chapter explores the nature of CBDC as state-issued money by analysing the state's authority in the creation of money and CBDC as legal tender if that status were conferred on it by legislation. The analysis is based on several fundamental theories of money, including the concept of sovereign power in minting money and the intellectual history of the state's approach to money, such as the state theory of money and theories on money as legal tender.

4.3. The main finding in this chapter is that the issuance by the central bank of CBDC as digital money remains consistent with the fundamental theories of money, which include sovereign power over money, the state theory of money, and theories on legal tender. Acknowledging that the state has the supreme authority to create money, it also has the authority to issue CBDC. Therefore, a CBDC should be analysed as state-issued money that has characteristics similar to those of other central bank money, such as banknotes and coins. Moreover, if CBDC were adopted as a means of payment, it would be deemed a valid means of payment. However, the state would need to enact legislation to proclaim it as legal tender.

II. Legal Analysis of CBDC as State-Issued Money

4.4. This section argues that CBDC qualifies as state-issued money as it exhibits a notable feature: it is created by the state and can serve as a valid means of payment. Like any other form of state-issued money, CBDC is also perceived as an expression of the sovereignty of the state over the monetary system.

4.5. The creation of CBDC by the state distinguishes it from other forms of money created by the private sector, such as commercial bank money and privately issued virtual money. The following paragraphs outline the legal analysis of CBDC as state-issued money, which is underpinned by two core theories of money: the sovereign power of minting money and the state theory of money.

A. The Sovereign Power of Minting Money

4.6. The concepts of sovereignty in issuing or minting money began with the king's authority to mint coins. The concept of sovereignty signifies the absolute control of a territory held by the highest authority, including control over money, which was vested in the king in earlier times.

4.7. However, in the modern era, control over money is now held by the state. Monetary sovereignty can now be understood as the state's supreme authority to issue and control the circulation of money within its own territory.

The King's Authority to Mint Coins

4.8. At one time, the issuance of money demonstrated the supreme authority of the king, and counterfeiting money was deemed an affront to the king. In Western Europe, sovereignty was held by the prince or king, who had the highest authority over a territory. This authority granted him absolute and exclusive control over the minting of coins. The concept of sovereignty can be traced back to the early 16th century, as seen in the writings of Bodin (1520–1596) and Machiavelli (1469–1527).[264] In his writings, Bodin highlighted that the principal mark of sovereign authority is the power to impose laws on all subjects, asserting that a sovereign prince must stand above the law.[265] This may be the first piece of writing on the principle of sovereignty as the fundamental foundation for the exercise of state power.[266] Similarly, Machiavelli established some of the grounds of modern political philosophy, arguing that princes should maintain absolute control over their territories and, thus, could employ any necessary means of expediency to achieve this goal.[267]

4.9. Seen historically, monetary sovereignty mainly involved the creation and control of coined money. It was originally limited to the right to strike coins (*ius cudendae monetae*) and it

[264] Lastra (n 18) para 1.12-1.13.
[265] ibid.
[266] Claus D Zimmermann, 'The Concept of Monetary Sovereignty Revisited' (2013) The European Journal of International Law Vol. 24 no. 3, 801.
[267] Lastra (n 18) para 1.12-1.13.

assigned legal values in the discharge of debts.[268] The idea of sovereignty over money as the royal prerogative to coin money was contended by Bodin and Grimaudet in the 15th century.[269] They claimed that 'the value of money depends on the state; that is to say, in a monarchy, upon the prince, and in an oligarchy, upon the state, which alone has the right to coin money, or to have it coined and to stamp a valuation upon it.'[270] The rules for the enforcement of this exclusive right were derived from the Roman Emperor Constantine found in the Codex of Justinian.[271] In a rescript included in the Codex, Constantine strictly limited the practice of striking coins so it would be performed only by his mints; minting false coins was considered a violation of his power and should be criminalised.[272] These provisions were later treated as the authority for the more general point that the sovereign power in the state has sole and exclusive power to issue and control the circulation of money in its territories.[273]

4.10. Roman law texts were the legal source justifying the state's sovereign power to issue money. The Roman conception of imperial power over the monetary system later found more detailed expression in early modern common law. The idea of the king's authority in minting coins was reflected in the dicta in the decision of the English Privy Council in Case of Mixt Monies.[274] Its decision stated *monetandi ius principum ossibus inhaeret* ('the issuing money belongs in the very bones of princes').[275] The state's power in issuing money has an equivalent scope for the king when issuing money. The English Privy Council's decision in *Case of Mixt Monies* shows the perception of the absolute supremacy of money attached to the king. Under the case, only the king may mint or strike coins within his territories; no other person may do so without his prior approval.[276] From this case, the king held the sovereign power to create lawful money, encompassing its weight, fineness, impression or design, denomination and public announcement, although such proclamation was not always required.[277]

4.11. In the 17th and 18th centuries, English lawyers Sir William Hale and Sir William Blackstone introduced the right to issue coins using more common terminology in common law as the sovereign's 'prerogative' that was associated with the king's sovereign power to mint coins.[278] The term 'prerogative' was also found in the legal ordinance of England in 1701, stating that the king's prerogative is deemed law.[279] As a result, rules made in the exercise of sovereign power were legally binding.

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[268] Fox, 'Money, Law and Institutions' (n 18) 161.
[269] Zimmermann (n 261) 801.
[270] ibid.
[271] Fox, 'Money, Law and Institutions' (n 18) 161.
[272] ibid.
[273] ibid.
[274] ibid 163.
[275] ibid.
[276] *The Case of Mixed Money in Ireland* [1605] Trin 2 James I, Davies's Rep 116.
[277] ibid 117.
[278] Fox, 'Money, Law and Institutions' (n 18) 163.
[279] The [Judgement of] Whole Kingdoms and Nations, Concerning the Rights, Power, and Prerogative of Kings, and the Rights, Priviledges, and Properties of the People. London, 1713, 33.

4.12. Scots and English legal sources of the 17th century explicitly acknowledged the right to fix the value of a coin with the sovereign's prerogative. The formal valuation of money with a stamp was not primarily concerned with showing the monetary value, but rather with showing that the coin was validly issued and circulated as money.[280]

4.13. Furthermore, under English law, domestic courts have recognised the sovereignty of other countries over their currencies and have prevented the counterfeiting of foreign currencies within their borders. For instance, in *Emperor of Austria*, the court affirmed that the emperor's authority was to control the circulation of money in its territories and the right to issue notes, based on the notion of *ius cudendae monetae*, which is attached to the supreme power in every state, as explained earlier.[281] Even though the court of England does not have jurisdiction over Hungarian territory, it ruled that the right of the emperor or the state includes issuing and circulating notes. This case illustrates that sovereign power over money is legally unbounded, and it was eventually extended from its original, narrower use in the coining of money.

4.14. The perception of the king's power in minting coins remains incontestable. As previously discussed in the theory of sovereign power over money, his authority to mint coins can be equated with the power of the state in creating money in modern times, as will be further explored below.

B. The State's Power to Create Money

4.15. The same idea that the sovereign power in a territory can determine what things would carry the legal power to discharge debts is found in the state theory of money developed by Knapp. The state, wrote Knapp, also has the power to proclaim money through the enactment of legal ordinances where such proclamation confirms the validity of means of payment that are not based on the weight or any material of money. Legal ordinances confer such power, enabling money as a means of payment to discharge debts.[282]

4.16. Knapp's theory used a legalistic approach that identifies the creation of money with the exercise of the state's power. In his theory, the law is an emanation of the state, and it can determine what things would be capable of discharging debts. Eventually, the law itself creates the concept of money that can discharge debts. This framework is fundamental in providing further legal analysis related to money as legal tender.

4.17. This section elaborates on the power of the state to create money, including CBDC and its delegation to the central bank through the legislative function, highlighting its connection to the state theory of money.

1. The General Power of the State

4.18. When discussing the state in detail from a modern perspective, Kelsen claimed in his general theory of law and state that the elements of the state comprise territory, people

[280] Fox, 'Money, Law and Institutions' (n 18) 161.
[281] See para 3.34.
[282] Knapp (n 18) 30.

and power.[283] While the 'power' of the state may be interpreted as the validity and efficacy of the legal order that can be imposed on people in its territory, sovereignty is said to be the central characteristic of this power.[284] The power of the state, on the other hand, can also be distributed among the three functions of the state: legislative, judicial and executive power.

4.19. From this theory, the creation of state-issued money through parliament or central banks and the proclamation of money as legal tender through legal order reflects the sovereignty of the state. The result is a direct exercise of state power over the monetary system.

Monetary Sovereignty of the State

4.20. The modern understanding of monetary sovereignty recognises the sovereign power of legislatures. Hence, legislation has become the method by which this sovereign power is exercised. In many countries, central banks hold practical control over the monetary system, a power conferred upon them through legislation. In effect, this power is delegated from the state to them through its sovereign body (ie the legislature). Despite this delegation, the state still holds ultimate power over money. Under both Knapp's and Kelsen's theories, the king or the state legislature still embodies the state's power.

4.21. The concept of the state's monetary sovereignty involves an analysis of the territory of the state and its money. According to Lastra, monetary sovereignty generally includes the power to issue money, regulate money, control monetary policy (including money supply and interest rates), control the exchange rate and determine exchange rate policy, and impose exchange and capital controls.[285] Furthermore, every sovereign state has the exclusive power to determine what constitutes legal tender within its territory and establish the nominal value of that currency.[286]

4.22. The principle of the state's power over money is recognised under public international law. It has been acknowledged by the Permanent Court of International Justice in 1929, which stated that a state is entitled to regulate its own currency.[287] Several common law cases, especially in the US, have significantly contributed to recognising such power, as elaborated below.

4.23. In *Juilliard v Greenman*,[288] the US Supreme Court emphasised the power of Congress under article 1, section 8 of the Constitution to borrow money on the credit of the US. This power had been interpreted to include the power vested in Congress to issue treasury notes and circulate them as legal tender for the payment of debts. This power was universally understood to belong to the sovereignty of the US. Under its authority

[283] Hans Kelsen, *General Theory of Law and State* (Transaction Publishers 2006) 255.
[284] ibid.
[285] ibid para 1.52.
[286] Lastra (n 18) para 1.44.
[287] ibid para 1.36.
[288] *Juilliard v Greenman* (1884), 110 U.S. 421, 131.

to borrow money and coin money, Congress has the power to create currency as lawful money.

4.24. Another important US case relating to the power of the state to determine money as legal tender is *Norman v Baltimore*.[289] In this case, the Court confirmed the power of Congress to create a monetary system and to declare that legal tender cannot be interfered with by private contracts. The decision also confirms the authority of Congress over legal tender, including its function to discharge debt:

> Congress may establish a uniform national currency, declare of what it shall consist, endow that currency and every unit thereof with the character and qualities of money having a defined legal value by requiring its acceptance at its face value, as legal tender in the discharge of all debts, whether preexisting or subsequently incurred, and to regulate the value of such money, unless by so doing property is or may be taken without due process of law.[290]

4.25. The conceptual ideas of sovereign right over money have modernised to include the right to circulate money, as seen in *Knox v Lee*,[291] *Parker v Davis*[292] and *Juilliard*.[293] These cases affirmed that Congress has the constitutional power to issue legislation to control the monetary system, including the circulation of paper money. Every contract related to the payment of money is subject to the constitutional power of the government over currency. The cases examined the power of Congress to control currency under the Constitution.[294]

4.26. These cases also demonstrate the supremacy of the state, as represented by Congress, in declaring money as the national currency and legal tender that can discharge all debts, both pre-existing and current, as stipulated in the US Constitution. This authority extends to circulating money. It is reasonable to assume that other sovereign states would have the same power, even though this power may not be explicitly written in their respective constitutions. The Supreme Court interpreted the narrowly expressed provisions of the Constitution as giving Congress all the powers to regulate the monetary system as a modern state would need to.

4.27. The issuance of CBDCs as state-issued money in digital form can reaffirm the monetary sovereignty of the state, particularly in a digital era marked by evolving payment methods, significant technological advances and a decline in the use of physical cash.

2. The State Theory of Money

4.28. The historical background related to sovereign power over money aligns with Knapp's state theory of money. This theory remains relevant as a foundational framework for

[289] See *Norman v Baltimore & Ohio Railroad* Co., 294 U.S 240 (1935).
[290] ibid.
[291] *Knox v Lee* (1871) 79 US 457.
[292] *Parker v Davis* (1871) 79 US 457.
[293] *Juilliard v Greenman* (1884) 110 US 421.
[294] ibid 130.

the state, including the central bank, and its authority to create money regardless of the materiality of money. This theory is applicable to the creation of CBDC as state-issued money in a digital form, where there is an absence of physical materials.

4.29. This theory identifies essential elements in the creation of money: the state has the authority to create money and, therefore, the power to determine money as a means of payment, designate the means of payment, and define the new unit as money. There should be no limitation on the state's authority to create a means of payment. According to Knapp, 'The following general principles remain: (1) The choice of the means of payment is a free act of the state's authority, (2) The denomination of the means of payment according to new units of value is a free act of the state's authority. (3) The definition of the new unit is also free of the state's authority.'[295]

4.30. Although he was an economist, some aspects of Knapp's theory were developed using legal approaches. In his theory, the state is 'the guardian and maintainer of law' and should have the ability to proclaim money as a means of payment.[296] The state has the power to create laws; the power of the state to proclaim money is exercised through the enactment of such laws.

4.31. From another perspective, the law plays a crucial role in the creation of money, as it is often required to create money as a means of payment. According to Knapp, 'Our law lays it down that only pieces formed in such and such a manner are to be admitted as means of payment, and the significant marks of the pieces are prescribed by law.'[297]

4.32. Furthermore, the proclamation of money can be made through legal ordinances, aligning with Knapp's argument that 'When legal ordinances give the name to the unit of values (as mark, franc or rouble) and define it by reference to the earlier unit, there is nothing to prevent us from giving the morphic means of payment a validity dependent not on weight but on fiat.'[298] The proclamation of the unit of value confirms the validity of a means of payment is not based on the weight or any material of money, but the order of the state through legal ordinances. By conferring the unit of value upon the thing (whether a piece of paper, metal or a unit of data), the state can transform it into a means of payment (ie the thing with the legal property of discharging debts). Since the state has conferred the unit on the means of payment, it can be argued that such means of payment can circulate as valid money.

4.33. Continuing with Knapp's theory, money is essentially just a means of discharging legal debts; hence, money and debts are legal concepts created by the law. Materials are not essential in the creation of money. In fact, the absence of physical materials in money cannot hinder the function of money in discharging debts, financial obligations or liabilities that the debtors should fulfil. Knapp compared money to stamps, tickets and tokens to support his view. These objects may lack intrinsic material or consist of non-

[295] Knapp (n 18) 24.
[296] ibid 39.
[297] ibid 27.
[298] ibid 30.

physical material, yet they can still serve as valid means of payment as long as the law declares that such objects have the function of a means of payment.[299]

4.34. Mann supported the notion of the state theory of money, whereby such a theory is the necessary consequence of the sovereign power of the monopoly over money.[300] It lies within the state's prerogative to create money or permit its creation by private persons so that it will then be recognised as money by law.[301] Furthermore, money cannot lose its character except by virtue of formal demonetization through law.[302]

4.35. On the other hand, the issuance of money by the private sector, such as commercial bank money through various financial products or banking services, or privately issued virtual money, such as cryptocurrencies, may not align with the state theory of money discussed earlier. In general, these commercial banks and private institutions operate as private entities that can create private money without legislative mandate.[303] However, as private institutions create this money, the legal liability for issuing that money rests solely with those institutions, rather than with the state.

4.36. However, under the state theory of money, the state retains the power to control all forms of money, primarily through the central bank's conduct of monetary policy.[304] This policy aims to control the supply of money, which indirectly affects money issued by the private sector.[305] Typically, this control is exercised by buying or selling securities in the open market, which impacts short-term interest rates and, in turn, affects long-term rates and overall economic activity.[306] Changes in interest rates then influence the lending behaviour of the banks, thereby affecting the creation of commercial bank money, such as bank deposits.[307] The state theory of money contrasts with the societary theory of money, which holds that the characteristics of money are determined by the commercial practice and society, not by the state.[308] However, the state theory remains valid because the state has a significant role in creating money, determining currency and controlling the money supply through the monetary policy of the central bank, including ensuring the stability of the financial system.[309]

4.37. Cryptocurrencies, in general, exist outside the traditional financial system and are not used as a means of payment or for day-to-day payments. Thus, their value is unlikely to

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[299] ibid 33.
[300] Frederick A Mann, *The Legal Aspect of Money: with Special Reference to Comparative Private and Public International Law* (5th edn, Oxford Clarendon 1992) 19.
[301] ibid.
[302] ibid.
[303] McLeay and others (n 2).
[304] International Monetary Fund, 'Monetary Policy and Central Banking' <https://www.imf.org/en/About/Factsheets/Sheets/2023/monetary-policy-and-central-banking#:~:text=Central%20banks%20use%20monetary%20policy,are%20moving%20to%20inflation%20targeting.> accessed 12 September 2025.
[305] Claeys and others, 'Cryptocurrencies and monetary policy' (n 3) 16.
[306] ibid.
[307] ibid.
[308] Lastra (n 18) para 1.49; Mann (n 300) 12-14.
[309] ibid para 1.50.

be affected by overall economic activity.[310] However, in the Eurosystem, monetary policy can impact the prices of cryptocurrencies, such as Bitcoin. If monetary policy becomes overly expansionary or the money supply increases significantly, it would lead to inflation, which, in turn, boosts demand for alternative assets like Bitcoin and drives up their prices.[311]

4.38. Further discussion of the applicability of Knapp's theory in CBDC extends to the central bank as the issuer of money, the issuance and circulation of CBDC, and the materiality of CBDC, as elaborated in the following paragraphs.

a. Central Bank as the Issuer of Money

4.39. The power of the state in issuing money has been channelled through a legislative function that can create laws or general norms related to money through the state's organs or representatives, such as the central bank. This statement is in line with the state theory of money as found in Knapp's and Mann's views, as well as in *Case of Mixt Money*,[312] which highlights that the state, represented by the central bank, is the only issuer of money. In the context of the issuance of CBDC as a digital form of money, in many countries, the central bank acts as the representative of the state entrusted with the power to issue money under relevant constitutional arrangements or laws. Thus, CBDC is typically issued by the central bank as the authorised institution related to money or currency, as discussed earlier in paras 3.15 to 3.18.

4.40. Since the delegated functions of the central bank must be specified by legislation, it is assumed that the power to issue CBDC should be established through legislation. As a new form of money, specific legislation is also needed to recognise CBDC as a form of money, particularly if it is to be granted legal tender status. The central bank's role as the institution representing the state in the issuance and circulation of CBDC must align with relevant laws and regulations. Depending on the applicable legal framework, specific legislation may be required to define these roles.

4.41. Modern studies on CBDC highlight that the state's authority to declare money as a means of payment or legal tender requires a legal framework.[313] Most central bank laws only authorise the issuance of currency in the form of (paper or plastic) banknotes and metallic coins, not in the form of digital tokens. Therefore, an amendment to the central bank law is needed to enable the issuance of CBDC by the central bank.[314]

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[310] Deutsche Bundesbank, 'The impact of the Eurosystem's monetary policy on Bitcoin and other crypto tokens' (2021) Monthly Report, 74 < https://www.bundesbank.de/resource/blob/877282/6bd23da5a9b8ab8f472938b016628d39/mL/2021-09-geldpolitik-krypto-token-data.pdf> accessed 12 September 2025.
[311] ibid 73-74.
[312] See para 3.29.
[313] Wouter Bossu and others, 'Legal Aspects of Central Bank Digital Currency: Central Bank and Monetary Law Considerations' (2020) International Monetary Fund Working Paper WP/20/254, 7 < https://www.imf.org/en/Publications/WP/Issues/2020/11/20/Legal-Aspects-of-Central-Bank-Digital-Currency-Central-Bank-and-Monetary-Law-Considerations-49827 > accessed 12 September 2025.
[314] ibid.

4.42. Countries that have launched CBDC already have a legal basis to support the issuance. In Jamaica, the Bank of Jamaica Act has been amended to include CBDC as its legal tender and to include the central bank's authority to issue CBDC.[315] In Nigeria, the state issued the Regulatory Guidelines on E-Naira as a legal basis for the adoption of its CBDC.[316] Likewise, the Bahamas issued the Bahamian Dollar Digital Currency Regulation 2021 to support the issuance of its CBDC.[317]

4.43. In the UK, the government and BoE have stated that they are still considering issuing CBDC as a new form of money. If CBDC were adopted there, the next step would be the assessment of the legal framework to accommodate CBDC. In Indonesia, the existing legal framework has also been adjusted to authorise the central bank to issue CBDC as a means of payment through an amendment of the Indonesian Currency Law as discussed earlier. However, as mandated under such Law, Bank Indonesia needs to issue detailed regulations on the Digital Rupiah for its implementation.

b. Circulation of Money

4.44. Knapp's theory was heavily relied upon in German cases and works of literature in the early 1900s, including the circulation of money as part of exercising the state's authority. In his theory, money was perceived as follows: (1) a measure of value and medium of payment only under the command of the state, and (2) money includes every medium of payment which the government or its agent authorises for value and publicly circulated as legal tender.[318]

4.45. As explained earlier, the circulation of money is part of the sovereignty of the state, where it is essential for monetary control.[319] The circulation of money is also regarded as the money supply, which refers to the total amount of money in circulation, including cash, coins and balances in bank accounts.[320]

4.46. Regarding the circulation of money, Mann gave an example of the promissory notes issued by the private parties. Worth 10 GBP each, they would not be legally treated as banknotes or money, even though they have been circulated and treated as such by society.[321] Therefore, to be legally deemed as money, it should only be issued and circulated by the competent authority, and thus, it can be considered as a means of exchange.[322] Mann also argued that the state's supremacy to impose currency on the

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[315] See Bank of Jamaica Act 1960 and Bank of Jamaica (Amendment) Act 2022.
[316] Central Bank of Nigeria issued Circular to All Stakeholders dated 2021 regarding the Regulatory Guidelines on the E-Naira < https://www.cbn.gov.ng/Out/2021/FPRD/eNairaCircularAndGuidelines%20FINAL.pdf> accessed 19 August 2025.
[317] See Bahamian Dollar Digital Currency Regulation 2021, <https://www.centralbankbahamas.com/viewPDF/documents/2022-02-11-11-53-25-Bahamian-Dollar-Digital-Currency-Regulations-2021-Final-Gazetted.pdf> accessed 12 September 2025.
[318] Nussbaum (n 17) 9.
[319] See para 4.20.
[320] The Federal Reserve System, 'What is the money supply? Is it important?' <https://www.federalreserve.gov/faqs/money_12845.htm> accessed on 12 September 2025.
[321] Mann (n 300) 19.
[322] ibid.

community was not only a necessity but also a duty that should be exercised. Issuing and determining legal tender is the state's responsibility for public order and administration. In line with this view, CBDC should be legally issued, proclaimed and circulated just like other forms of central bank money.

4.47. Griffoli and others threw some light on the definition of CBDC that relates to its circulation. They stated that CBDC is 'a new form of money, issued digitally by the central bank and intended to serve as legal tender' and is distinct from other forms of money typically issued by a central bank.[323] However, from the liability perspective, CBDC is categorised as a central bank liability that can be given status as legal tender for the public use.[324]

4.48. Similar to other forms of central bank money, CBDC should be 'circulated' or made available for the public in the designated network or platform by the central bank as the state's representative. Digital circulation should remain valid because, according to Mann, the status of a thing as money does not depend on the value of the material but on its purchasing power and external value.[325] In this context, 'purchasing power' is the capacity to command the acquisition of goods and services despite inflation or deflation, while 'external value' refers to its foreign exchange value against other currencies, which can be assessed through the circulation of money.[326] This characteristic of money also aligns with the state theory of money, as the state cannot decree the value of its money outside its own sovereign territory.

c. Materiality of Money

4.49. Previous chapter shows how the materiality of money can be divided into the eras of *metallism* and *nominalism*.[327] During the *metallist* era, the value of money as a medium of exchange was based on its bullion content; its value in payments was linked to its market value as bullion.[328] This reflects the commodity theory of money which treats money as purely a commodity origin and applies purchasing power in supply and demand.[329] In contrast, Knapp's theory belongs to the *nominalist* era, where it separates the concept of money from its metallic content, highlighting that there should be no limitation on what materials can constitute money as a means of payment. Furthermore, the state must determine its nominal value and accept it in payments made to the state.[330]

4.50. Knapp's theory does not limit the characteristics or the materials of the unit that can be determined as money by the state. In addition, Knapp contended that legal ordinances

[323] See Grifolli and others (n 55) 7 and see para 3.21.
[324] Bank for International Settlements, 'Central Bank Digital Currencies' (n 56) 3.
[325] Mann (n 300) 20.
[326] See Tim Callen, *Purchasing Power Parity: Weights Matter*, Economic Concepts Explained < https://www.imf.org/en/Publications/fandd/issues/Series/Back-to-Basics/Purchasing-Power-Parity-PPP > accessed 12 September 2025.
[327] See paras 3.24-29.
[328] Nussbaum (n 17) 2; Ellis (n 17) 5 and 91.
[329] See Nussbaum (n 17) 22; See Ellis (n 17) 4.
[330] Wray (n 252) 10.

are essential to explicitly proving the validity of money, whereas they are not necessarily bound to any particular material of money.[331] As mentioned earlier, legal ordinances or legislation hold an important role in the validity of money as a means of payment.

4.51. The development of the materiality of money reflects an evolution from simple to complex forms, as Knapp argued in his general theory of money, which covers both specie and paper money.[332] Knapp compared money to other forms of payment, such as tickets, stamps and tokens, that derive their function from legal ordinances.[333] When the state accepts tickets or pay tokens, including credit money, they become chartal money. Based on this reasoning, Knapp believed that money as a means of payment cannot refer to any particular material, as such material may be changed.

4.52. As stated previously, Knapp's ideas would be suitable for explaining CBDC as digital money that does not contain any physical material but would still function as money and serve as a means of payment. The essential character of CBDC as a means of payment, according to Knapp, is the crucial character of CBDC as a sign-bearing object that has the validity and legality to be used as payment or legal tender by the public.

4.53. Changes in the materials of money over time, as evidenced by legal records or cases explained in the earlier chapter, show the relevance of the materials of money from a legal perspective. However, as the state creates money, the law may be adjusted to accommodate such changes. From a theoretical standpoint, theories by Knapp and Mann have enabled flexibility in the materials that can be used as money; thus, the state can create money from any material. Knapp's theory in particular appears progressive in the sense that it involves a gradual progression of stages, from precious metals and physical tokens to digital tokens.

C. CBDC Represents Monetary Sovereignty of the State in the Digital Era

4.54. In the modern era, having control over money and currency has emerged as a vital component of state power.[334] After discussing the concept of sovereignty and the features of CBDC as state-issued money, one can conclude that the issuance of CBDC by the central bank is a manifestation of the monetary sovereignty of the state in the digital era using the following arguments.

4.55. First, from the perspective of the authority of the state, the issuance of CBDC shows that the state holds unlimited power in issuing money in any form, including digital CBDC. The state's power in this context can be perceived as reinstating the sovereignty of the state. Second, considering the material aspects of money and technological advancements in the digital era, the existence of CBDC as state-issued money in digital

[331] Knapp (n 18) 30.
[332] ibid 2.
[333] ibid 38.
[334] Edoardo D Martino, 'Monetary sovereignty in the Digital Era: The law and macroeconomics of digital private money' (2023) Computer Law and Security Review, 1 < https://doi.org/10.1016/j.clsr.2023.105909 > accessed 12 September 2025; Katharina Pistor, 'From Territorial to Monetary Sovereignty' (2017) 18 Theoretical Inquiries in Law 491, 495.

form and denominated in domestic currency illustrates how state-issued money is adapting to the digital era. The latter argument will be the focus of the analysis of this section.

CBDC Exists as a Digital Version of State-issued Money

4.56. The introduction of CBDC can strengthen the role of traditional money in the context of maintaining monetary sovereignty. Cash usage is declining in modern times.[335] The issuance of CBDC in the digital era is expected to promote or increase the use of state-issued money. The greater the use of fiat as money issued by the sovereign power in the state, the greater the degree of monetary sovereignty to preserve monetary policy autonomy and prevent destabilising capital flows.[336]

4.57. The issuance of CBDC could strengthen the role of domestic currency and prevent state-issued money from being replaced by private money or digital alternatives, including cryptocurrencies or stablecoins.[337] In a broader context, CBDC can be issued to support the central bank in conducting effective monetary policy, including acting as a lender of last resort.[338] The issuance of CBDC is needed to show how domestic currencies can adapt to the new state of technology and protect them from outside competition based on digital superiority.[339]

4.58. The traditional roles of central banks are commonly related to monetary policy and financial stability. These roles include providing market liquidity, acting as a lender of last resort, ensuring financial stability and, for some countries, managing the resolution of failing institutions.[340] State-issued money serves as the anchor of a monetary system, and placing it at the centre would allow the central bank to implement an effective monetary policy and function as a lender of last resort.[341] The issuance of CBDC as digital state-issued money is expected to positively impact the effectiveness of monetary policy as well as financial stability. If the central bank issues CBDC as a monetary tool, it would allow the direct implementation of monetary policy, affecting the intertemporal decisions of households and entities rather than relying on traditional banking channels.[342] As a lender of last resort, the central bank may also give short-term liquidity loans to banks in the form of CBDC. However, technical procedures and technologies need to be prepared by the central bank to enable CBDC with this function.

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[335] See para 1.2.
[336] Ibid 16.
[337] Brooks (n 129) 1; Das and others (n 73).
[338] Brooks (n 129) 1.
[339] ibid 4.
[340] Erlend Walter Nier, 'Financial Stability Framework and Role of Central Bank: Lessons from the Crisis' (2009) IMF Working Paper WP/09/70 < https://www.imf.org/external/pubs/ft/wp/2009/wp0970.pdf > accessed 12 September 2025.
[341] Brooks (n 129) 13.
[342] Raphael Auer and others, 'Central Bank Digital Currencies: Motives, Economic Implications and the Research Frontier' (2021) BIS Working Paper No 976, 19 < https://www.bis.org/publ/work976.pdf > accessed 12 September 2025.

4.59. Furthermore, the adoption of CBDC allows central banks to control the monetary supply effectively, as it can influence spending to achieve its monetary policy targets.[343] With its legal tender status, CBDC would serve as an alternative tool or instrument for the central bank to achieve its policy targets through a digital form, as it is available for public use and convertible with existing banknotes and coins. However, if the use of private money or commercial bank money increases significantly, the state can still control the money supply just as under existing conditions. However, the central bank might rely on its interest rate policy to influence the borrowing and saving decisions of households and businesses.[344]

III. Legal Analysis of CBDC as Legal Tender

4.60. To function as a means of payment, CBDC should be declared legal tender by the state. This section explores criteria required for a CBDC to be considered legal tender within a given jurisdiction. The analysis requires a closer look at the concept of legal tender, including the characteristics of money that hold this status. The first part of the inquiry is theoretical, identifying and analysing theories of state-issued money as legal tender and their applications in English case law. However, not all state-issued money hold the status of legal tender; rather, this is an additional status given by the state.

4.61. This section argues that legal tender is a status of money or monetary objects conferred by the state through legislation to discharge a debt. Unless it is agreed otherwise, a monetary debt calls for the delivery of legal tender money. However, in the UK, where conditions may not be generalised to other countries, some monetary objects can still discharge debt under the law, even though they do not have legal tender status. The function of the legal tender is then solely concerned with whether such money can discharge debts, but rather it is a legal acknowledgement by the state that such money is a valid means of payment to discharge debts.

4.62. Legal tender status generally distinguishes state-issued money and other forms of money issued by the private sector. In practice, some countries confer legal tender status upon other monetary objects designated by the state, reflecting the sovereignty of the state, which ultimately holds the highest authority to determine what constitutes money.

A. Concept of Legal Tender

1. Legal Tender, Tender and Payment

4.63. The terminology of legal tender must differentiate between ‘tender’ and ‘payment’. A tender is a one-sided or unilateral act by the buyer, such as providing goods and services or offering money to discharge any liability.[345] It does not require the seller’s acceptance

[343] Ben Dyson and others, ‘Sovereign Money: An Introduction,’ (2016) Positive Money, 4, < https://www.datocms-assets.com/132494/1718270001-sovereignmoney-anintroduction-20161214.pdf > accessed 12 September 2025.
[344] ibid.
[345] Fox, *Property Rights in Money* (n 20) para. 1.88.

to fulfil the concept of tender. When the seller accepts a tender to discharge the buyer's debts, these acts amount to a 'payment'.[346] When the buyer accepts the seller's performance, this acceptance discharges the seller's liability; therefore, the payment is considered complete.

4.64. When the buyer offers money as legal tender, this act can be understood as a performance of tender to complete the payment as intended between the buyer and the seller. The buyer may perform its liability by offering the seller a different form of money or medium of exchange, known as non-legal tender money. The payment is still considered successful if the seller agrees to receive non-legal tender money to discharge the buyer's debts.

4.65. As discussed in a previous chapter, there are three general functions of money: a medium of exchange, a store of value and a unit of account.[347] However, as the idea of debt predates the idea of money, one can argue that money was initially created to calculate and discharge debts arising out of commercial transactions or other economic obligations such as tax liabilities.[348] Furthermore, money can have legal capacity to discharge debt and such capacity can be given by legislation without giving it legal tender status.

4.66. The discussion shows that legal tender money, such as banknotes, coins or any kind of state-issued money made legal tender by legislative enactment, must be accepted by creditors as payment of debts unless the creditors have requested a different form of tender to fulfil their monetary obligations. In some countries, creditors may face disincentives for refusing legal tender, a topic that will be explored in detail below.

2. Theories on Legal Tender

4.67. In analysing the distinctive characteristic of money as legal tender, it is helpful to begin with the consequences of tender. Nussbaum and Mann discussed legal tender in terms of its legal and practical implications for acceptance. According to Nussbaum, legal tender is considered money under the law, and a creditor is not privileged to refuse if it is tendered by a debtor to repay its debt.[349] Mann argued that the creditor who refuses to accept legal tender might be exposed to certain risks.[350] Although there may be disadvantages to refusing this legal tender, the creditor cannot be required to accept it if they have stipulated a previously agreed-upon alternative way to discharge the monetary obligation. Since legal tender is the default method of payment under the legislation, the creditor must accept legal tender in discharging the debts unless there is a reason why the creditor refuses to accept such legal tender.

4.68. Modern legal scholars have different approaches to defining legal tender. Fox viewed legal tender as a quality conferred by the state on certain forms of the medium of

[346] ibid.
[347] Nussbaum (n 17) 11.
[348] Gleeson (n 20) 32.
[349] Nussbaum (n 17) 45-46.
[350] Mann (n 300) 43.

exchange.[351] Proclaiming money as legal tender means acknowledging that the tender of such money is a valid way of offering to paying debts.[352] Proctor, on the other hand, highlighted the ability of legal tender to settle debts, referring to legal tender as the money set in national law that will be effective in settling debts expressed in the national currency. He also argued that while all legal tender qualifies as 'money', not all money qualifies as legal tender.[353] From these views, it can be understood that legal tender is a status conferred by the state on specific types of money or monetary objects. This legal status is an intangible attribute that gives them the ability to settle debts regardless of their materiality, and as a default method of settlement. Additionally, the legal tender status is exclusively conferred by the state through legislation; therefore, it cannot be reassigned to other objects that are not specified in the legislation.

4.69. As the state has the power to confer a legal tender status on any kind of monetary object, this status may also be conferred by the state on non-state-issued money, including virtual money, as seen in El Salvador and the Central African Republic. These countries legislated to make Bitcoin their legal tender. They have adopted Bitcoin, a privately issued virtual currency, as their official legal tender despite criticisms regarding its unpredictable values.[354] Furthermore, El Salvador enacted the Bitcoin Law to regulate Bitcoin as an unrestricted kind of legal tender to be used in any transactions domestically. Under this law, Bitcoin will be adopted as an official unit of account, and the prices may be expressed in Bitcoin. However, because El Salvador adopted the US dollar as legal tender in 2001, the US dollar will still be used as the currency of reference for accounting purposes.[355]

4.70. In English law, the legal status of monetary objects such as coins is conferred by legislation as shown in section 2 of the Coinage Act 1971, as amended by section 1 of the Currency Act 1983, which reads as follows:

(1) Gold coins shall be legal tender for payment of any amount, but shall not be legal tender if their weight has become less than that specified in Schedule 1 to this Act, or in the proclamation under which they are made, as the least current weight.

(1A) Subject to any provision made by proclamation under section 3 of this Act, coins of cupronickel, silver or bronze shall be legal tender as follows:

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[351] Fox, *Property Rights in Money* (n 20) para 1.90.

[352] ibid.

[353] Charles Proctor, 'Legal Tender Under English Law' in Robert Freitag and Sebastian Omlor (eds), *The Euro as Legal Tender: A Comparative Approach to a Uniform Concept* (De Gruyter, 2020) 91.

[354] See International Monetary Fund, 'IMF Executive Board Concludes 2023 Article IV Consultation with El Salvador' (2025) < https://www.imf.org/en/News/Articles/2025/03/19/pr25069-el-salvador-imf-executive-board-concludes-2023-article-iv-consultation-with-el-salvador#:~:text=Directors%20underscored%20the%20importance%20of,sustainability%2C%20and%20consumer%20protection%20persist. > accessed 12 September 2025; International Monetary Fund, 'Staff Report For The 2022 Article IV Consultation and Request for A 38-Month Arrangement Under The Extended Credit Facility—Debt Sustainability Analysis' (2023) 6 < https://www.imf.org/en/Publications/CR/Issues/2023/05/02/Central-African-Republic-2023-Article-IV-Consultation-and-request-for-a-38-month-533019> accessed 12 September 2025.

[355] Bitcoin Law of El Salvador (n 75).

(a) coins of cupronickel or silver of denominations of more than 10 pence, for payment of any amount not exceeding £10;
(b) coins of cupronickel or silver of denominations of not more than 10 pence, for payment of any amount not exceeding £5;
(c) coins of bronze, for payment of any amount not exceeding 20 pence;

(1B) Other coins, if made current by a proclamation under section 3 of this Act, shall be legal tender in accordance with the provision made by that proclamation or by any later proclamation made under that section.

This Act clearly provides legal specifications for monetary objects designated as legal tender, including materials such as gold, cupronickel, silver and bronze coins. It also specifies certain weights as quality standards for these coins, along with their denominations. Additionally, the Act stipulates specific conditions under which these coins may be used for payment.

3. The Function of the Status of Legal Tender

4.71. As discussed earlier, legal tender is a status conferred by law on a monetary object or state-issued money, giving it the ability to settle debts. This status shows that claims on such money can be legally enforced against the state as the issuer of legal tender. With this legal tender status, the state acknowledges that such money is a valid means of payment available to the public and affirms it is able to settle debts as guaranteed by law.

4.72. Examples of legal tender money that can be used to settle debts are central bank money, like banknotes and coins. In the UK, there is a classification of legal tender money. The Royal Mint coins and banknotes issued by the BoE are the only legal tender in England and Wales.[356] Meanwhile, in Scotland and Northern Ireland, the only valid legal tender money is Royal Mint coins.[357] In the US, 31 USC 5103 provides that coins and notes issued and circulated by the Federal Reserve and national banks are legal tender for all debts, public charges, taxes and dues.[358]

4.73. A state can also proclaim non-state-issued money as a legal tender or a valid means of payment to settle debts. For instance, in Ecuador, the US dollar is used as the primary unit of account and accepted for transactions. Similarly, other countries permit debt payments to be paid in US dollars.[359]

4.74. However, if money or other monetary objects are not given any legal tender status, they can still be used to settle debts if agreed upon by both the creditor and the debtor. This is the practice in the UK. Scottish banknotes are an example of non-legal tender money that can still be used to settle debts in the UK, particularly in Scotland. This circumstance might be unusual compared to other countries that typically declare their money as legal

[356] Bank of England, 'What is legal tender?' 2020 < https://www.bankofengland.co.uk/explainers/what-is-legal-tender > accessed 12 September 2025.
[357] ibid.
[358] See 31 U.S.C. §5103.
[359] See para 2.31.

tender and capable of discharging debts. Scottish banknotes are not legal tender in England and Scotland, yet they may be accepted to settle debts at the discretion of the creditor or by mutual agreement between the creditor and the debtor.[360] Although these banknotes are not legal tender, they must be made by a statutory instrument approved by the House of Parliament.[361]

4.75. The practice in the UK suggests that the legal tender status granted to money by law may not be directly related to its ability to discharge debts, as debts can be settled through mutual agreement between the creditor and debtor. Related to the function of legal tender status on money, it can be argued that such status serves as a legal acknowledgement by the state that the money in question is a valid means of payment and can be used to settle debts. Such money is legally acknowledged by the state and widely accepted by the public; therefore, it can be an option for the public to use to settle debts.

4. Conferring Legal Tender Status onto CBDC

4.76. Regarding the issuance of CBDC, legal tender status should be given to CBDC if it were to be treated like other central bank money with legal tender status. In the previous chapter, CBDC for retail transactions is intended for public use and is available in a digital form of existing banknotes and coins.[362] When the existing banknotes and coins are declared as legal tender, a similar legal treatment should be given to CBDC to avoid confusion in the public on whether CBDC is a valid means of payment and can be used to settle debts.

4.77. When the law recognises CBDC as legal tender, it also ensures that the rights of CBDC holders are guaranteed by the state, just like existing legal tender money such as banknotes and coins. Consequently, claims in CBDC should be enforceable in the same manner as claims of existing legal tender money.

4.78. In general, conferring legal tender status to CBDC would ensure similar legal treatment between CBDC and banknotes and coins as existing legal tender. Thus, it can be perceived that the state also guarantees the convertibility among those forms of money at the same value. If CBDC is intended to be exchanged for other kinds of central bank money, then it will be necessary for CBDC to have legal tender status to ensure its full convertibility and equivalence with those other forms.

5. Acceptance and Refusal of Legal Tender Money

4.79. After the state proclaims money as legal tender, in principle, the state guarantees the validity of such money as a means of payment and its capability to settle debts. Refusal to accept legal tender, however, can still be made by the creditor under certain

[360] ibid.
[361] See Banking Act 2009, s 215 (2).
[362] See Chapter 2.

conditions.[363] The law can force the acceptance of such money or objects as a means of payment.[364] When money is recognised as legal tender and accepted by the creditor and debtor as a valid tender for the payment of debts, it can settle any monetary obligation in private transactions, such as purchasing goods, and public transactions, such as paying taxes and administrative sanctions.[365] In the traditional view, a monetary obligation is discharged when there is an exact coincidence between the time at which money as legal tender is delivered and the debt is repaid, meaning that the delivery of cash settles the debt.[366]

4.80. Legal tender money might be declined in circumstances that include the quality of money, the time of payment, the insufficiency of payment,[367] as well as the creditor's preference for tender of a different kind of money as agreed earlier by the debtor. In this case, such refusal might be based on disagreement with the debtor on the quality of money or conditions of payment, but not the status of such money as legal tender.

4.81. In some countries, like the US and the UK, no statutes require individuals or businesses to accept notes or coins as payment for goods or services. They can decide to accept cash or other methods of payment unless there is a specific law, like the state law, that says otherwise.[368] In Indonesia, the principle of freedom of contract allows the creditor and debtor the flexibility to determine their own payment terms and conditions, including a method of payment that can discharge debts.[369] Additionally, Bank Indonesia regulation prohibits the use of non-legal tender money for settling debts, except in transactions specified in that regulation.[370] When the agreed payment method between the creditor and debtor involves legal tender money, the provisions governing its use, acceptance and refusal of legal tender under the Indonesian Currency Law shall apply.

4.82. This Law stipulates that the sole legal tender money in the country is Rupiah, which can be in the form of banknotes, coins, and also the Rupiah Digital, which is set to be implemented soon. Under this Law, the creditor may refuse to accept legal tender if they are in doubt about the physical quality of the money or if the tender is not in accordance with the earlier agreement with the debtor.[371] Apart from these reasons, if the creditor refuses to accept legal tender money, despite an agreement with the debtor to use it as payment, and prefers to accept foreign money instead, the creditor may be subject to criminal and administrative sanctions, including imprisonment and fines.[372]

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[363] Helmut Siekmann, 'Monetary Aspects of the Euro as Single European Currency – A German Perspective,' in Robert Freitag and Sebastian Omlor (eds), *The Euro as Legal Tender: A Comparative Approach to a Uniform Concept* (De Gruyter, 2020) 12.
[364] Ellis (n 17) 23.
[365] Siekmann (n 363) 12.
[366] Vincenzo De Stasio and Stefano Boatto, 'The Euro as Legal Tender from an Italian Perspective,' in Robert Freitag and Sebastian Omlor (eds), *The Euro as Legal Tender: A Comparative Approach to a Uniform Concept* (De Gruyter, 2020) 61.
[367] Nussbaum (n 17) 51.
[368] The Federal Reserve System, 'Is it legal for a business in the United States to refuse cash as a form of payment?' < https://www.federalreserve.gov/faqs/currency_12772.htm > accessed 12 September 2025.
[369] See Indonesian Civil Code, art 1320.
[370] See Bank Indonesia Regulation No. 17/3/PBI/2015.
[371] Indonesian Currency Law, art 23.
[372] Indonesian Currency Law, art 33(2).

4.83. In the ancient era, and perhaps until today, the quality of money held significance, especially when legal tender money consisted of precious metals or paper. Over time, this money could become worn and lose its required metallic content. CBDC, as digital money or token paper money, is unlikely to face similar issues in terms of material, as its functionality is based on the legal tender status conferred by legislation rather than the physical quality of its materials. Nonetheless, the challenges CBDC may face are more likely related to their processing or settlement mechanisms within the system.

4.84. The creditor or merchant should not refuse CBDC as payment because they doubt that CBDC would be regarded as a legal tender that has the same value as other forms of central bank money. In CBDC transactions, there can be identified practical or technical reasons that cause CBDC not to be accepted as payment by the creditor, such as:

a. Limited or unavailability of infrastructure or devices to support CBDC as a means of payment, both for offline CBDC and online CBDC; and
b. Poor networking or reception hinders the system's ability to receive CBDC as payment, which can further result in the payment violating the agreed-upon terms and conditions, such as being considered late.

4.85. To anticipate such conditions and to allow effective adoption of CBDC by the public, the infrastructure, including systems, devices and connections needed to perform CBDC transactions, must be made easy for creditors or merchants. After all, it is unjust to require a creditor to accept money that they may not have the technical means to support.

B. Characteristics of CBDC as Legal Tender

4.86. After analysing the theories and concepts of legal tender, a CBDC must meet certain characteristics of legal tender: its status as legal tender must be granted by law, and it must be accepted or agreed upon by transacting parties for settling monetary obligations. Additionally, CBDC should be convertible to existing legal tender money, meaning it must have the same face value as the existing ones. The elaboration of these characteristics is below.

4.87. First, once it has a status as legal tender, CBDC will then have the power to discharge the monetary obligation unless the parties have agreed on the use of other means of payment. A monetary obligation calls for the delivery of legal tender as the default method of payment unless some other method is required. When the debtor provides other means of payment besides cash, such as CBDC, then the creditor's acceptance of these different performances will enable the debtor to discharge the debts. As a means of payment, CBDC should be recognised as having the same function as traditional money.

4.88. Second, a legal tender must be recognised and accepted to settle any monetary obligation in both private and public transactions.[373] Monetary obligations in private

[373] Siekmann (n 363) 12.

transactions can take the form of a sale and purchase agreement or retail transactions. In contrast, monetary obligations in public transactions typically involve transactions with the government, such as paying taxes and administrative sanctions. Related to the designs of CBDC based on its purposes, as previously examined, retail CBDC is intended to be used by the public for retail transactions. This type of CBDC will most likely fulfil the characteristic of legal tender because it is proposed to be circulated in public, and similar to traditional money, it functions to discharge debts or monetary obligations arising from the transactions, private or public. Meanwhile, wholesale CBDC is used by certain firms or parties and for certain wholesale transactions, meaning that it might not be available to the public, and it does not require the acceptance of the public as a means of payment. This observation leads to the conclusion that CBDC can be declared as an ideal legal tender if it were accessible to the public and had a function to discharge any debts or monetary obligations, which fit the type of retail CBDC.

4.89. When CBDCs are declared legal tender, the next question to discuss is whether there should be a threshold or limit on their use as legal tender. The state can determine the terms or limits for CBDC or other central bank money to be used as legal tender, based on various factors, including the purposes of such limitations.

4.90. The limitation on the use of legal tender money in the UK is outlined in section 2 of the Coinage Act 1971. This Act regulates that gold coins designated as legal tender may be used for payment of any amount, but it limits the use of other specific coins, such as cupronickel, silver and bronze, to a certain amount of payment. In the context of CBDC, many factors need to be considered when setting this limit. These factors include the design of CBDC, the verification technology employed and the aim of limiting the amount to prevent money laundering. In the e-CNY project, the People's Bank of China applies the general principle of 'anonymity for small amounts, traceability for large amounts in accordance with the law'.[374] The limit for a single transaction in retail CBDC that can maintain anonymity is capped at 2,000 CNY (approximately 296 USD).[375] In the Digital Euro project, the moderate amount proposed in the simulation for the digital euro to be personally held is 3,000 EUR, based on the maximum deposit outflow that could be restricted.[376] In contrast, wholesale CBDC is intended to be used only for high-value payments. However, the threshold for these high-value payments might not be universally defined and can vary from country to country. For example, in the UK, a high-value payment system processed through clearing house automated payment system

[374] Changchun Mu, 'Balancing Privacy and Security: Theory and Practice of the e-CNY's Managed Anonymity' 3, <http://www.pbc.gov.cn/en/3935690/3935759/4696666/2022110110364344083.pdf> accessed 12 September 2025.
[375] ibid.
[376] Barbara Meller and Oscar Soons, 'Know your (holding) limits: CBDC, financial stability and central bank reliance' (2023) ECB Occasional Paper Series No 326, 5 <https://www.ecb.europa.eu/pub/pdf/scpops/ecb.op326~d5c223d9b4.en.pdf> accessed 12 September 2025.

(CHAPS) has no minimum or maximum payment limits.[377] The average payment value daily, however, is approximately 1.8 million GBP.[378]

4.91. Third, CBDC is intended to be convertible with other forms of central bank money and should have full face value. If CBDC is proclaimed by law as a means of payment, a creditor is required to accept it at full face value when offered.[379] Hence, the value of legal tender offered to the creditor should be an equal amount to the means of monetary obligation.[380] There should be no deduction of value from the amount of legal tender. For instance, in the context of banknotes, two banknotes with a nominal value of 5 GBP shall have a full-face value; therefore, they can be used to settle a monetary obligation in the amount of 10 GBP. The creditor cannot request the settlement of debt only by using certain banknotes, such as a 10 GBP banknote, because he thinks that two 5 GBP banknotes have less value than one 10 GBP banknote. Apply this notion to CBDC, where it does not have a nominal payment with CBDC, which can also be used to settle a monetary obligation, and the creditor should not refuse it because they request certain serial numbers or devices that process CBDC.

4.92. The state or the central bank is responsible for guaranteeing the value of CBDC to that of the value of traditional money, such as banknotes and coins. Gutknecht and others have stated that the acceptance of a monetary object at its face value would promote the use of a monetary object as a means of payment, a store of value and a unit of account.[381] There should be no additional charges for a debtor who chooses to pay with a CBDC, as it must be treated the same as other forms of central bank money.

Wholesale CBDC and Retail CBDC as Legal Tender

4.93. CBDC can be proclaimed as legal tender as designated by the state, regardless of its distinct features and characteristics. Although the earlier chapter outlines distinct features and characteristics between wholesale and retail CBDCs, these differences should not prevent the state from conferring legal tender status on CBDCs.[382] However, the unique attributes of wholesale and retail CBDC lead to their distinct implementations as legal tender, as elaborated below.

4.94. From the perspective of their availability, only specific holders can use wholesale and retail CBDC to discharge debts. The wholesale CBDC is limited only to financial institutions, while the retail CBDC will be available for the public. It means that only

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[377] Bank of England, 'CHAPS' <https://www.bankofengland.co.uk/payment-and-settlement/chaps> accessed 12 September 2025.

[378] Bank of England, 'A brief introduction to the Real-Time Gross Settlement system and CHAPS,' <https://www.bankofengland.co.uk/payment-and-settlement/a-brief-introduction-to-the-real-time-gross-settlement-system-and-chaps> accessed 12 September 2025.

[379] ibid.

[380] Euro Legal Tender Expert Group (ELTEG), 'Report on the definition, scope and effects of legal tender of euro banknotes and coins' (2010), 4 <https://ec.europa.eu/economy_finance/articles/euro/documents/elteg_en.pdf> accessed 12 September 2025.

[381] Zellweger-Gutknecht and others (n 63) 294.

[382] See Chapter 2.

specific parties or institutions can enjoy the function of each wholesale and retail CBDC in discharging debts. In earlier paragraphs, it has been discussed that legal tender money can be designed to be used only for parties as designated by the state, such as in the existing regulations on legal tender in the UK, where BoE banknotes are designated to be used as legal tender only in England and Wales.[383] Applying a similar regulatory approach to CBDC, the state can determine specific parties or institutions that can use CBDC as legal tender, including determining which parties or institutions are the holders of wholesale and retail CBDC.

4.95. Wholesale and retail CBDC will have different transaction thresholds. Wholesale CBDC is intended for use only in high-value transactions, whereas retail CBDC is designed for small-value transactions. If CBDC were proclaimed as legal tender, then there should be a threshold for each type of CBDC and an eligibility requirement for CBDC holders. These should be governed by regulation. This approach is similar to that in the UK, where certain legal tender, such as cupronickel, silver and bronze coins, are subject to restricted transaction limits as regulated in section 2 of the Coinage Act 1971.[384]

4.96. Under the Indonesian Currency Law, the Digital Rupiah is given a status of legal tender regardless of its purpose.[385] It means that wholesale and retail designs of Digital Rupiah can be used as a means of payment to discharge debts. Based on the analysis above, further regulations on Digital Rupiah should determine the threshold for each design of Digital Rupiah. The eligibility of the party as CBDC holders, including the process of acquiring and redeeming Digital Rupiah, should also be regulated in detail.

4.97. When determining the threshold for Digital Rupiah, the regulation can set a lower limit for wholesale design and an upper limit for retail design. Consequently, these thresholds affect the level of privacy that is designed for the transactions. Privacy concerns will be elaborated in Chapter 9.

IV. Conclusions

4.98. Consistent with the fundamental theories of money elaborated earlier, the state holds the highest authority over money, including the power to issue, circulate and proclaim money, such as banknotes, coins and CBDC, as legal tender within its territory. Most countries delegate this power to the central bank through legislation.

4.99. CBDCs issued by the central bank will be categorised as state-issued money, regardless of the lack of physical material, as the materiality of money is not an essential element under the law. The circulation of CBDC to the public should be made to affirm its validity as state-issued money if it were introduced as a means of payment. Furthermore, proclaiming CBDC as a means of payment and conferring its status as legal tender through law is necessary to exercise the sovereign power of the state over money,

[383] See para 3.15; See Bank of England, 'What is legal tender?' (2020) < https://www.bankofengland.co.uk/explainers/what-is-legal-tender > accessed 12 September 2025.
[384] See para 3.35.
[385] See Indonesian Currency Law, art 2(2).

especially in the digital era, and to ensure that CBDC serves as a viable payment option for the public.

4.100. Detailed regulation on CBDC is also needed to govern the classification of CBDC as wholesale or retail, the thresholds of CBDC transactions, and requirements for the holders. If certain thresholds are set, the central bank should implement an adequate approach for deciding the level of privacy in CBDC transactions.

CHAPTER 5

LEGAL CONSIDERATION IN DESIGNING TECHNOLOGY FOR CBDC

I. Introduction

5.1. The previous chapter highlighted the importance of the legislative basis for creating CBDC as a lawful means of payment. Such a foundation provides the legal capability of CBDC to discharge debts and, if designated by the state, confer the status of legal tender. However, the legal basis for CBDC must also consider the legality of the underlying technology, including the system and infrastructure involved in its issuance, distribution and processing.

5.2. The technology used for CBDC will have crucial roles in the financial system as it can be categorised as part of systemically important payment systems, just like other existing infrastructures (ie central securities depositories, securities settlement systems, and central counterparties). A CBDC, as a monetary tool for the central bank, must be carefully planned to achieve its optimal quantity.[386] Furthermore, the process of CBDC should not lead to randomised finality of settlement like that of privately issued cryptocurrencies. Transactions using CBDC, whether large value or retail, could pose systemic risks, particularly in the event of disruptions such as settlement delays. Such disruption, if it continues, may affect financial stability in various ways since people may not be able to

[386] In the Euro areas, for instance, Burlon and others suggested that the optimal amount of CBDC in circulation in the euro areas should be between 15% and 45% of quarterly GDP in equilibrium. If CBDC is kept within this range, it is unlikely to have a significant impact on bank lending and valuations in the long run. See Lorenzo Burlon and others, 'The Optimal Quantity of CBDC in a Bank-Based Economy' (2022) Working Paper Series No 2689 < https://www.ecb.europa.eu/pub/pdf/scpwps/ecb.wp2689~846e464fd8.en.pdf > accessed 12 September 2025.

make payments for goods and services. Therefore, discussing the technology of CBDC, especially from a legal standpoint, is essential.

5.3. This chapter explores the rule of law and the rule of code in the technology used by CBDC, where the implementation of these rules results in distinct legal consequences or liabilities. Having a legal basis for CBDC is one of the key implementations of the rule of law, ensuring that CBDC is issued and operated within a legitimate system. Following the codes in protocols within the system results in a self-executing process.

5.4. The issuance and operation of CBDC may use various technologies, such as DLT, blockchain, a conventional or centralised central bank system, and hybrid technology. This chapter analyses the legal aspects of using DLT, which is likely to be adopted by many central banks to operate CBDC. If DLT is utilised, it must allow the central bank to retain authority over the system, ensuring its security and protecting CBDC holders. In this context, a permissioned DLT or any governance framework that enables the central bank to maintain such control should be preferred. This control implements the monetary sovereignty of the state, as discussed in the previous chapter.[387] Understanding the diverse range of participants in a DLT ecosystem, identifying fundamental legal relationships and establishing legal arrangements among them can be beneficial for understanding legal liabilities and rights, as well as pursuing legal responsibilities when necessary.

II. Rule of Law and Rule of Code in CBDC Technology

5.5. This section discusses the rule of law and the rule of code in the technology used in CBDC. The implementation of these rules should be understood and properly designed by the central bank, especially when autonomous features are deployed to operate CBDC.

5.6. Implementing the rule of law means that any action, including technology or systems used in the issuance and process of CBDC, must have a legal basis to be recognised as valid. By contrast, under the rule of code, the technology must incorporate protocols written in code that enable self-executing processes. It is necessary to ensure the legal nature of actions taken within the system and to understand the legal consequences of these actions, whether they stem from the rules or codes. Only in this way will CBDC operate as a direct equivalent of other kinds of state-issued money that are used to discharge debt. However, the nature of CBDC as state-issued money should follow the rule of law, which, in some circumstances, should be able to override the rule of code.

5.7. For a CBDC system to operate effectively, it must also comply with relevant laws and regulations, particularly those related to anti-money laundering and data privacy. Adhering to international standards such as those set by the International Organization for Standardization (ISO) is also necessary to increase trust and confidence among stakeholders in the CBDC system.

[387] See Chapter 4.

A. Rule of Law

5.8. Both common law and civil law jurisdictions would require CBDC to operate according to the rule of law. Any action by the state must have a legal basis to be considered valid by the relevant legal system. The concept of the rule of law may be 'an essentially contested concept', but, at its core, it is about ensuring legal certainty.[388] The laws and relevant decisions must be made public and clearly defined. For example, if the UK government or central bank cannot provide a legal foundation for their actions, then the UK courts would consider those actions unlawful or unauthorised.[389]

5.9. As discussed in the previous chapter, CBDC is perceived as an expression of the sovereignty of the state over the monetary system. The state, through legislation, may proclaim CBDC as a means of payment that can legally discharge debts and confer a legal tender status as designated.[390] Establishing the legal ground through legislation for recognising CBDC as a valid means of payment is in line with the principle of the rule of law. This principle should also extend as a basis for creating a legitimate technology or system to issue and operate CBDC.

5.10. A CBDC system would involve many participants to function effectively. Creating a legitimate technology for CBDC means that all actions taken by the participants in the ecosystem are legally authorised. They can carry full legal responsibility, ultimately resulting in a legitimate CBDC and its operation. A legal foundation for CBDC technology is needed to protect the regulator and the stakeholders, particularly CBDC holders as end-users. Furthermore, similar to the existing payment system, the CBDC system should include at least a legal foundation for its technological form of issue and operation that is provided in legislation, regulations, or any documentation that is valid and enforceable under relevant law. In particular, legislation would be needed to recognise the tokens passing on the system as payment media issued by the central bank, which have similar recognition for coins and banknotes as legal tender money. Otherwise, CBDC will not have the effect of discharging debts.

5.11. In the absence of legal grounds for the CBDC system, the legality of CBDC may be called into question. Any actions related to the issuance and operation of CBDC could be considered illegitimate or unlawful. As a consequence, CBDC would be legally ineffective as it does not have the capacity to discharge debts, and the issuance of CBDC would be useless. Since legal tender status is essential for CBDC to be fully equivalent to or interchangeable with other kinds of central bank money, a lack of legal ground for its issue would prevent CBDC from being exchanged with other central bank money. Additionally, CBDC holders would not be able to transact with CBDC, and there would be no legal protection when acquiring an illegitimate CBDC.

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[388] James R Maxeiner, 'Some Realism About Legal Certainty in the Globalization of the Rule of Law' in M N S Sellers and T Tomaszewski (eds), *The Rule of Law in Comparative Perspective* (Springer 2010) 45.

[389] Paul Craig, 'The Rule of Law' (2007) Appendix 5 of the Constitution Sixth Report < https://publications.parliament.uk/pa/ld200607/ldselect/ldconst/151/15102.htm > accessed 12 September 2025.

[390] See para 4.20.

5.12. There are some examples of the creation of a legal basis for the technology used in the existing payment system, including the real time gross settlement (RTGS) infrastructures for payment settlement in the UK and Indonesia, as well as the legal basis for DLT in crypto assets within the EU, as elaborated below.

5.13. In the UK, RTGS infrastructure is vital for the BoE to achieve its objectives under the Banking Act 2009 in maintaining monetary and financial stability.[391] The BoE owns and operates RTGS in the UK, which was first introduced in 1996. Furthermore, the BoE discloses documents on the scope of RTGS services and infrastructure used in the UK.[392] Although it is not covered by UK legislation, the legal status of RTGS, including its governance, is explained in the BoE's internal documents, which remain valid and enforceable under English law.[393] The UK RTGS system complies with international principles and standards for systemically important payment systems (SIPS).

5.14. Similarly, the RTGS system in Indonesia is operated and regulated by Bank Indonesia as the central bank, namely Bank Indonesia-RTGS or BI-RTGS. The operation of BI-RTGS is derived from Article 15 of the Bank Indonesia Law, and the legal foundation that gives legitimacy to this system can be found in detail in Bank Indonesia Regulation No 22/23/PBI/2020 and Bank Indonesia Regulation No 17/18/PBI/2015. Similar to the RTGS in the UK, BI-RTGS operates as an electronic funds transfer system, managed by Bank Indonesia, to facilitate real-time settlement for individual transactions. As the authority of RTGS as mandated under the Central Bank Act, Bank Indonesia must ensure that the BI-RTGS system complies with the international principles and standards for SIPS. Bank Indonesia also stated that BI-RTGS ensure the implementation of 18 core principles.[394] Like the UK RTGS system, BI-RTGS also complies with these international principles and standards for SIPS.

5.15. If CBDC were adopted as a means of payment, the legal basis of the system employed to process CBDC should be enacted. For Indonesia, this means there should be a Bank Indonesia regulation governing the use of DLT for processing the Digital Rupiah. If DLT were integrated with the existing payment system infrastructure or BI-RTGS, then an amendment of the existing Bank Indonesia Regulation related to BI-RTGS should be made.

5.16. Another example of the legal basis for DLT used for crypto assets in Europe is Regulation EU 2023/1114 of the European Parliament and the Council of 31 May 2023 on Markets in Crypto-Assets (known as MiCA Regulation). This regulation provides legality of DLT specifically for crypto assets, where under this regulation, DLT is defined as 'technology

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[391] See Banking Act 2009, s 181. This regulation enables the Bank of England to oversee certain systems for transferring money and certain persons in relation to such systems.

[392] See Bank of England, 'Bank of England's Real-Time Gross Settlement Service: Service Description' (2018) <https://www.bankofengland.co.uk/-/media/boe/files/payments/rtgs-and-chaps-service-description.pdf> accessed 12 September 2025.

[393] ibid.

[394] See Bank Indonesia, 'Principles for Financial Market Infrastructures Disclosure Framework: Sistem Bank Indonesia Real Time Gross Settlement (BI-RTGS)' (2021) <https://www.bi.go.id/id/edukasi/Documents/Disclosure-Framework-Bilingual-Sistem-BI-RTGS-2021.pdf> accessed 12 September 2025.

that enables the operation and use of distributed ledgers'.[395] In this context, a distributed ledger is 'an information repository that keeps records of transactions, and that is shared across, and synchronised between, a set of DLT network nodes using a consensus mechanism'.[396]

B. Rule of Code

5.17. A system or infrastructure to issue and operate CBDC, such as DLT, may include autonomous features that cover the interaction between actors in certain layers. These interactions are determined by protocols written in code, enabling self-executing processes. These processes are more likely to be subject to the rule of code rather than the rule of law. To ensure the legitimacy of the processes, the system or infrastructure would still require a legal foundation.

5.18. For blockchain-based networks for private cryptocurrencies, the existence of law might not be necessary, as people can create their own systems of rules and smart contracts supported by the underlying protocol, as this is referred to as *lex cryptographica*.[397] Although it is called 'lex', it is not technically a law in the sense used by legal scholars. This protocol does not regulate money and may not be explicitly recognised by the law. However, for the CBDC system, maintaining a balance between the implementation of the rule of law and the rule of code, including the underlying protocol, is essential; however, for some aspects, the rule of law should be prioritised.

5.19. The rule of code can also be observed in smart contracts, which may be deployed to CBDC systems, although some central banks, like the Bank of England, might not use smart contracts in the systems to avoid the pure programmability of money.[398] The options for using features in CBDC systems depend on the technology used by the central bank. In a smart contract, the performance of obligations is specified in the code using a strict and formal programming language, eliminating the need for law, as these obligations are self-executing algorithms.[399] When the nodes on the blockchain-based network execute the contract without relying on any central authority or trusted party, the system is governed by the rule of code, executing process autonomously.

5.20. The fulfilment of obligations is automatically executed through algorithms specified in the code, and therefore, there should be no situation in which the system fails to comply with the rule of code. That said, there should be no circumstances leading to discussion on the legal consequences for failing to adhere to the code, as outlined in the rule of law. Nonetheless, the discourse on the rule of code can be extended to the legal liability

[395] MiCA Regulation, art 3.1(1).
[396] ibid art 3.1(2).
[397] Primavera De Filippi and Aaron Wright, *Blockchain and the Law: The Rule of Code* (Harvard University Press 2018) 6.
[398] Society for Computers and Law, 'Smart contracts: can code ever be law?' (2018) < https://www.scl.org/10222-smart-contracts-can-code-ever-be-law/ > accessed 12 September 2025; Bank of England
[399] Filippi and Wright (n 397) 74.

of participants when the system executes incorrect protocols, resulting in erroneous actions in CBDC transactions.

5.21. Given the numerous studies on liabilities associated with DLT and the features of smart contracts, particularly regarding the execution of codes within DLT as a potential technology for CBDC,[400] this discussion focuses on the legal liabilities of the central bank, as the issuer of CBDC, toward CBDC holders as end-users.

5.22. CBDC transactions involve the self-execution of codes in protocols developed by participants in the CBDC ecosystem, such as the application programming interface (API). This API may include a protocol on smart contracts consisting of codes that facilitate communication between participants,[401] such as payment stoppage requests and temporary CBDC account freezes.[402] The analysis of legal liabilities arising from the failures of execution of code, where a CBDC holder's instructions are not carried out as intended, would depend on the design and architecture of the CBDC system. If the CBDC architecture is designed as a one-tier or direct model, where no banks act as intermediaries, individuals can seek legal liability directly from the central bank as the issuer of CBDC and their direct counterparty. However, in a two-tier architecture, where banks are involved as intermediaries, a CBDC holder would primarily seek legal liability from the intermediary bank, as there is no direct legal relationship between the holder and the central bank. Nevertheless, as discussed in the previous chapter, the claims of CBDC as central bank money remain a legal liability of the central bank, regardless of its design or architecture.[403]

Protocols as Constitutions in DLT Created by Rule of Code

5.23. Protocols in DLT set a technical 'constitution' for the DLT system, as they are determined by a code base or rule of code created by the developers, and the core developers have the power to modify the rules.[404] As CBDCs are issued by the central bank, the issuance and processing of CBDCs would be based on software protocols created or approved by the central bank. This means these protocols can be designed to follow the applicable laws and regulations.

5.24. Bitcoin uses software called Bitcoin Core, which is a permissive open-source software licensed under the MIT license.[405] These protocols can be used for almost any purpose as long as the source is credited. Satoshi Nakamoto originally wrote the code, but hundreds of developers now manage it, although only certain ones have the power to modify the software.[406]

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[400] See para 2.16.
[401] Bank Indonesia, 'Proof of Concept: Wholesale Rupiah Digital Cash Ledger' (n 41) para 3.3.3.
[402] BIS Innovation Hub and Bank of England, 'Project Rosalind: Building API Prototypes for Retail CBDC Ecosystem Innovation' (2023) 17 < https://www.bis.org/publ/othp69.pdf > accessed 12 September 2025.
[403] See paras 2.55-60.
[404] Arvind Narayanan and others, *Bitcoin and Cryptocurrency Technologies* (Princeton University Press 2016) 172.
[405] Narayanan and others (n 404) 170-171.
[406] ibid.

5.25. Another example of a protocol is the offline protocol if CBDC is intended as an offline payment method. The system should ensure the integration of 'offline capabilities', including applying an offline protocol that can reduce the risk of double-spending.[407] The offline capabilities should have better resilience and adopt better accessibility features in more secure hardware. One of the protocols that can be used for CBDC is the offline payment system protocol (OPS Protocol) proposed by Visa.[408] With the OPS Protocol, users can make digital payments in CBDCs to other users when they are both temporarily offline from payment intermediaries or the internet. This protocol provides arithmetic, a specific programming language and instructions that can be executed with the supporting apps and hardware.[409] Furthermore, the OPS Protocol consists of several sub-protocols or codes related to client setup, deposit, offline payment, claim, collect, withdraw and replay/rollback protocol.[410] The central bank, as the issuer of CBDC, has the authority to ensure the compliance of this protocol with applicable laws such as privacy law, anti-money laundering law and payment system law (ie the legal status of transactions regarding settlement finality).

C. Conforming with International Standards

5.26. In addition to compliance with the law and the execution of the code, the operation of the CBDC system would need to comply with international standards. These standards help to build consumer confidence that the goods or services they receive are safe, reliable and of good quality.[411] Conforming to these international standards (eg security and interoperability) should be considered when designing a CBDC system.

5.27. In the existing payment system infrastructure, the UK RTGS system complies with several international standards. One such standard is the International Standard of Assurance Engagement ISAE 3402, in which the 2021/2022 report stated that the design and operation of the control framework, processes and technology for RTGS were achieved.[412] ISO 27001 certification for information system security management is also achieved by RTGS in the UK.[413] The implementation of this ISO helps to mitigate cybercrime and any cyber risks related to operations in the system.

5.28. Another relevant standard is the ISO 20022 messaging standard, which can be used by all financial standards initiatives to enable communication interoperability between financial institutions as participants, market infrastructures, and end-user

[407] ibid 34.
[408] Mihai Christodorescu and others, 'Towards a Two-Tier Hierarchical Infrastructure: An Offline Payment System for Central Bank Digital Currencies' (2020) <https://arxiv.org/pdf/2012.08003.pdf> accessed 12 September 2025.
[409] Narayanan and others (n 404) 56.
[410] ibid 6.
[411] International Organization for Standardization, 'Benefits of ISO standards' < https://www.iso.org/benefits-of-standards.html > accessed 12 September 2025.
[412] Bank of England, 'Real-Time Gross Settlement (RTGS) System and CHAPS Annual Report 2021/2022' (2022) <https://www.bankofengland.co.uk/report/2022/rtgs-and-chaps-annual-report-2021-22> accessed 12 September 2025.
[413] ibid.

communities.[414] Bank Indonesia has made a statement that its wholesale CBDC will adopt this ISO in DLT as a messaging standard to facilitate the harmonisation of cross-border and cross-industry transactions.[415]

III. Legal Aspects of DLT as a Possible Technology for CBDC

5.29. After covering the rule of law and rule of code in CBDC technology, the discussion will now shift to a further exploration of the legal aspects of DLT as a viable technology for CBDC transactions. The coverage of this section focuses its discussion on the preferred governance model for DLT in processing CBDC and the legal relationships between participants in the DLT ecosystem, including their legal liabilities. It begins with an overview of DLT, the types of governance of DLT, and the elements in DLT that consist of participants and layers of DLT.

5.30. Governance within DLT can vary depending on the type of DLT, such as permissioned and permissionless, as well as fully centralised ones, including other terminology that might be a combination of those types. Despite the diverse terms used to describe governance in DLT, a permissioned DLT or any governance framework that allows the central bank to retain control over the CBDC system should be preferred. As the designs of DLT may also differ, resulting in a variety of participants involved in the system, the central bank should be able to identify the existence and roles of these participants to further understand the legal relationship among them, including their legal liabilities. These legal relationships can be generally outlined in the regulations issued by the central bank or documented in the agreements between the participants.

A. Understanding DLT

1. DLT as a Viable Technology for CBDC

5.31. Related to the use of DLT for CBDC, central banks are still experimenting with the CBDC technology. No cases have yet shown that DLT could be the primary engine for CBDC. However, many studies demonstrate the significant potential for utilising DLT in CBDC. Some central banks have stated their preference to use DLT, such as the Monetary Authority of Singapore (MAS) and Bank Indonesia,[416] while others prefer to use blockchain technology, such as the Reserve Bank of India,[417] the Reserve Bank of

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[414] International Organization for Standardization, 'Introduction to ISO 20022: Universal Financial Industry Message Scheme' 3 <https://www.iso20022.org/sites/default/files/2022-02/introtoiso20022.pdf> accessed 6 February 2025.

[415] Bank Indonesia, 'Proof of Concept: Wholesale Rupiah Digital Cash Ledger' (n 41) 19.

[416] Raphael Auer and Rainer Böhme, 'Central Bank Digital Currency: The Quest for Minimally Invasive Technology' (2021) BIS Working Paper No 948, 12 <https://www.bis.org/publ/work948.pdf> accessed 12 September 2025.

[417] See Ministry of Finance of India, 'Press Release: CBDC Pilot Launched by RBI has Components Based on Blockchain Technology' (2022) <https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1882883#:~:text=Central%20Bank%20Digital%20Currency%20(CBDC,components%20based%20on%20blockchain%20technology&text=The%20Reserve%20Bank%20of%20India,)%20on%20October%207%2C%202022> accessed 12 September 2025; and See Reserve Bank of India, 'Concept Note on CBDC,' (2022)

Australia[418] and Korea.[419] Another option is to upgrade an existing system or a centralised central bank system, as Jamaica did,[420] or to use a hybrid technology combining DLT and centralised technology, as in China.[421]

5.32. Related to the conventional central bank system as technology for CBDC, the Bank of Jamaica uses conventional technology that can easily integrate with its RTGS system, rather than processing CBDC with blockchain technology.[422] It uses Digital Symmetric Core Currency Cryptography (DSC3), which has the capacity to deploy CBDC.[423] DSC3 employs symmetric key cryptography and multiple layers of digital security to safeguard cryptographic objects against counterfeiting. With this technology, the central bank has complete control over the issuance of CBDC through a digital bearer instrument scheme. The DSC3 automates the process of issuance and distribution of CBDC, and the settlement process will then be performed in the RTGS system.[424] In general, this technology allows CBDC to seamlessly interface with the existing central banking systems used for the payment and settlement of currency through an open API.[425]

2. Definition of DLT

5.33. DLT is 'an umbrella term to designate multi-party systems that operate in an environment with no central operator or authority, despite parties who may be unreliable or malicious ("adversarial environment")'.[426] It is an electronic record-keeping system that allows a network of independent participants to reach a consensus on verified cryptographic transactions.[427] This system can resist data duplication across multiple nodes and be tamper-evident by connecting them with cryptographic

<https://rbidocs.rbi.org.in/rdocs/PublicationReport/Pdfs/CONCEPTNOTEACB531172E0B4DFC9A6E506C2C24FFB6.PDF> accessed 12 September 2025.

[418] See Reserve Bank of Australia and Digital Finance Cooperative Research Centre, 'Australian CBDC Pilot for Digital Finance Innovation: White Paper' (2022) 8 <https://www.rba.gov.au/payments-and-infrastructure/central-bank-digital-currency/pdf/australian-cbdc-pilot-for-digital-finance-innovation-white-paper.pdf> accessed 12 September 2025.

[419] See Bank of Korea, 'Central Bank Digital Currencies – 1st Proof of Concept Experiments,' (2022) <https://www.bok.or.kr/eng/main/contents.do?menuNo=400411> accessed 12 September 2025.

[420] See Bank of Jamaica, 'BOJ Prepares for Central Bank Digital Currency' (2021) <https://boj.org.jm/cbdc-information-press-release-22-march-2021/> accessed 12 September 2025. In this statement, the issuance and distribution of CBDC by the Bank of Jamaica will be integrated with its conventional market infrastructure namely the JamClear RTGS. However, the Bank of Jamaica has announced eCurrency Mint Incorporated as a provider to support the needs of software, hardware and cryptographic security protocol technology for JamDex as Jamaica' CBDC.

[421] People's Bank of China (n 124).

[422] Bank of Jamaica (n 34).

[423] E-Currency Mint Inc, 'DSC3-Digital Symmetric Core Currency Cryptography,' (2020) <https://www.ecurrency.net/post/cbdc-dsc3> accessed 12 September 2025.

[424] ibid.

[425] Cision PR Newswire, 'eCurrency Announces Centralized Capability' (2023) <https://www.prnewswire.com/news-releases/ecurrency-announces-centralized-cbdc-capability-301807093.html> accessed 2 March 2025.

[426] Rauchs and others, *Distributed Ledger Technology Systems: A Conceptual Framework* (Cambridge Centre for Alternative Finance 2018) 15.

[427] ibid 24.

hashes.[428] The consensus process then creates a result (ie a ledger) that serves as the authoritative set of records. However, there is no universal understanding of DLT, as the term can be used in a broad or narrow sense. These technologies may evolve in the future, potentially leading to an expanded understanding.

5.34. The concept of DLT was first introduced in 1982 by Lamport and others through a problem in game theory called 'Byzantine Generals Problems' that explained how 'computer systems must handle conflicting information in an adversarial environment'.[429] In this scenario, the enemy city is surrounded by the generals and their troops, who must agree on a time to attack to win. However, there may be traitors among the generals who could send false messages through messengers that can be intercepted or corrupted. To reach a consensus on when to attack, at least two-thirds of the generals must remain loyal. This process is analogous to the DLT system, where each general represents a node in the network, the messenger symbolises signals between nodes, and the decision on when to attack is similar to the validation of a new block in the DLT system.

3. Blockchain as part of DLT

5.35. Although the terms 'DLT' and 'blockchain' are frequently used interchangeably, blockchain is considered a specific technology that falls under the larger umbrella of the DLT landscape. Blockchain uses a unique data structure made of a chain of hash-linked blocks of data. The concept was introduced by Haber and Stornetta in 1991,[430] who suggested a method to secure the timestamping of digital documents, providing an approximate indication of when a document came into existence. A paper on blockchain later suggested an improvement by grouping the documents into blocks and connecting those blocks in a chain. Blockchain can be viewed as the first type of distributed ledger used to create digital currency and a part of technology in the DLT system.

5.36. The World Bank defines blockchain as '[A] particular type of data structure used in some distributed ledgers which stores and transmits data in packages called "blocks" that are connected to each other in a digital "chain". Blockchains employ cryptographic and algorithmic methods to record and synchronise data across a network in an immutable manner.'[431] In simpler terms, blockchain is a digital record of a series of transactions, while DLT is a collective record of several blockchains.[432]

5.37. Meanwhile, at the core of DLT lies the principle of decentralisation. There is no central authority in control; instead, anyone can use the currency with relevant software and

[428] ibid.
[429] Leslie Lamport and others, 'The Byzantine Generals Problem' (1982) 4(3) ACM Transactions of Programming Languages and System, 387-389.
[430] See Stuart Haber and W Scott Stornetta, 'How to Time-Stamp a Digital Document' (1991) 3(2) *Journal of Cryptology*, 99–111 < https://link.springer.com/article/10.1007/BF00196791 > accessed 12 September 2025; See Rauchs and others (n 420) 15.
[431] The World Bank, 'blockchain definition' < https://digitalfinance.worldbank.org/glossary > accessed 12 September 2025.
[432] Daniel Broby, 'Central Bank Digital Currencies: Policy Implications' (2023) Law and Financial Markets Review Vol. 16 <https://doi.org/10.1080/17521440.2023.2209294> accessed 12 September 2025.

keep a copy of the ledger to access a full history of transactions made using an agreed protocol. According to the World Bank, DLT is an innovative and quickly developing method for storing and sharing data across various data stores.[433] Through DLT, transactions and data can be recorded, disseminated and synchronised among numerous networks of participants.[434]

5.38. The UK Jurisdiction Taskforce (UKJT) of the LawTech Delivery Panel has also recognised a similar view on DLT. According to UKJT, DLT is a technology that synchronises digital records between network participants, allowing them to maintain identical digital records with specific rules governing the conditions under which those digital records can be generated, updated, and then harmonised among them.[435] DLT can be designed with various features and mechanisms depending on the goal of the CBDC project.

B. Key Element in DLT Governance: The State's Authority in the Issuance of Money

5.39. The level of centralisation in DLT may vary among permissioned, permissionless and centralised ledgers (fully centralised).[436] A fully centralised system requires a central authority, which is usually costly and exposes it to a high-cost single point of failure.[437] This section mainly explores the governance in DLT to determine the optimal choice for issuing CBDC that would enable central banks to exercise their mandates effectively. The discussion is focused on the permissioned and permissionless DLT, even though there are other variations of DLT, such as private and hybrid DLT. Other forms of DLT may emerge in the future, offering a range of governance options.

5.40. From a legal perspective, a permissioned DLT or any type of DLT that allows the state to maintain its sovereign control over the system would be the most suitable option to operate CBDC. This aligns with the state's authority over the issuance of money, as explained in Chapter 4.

1. Permissioned DLT

5.41. Permissioned DLT is a closed system that only allows a predefined set of trusted parties or participants to access and participate in the system.[438] Using permissioned DLT might be the best choice for CBDC as it allows the central bank to fully exercise its mandates and maintain control over the system, which is needed to exercise its roles in creating money. The central bank is the governing authority in this system, and its presence is essential to provide permissions to participants to join the network, validate

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[433] World Bank, 'Distributed Ledger Technology and Blockchain' (2017) Fintech Note No 1, VII <https://documents1.worldbank.org/curated/en/177911513714062215/pdf/122140-WP-PUBLIC-Distributed-Ledger-Technology-and-Blockchain-Fintech-Notes.pdf> accessed 12 September 2025.

[434] ibid.

[435] UK Jurisdiction Taskforce of the LawTech Delivery, 'Public Consultation: The Status of Cryptoassets, Distributed Ledger and Smart Contracts under English Private Law' (2019) 11.

[436] UK Government Office for Science, 'Distributed Ledger Technology: beyond block chain' (2015) 35 <https://assets.publishing.service.gov.uk/media/5a818d6fe5274a2e87dbe3dd/gs-16-1-distributed-ledger-technology.pdf > accessed 15 February 2025.

[437] ibid 6.

[438] Rauchs and others (n 426) 61.

transactions and update the ledger. In this system, access to operating a node is subject to permission from the governing authority.

5.42. Permissioned DLT also allows the central bank as developer or administrator to directly set and control the protocols or 'constitution' of the DLT.[439] This level of control is crucial to ensure suitable and effective regulation, supervision and oversight for any system involved in processing CBDC due to its potential impact on financial stability and to safeguard financial stability through central bank policies enacted related to CBDC transactions. If CBDC is created through a permissioned network, then the central bank, as the controlling authority, can autonomously set the rules on the networks, including rules relating to the processing of transactions, authentication and recording processes when performing transactions related to CBDC.[440] Creating 'how-to' rules would impact the legal consequences of smart contracts, including their enforceability.

5.43. Additionally, opting for permissioned DLT provides legal protection for both the central banks and participants in the system since the central bank would have privileged powers over the network and may perform any action if necessary. Having full control over the system would enable the central bank to ensure the protection of participants, including the public as end-users, especially in certain conditions, such as when there is a need to update the system due to security issues. In many CBDC projects, the central banks tend to consider only permissioned DLT due to its lower economic cost compared to permissionless DLT. Several CBDC projects experimenting with permissioned DLT are the Australian CBDC Pilot Project,[441] Project Jura,[442] Project Jasper[443] and Project Aber.[444]

2. Permissionless DLT

5.44. Permissionless DLT was introduced by Satoshi Nakamoto in his paper in 2008 as a public DLT and was the first DLT implementation to operate Bitcoin.[445] Permissionless DLT, in the context of the Bitcoin system, refers to a system that can process all transactions in a way that is visible to the public, and anyone, through consensus, can initiate and

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[439] See paras 5.4 and 5.30.

[440] World Economic Forum, 'Central Banks and Distributed Ledger Technology: How Are Central Banks Exploring Blockchain Today?' (2019) 5 < https://www3.weforum.org/docs/WEF_Central_Bank_Activity_in_Blockchain_DLT.pdf> accessed 12 September 2025.

[441] Reserve Bank of Australia and DFCRC, 'Australian CBDC Pilot for Digital Finance Innovation' (2023) 12 < https://www.rba.gov.au/payments-and-infrastructure/central-bank-digital-currency/pdf/australian-cbdc-pilot-for-digital-finance-innovation-project-report.pdf> accessed 12 September 2025.

[442] Banque de France and others, 'Project Jura: Cross-border Settlement Using Wholesale CBDC' (2021) <https://www.bis.org/publ/othp44.pdf> Accessed 12 September 2025.

[443] Payments Canada and others, 'Project Jasper: A Canadian Experiment with Distributed Ledger Technology for Domestic Interbank Payments Settlement' (2017) <https://payments.ca/sites/default/files/2022-09/jasper_report_eng.pdf> accessed 12 September 2025.

[444] Saudi Central Bank and Central Bank of the U A E, 'Project Aber' (2019) <https://www.sama.gov.sa/en-US/News/Documents/Project_Aber_report-EN.pdf> Accessed 12 September 2025.

[445] See Satoshi Nakamoto, 'Bitcoin: A Peer-to-Peer Electronic Cash System' (2018) < https://bitcoin.org/bitcoin.pdf > accessed 12 September 2025.

validate transactions as well as update the record of transactions since there is no central authority involved.[446]

5.45. The presence of a central bank as a formal administrator in permissionless DLT is not necessary, as transaction validation and communication are achieved through the consensus of participants. Consensus is essential, and no central authority is involved. Any party can initiate the transaction or operate a node in the network, meaning that any party could issue and validate CBDC. In other words, the issuance of CBDC would depend on the consensus of participants in the system. If a CBDC is issued through permissionless DLT, the central bank may be unable to conduct its tasks as the issuer of the CBDC or take needed actions to ensure the smooth issuance and transaction of the CBDC.

5.46. Permissionless DLT potentially restricts the state or the central bank from having exclusive control over the issuance of CBDC as the national currency in digital form. Just as with the issuance of banknotes and coins, the central bank, acting on behalf of the state, must have full control in creating money for the public to discharge debts. This view is supported by the fundamental theories of money, such as the state theory of money, and is backed by legislation, as discussed in the earlier chapter.[447]

5.47. The central bank may act as a transaction coordinator to update the ledger, but a consensus among participants in the CBDC ecosystem must be achieved first. However, achieving a consensus would be beyond the central bank's scope.[448] Considering the limitation of the roles of the central bank in this design, it can be argued that permissionless DLT might not be the best option for the central bank in issuing CBDC.

5.48. The central bank may want to adopt the security feature of permissionless DLT, especially for CBDC. In terms of security, permissionless DLT may be considered more secure than other DLTs due to public systems being distributed across significantly more nodes, thus creating a challenging situation for a malicious actor trying to gain majority control.[449] Currently, there is no central bank report or CBDC project exploring the use of permissionless DLT for CBDC.[450] Nonetheless, having permissioned DLT and deploying only the security feature from permissionless DLT might need to be discussed from a technical perspective to determine its feasibility.

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[446] International Telecommunication Union, 'Technical Report FG DLT D1.2 – Distributed Ledger Technology Overview, Concepts, Ecosystem' (2019) 2 <https://www.itu.int/en/ITU-T/focusgroups/dlt/Documents/d12.pdf> accessed 12 September 2025.

[447] See Chapter 4.

[448] Bank of England, 'The Digital Pound: Technology Working Paper' (2023) 50 <https://www.bankofengland.co.uk/-/media/boe/files/paper/2023/the-digital-pound-technology-working-paper.pdf> accessed 12 September 2025.

[449] Sky Guo and others, 'DLT Options for CBDC' (2024) Journal of Central Bank Theory and Practice, 66 <10.2478/jcbtp-2024-0004> accessed 12 September 2025.

[450] Raphael Auer and others, 'Rise of the Central Bank Digital Currencies' (2023) International Journal of Central Banking, 206 <https://www.ijcb.org/journal/ijcb23q4a5.pdf> Accessed 12 September 2025.

3. Other Types of DLT

5.49. Other variations that might derive from the characteristics of permissionless and permissioned DLT are private DLT and hybrid DLT. Private DLT operates within exclusive invitation-only networks where a central authority controls participants and assigns roles to participants.[451] Nevertheless, many studies suggest that private DLT and permissioned DLT are often referred to interchangeably due to their similarities.[452] As the term implies, permissioned DLT enables parties to become participants and perform roles upon receiving permission from the central authority.[453] Under this notion, just like permissioned DLT, this type enables the central bank to control the system, which, in this case, could serve as the optimal choice for CBDC.

5.50. A hybrid DLT system mainly incorporates features in permissioned DLT while leveraging the complete benefits of interoperability with the existing system and transparency from other participants offered by permissionless or public DLT.[454] This type of DLT allows the flexibility to choose what data to publish or to keep private. If the central bank can exert complete control over the DLT system, similar to what is possible in permissioned DLT, this type of DLT would become an option for the central bank in operating CBDC.

C. Elements of DLT

1. Actors and Layers in DLT

5.51. This discussion focuses on the DLT framework, which includes relevant actors and layers in the DLT system. In general, the actors in the DLT system consist of a minimum of developers, administrators, gateways and participants. They have their specific tasks and functions that are performed across the protocol layer, network layer and data layer. However, they can also undertake the roles of other actors in different layers. Examples of these actors and their functions are discussed in some of the CBDC projects conducted by some central banks.

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[451] Zoltan Vardai, 'What are Public, Private, and Permissioned Blockchain?' (2021) <https://forkast.news/what-are-public-private-permissioned-blockchains/> accessed 12 September 2025 ; Kathleen E Wegrzyn and Eugenia Wang, 'Types of Blockchain: Public, Private, or Something in Between' (2021) <https://www.foley.com/en/insights/publications/2021/08/types-of-blockchain-public-private-between> accessed 12 September 2025.

[452] See 101 Blockchain, 'Permissioned v. Permissionless Blockchains' (2020) <https://101blockchains.com/permissioned-vs-permissionless-blockchains/>; Binance Academy, 'What are Permissioned and Permissionless Blockchains' (2023) <https://academy.binance.com/en/articles/what-are-permissioned-and-permissionless-blockchains> accessed 12 September 2025; World Bank, 'Distributed Ledger Technology and Blockchain,' (2017) <https://documents1.worldbank.org/curated/en/177911513714062215/pdf/122140-WP-PUBLIC-Distributed-Ledger-Technology-and-Blockchain-Fintech-Notes.pdf> accessed 12 September 2025.

[453] Vardai (n 451); Wegrzyn and Wang (n 451).

[454] Guo and others (n 449) 50.

a. Actors in DLT in General

5.52. There are at least four groups of actors in a DLT system: (1) developers, (2) administrators, (3) gateways and (4) participants.[455] These actors can perform various roles in the DLT system. Another study discussed the actors in the DLT system and found that in a public blockchain system, the key direct actors are classified as developers, record producers, nodes, and the designers or creators of the system.[456] There is a range of actors and participants in the DLT system. How to identify the actors would depend on the design of the system, the type of public and private cryptographic keys, and so on.[457]

5.53. The 'developers' – those who create and assess the core protocol codebase – construct the DLT client, which serves as an interface to the DLT system, devise associated applications, and develop infrastructure that enables the protocols to communicate with each other.[458] Developers often create software and guidelines for reporting and other actions.

5.54. The 'administrators' are the actors who have functions to control. They have access to the core protocol codebase and may alter or change such code. These administrators are typically involved in the governance process as they have absolute control over the DLT system. However, the roles of administrators can vary depending on the designs of DLT systems, such as in permissioned and permissionless DLT.[459]

5.55. Another actors in DLT, 'gateways', are in charge of granting participants access to the system, transmitting external data to the system, acting as custodians who can hold assets in custody, supporting the purchase and sale of digital assets, and as issuers that can issue or redeem tokens that represent assets electronically on the ledger.[460] In clearing and settlement use cases, the ledgers are the core of the DLT system as they maintain records of ownership and balances of digital representations of physical assets.[461] Ledgers also maintain a history of all transactions, as they do in blockchain implementation. Furthermore, records in the ledgers are final and unlikely to be altered.[462]

5.56. Last, the 'participants' in the DLT system include (1) auditors who verify the validity of transactions and records, inform the network of any invalid records, and relay valid transactions and records, (2) record producers or miners/validators who create potential records in the ledger, (3) lightweight clients who request auditors for data on specific

[455] Rauchs and others (n 426) 29.
[456] Darra Hofman and others, 'Blockchain Governance: De Facto (x)or Designed?' in V. L. Lemieux, C. Feng (eds.), *Building Decentralized Trust* (2021) 29 <https://www.cs.ubc.ca/~bestchai/papers/2021-bchain-governance.pdf> accessed 12 September 2025.
[457] ibid.
[458] ibid.
[459] Rauchs and others (n 420) 30.
[460] ibid.
[461] Bank for International Settlements, 'Distributed Ledger Technology in Payment, Clearing and Settlement: An Analytical Framework' (2017) 3 <https://www.bis.org/cpmi/publ/d157.pdf> accessed 12 September 2025.
[462] ibid.

transactions, and (4) end-users who require a gateway to access the system such as through wallet.[463]

5.57. When discussing CBDC technology or systems in more detail, it is important to recognise the legal relationship among actors within the CBDC ecosystem, such as providers, payment service providers and users. For comparison, existing payment systems like the RTGS system establish legal relationships through RTGS Account Mandate Terms and Conditions and multilateral agreements involving payment system operators.[464] Similar to the UK, Bank Indonesia manages legal relationships with relevant parties involved in BI-RTGS, including bilateral and multilateral agreements with providers.[465] The legal relationship between relevant actors in the DLT system is analysed below.

b. Actors in DLT in the CBDC ecosystem

5.58. To better understand the actors involved in the DLT system, the implementation of CBDC by the Bank of Jamaica and the retail CBDC project carried out by the MAS in Project Ubin Phase 1 is explained below. The implementation of CBDC by the Bank of Jamaica involves a private company, E-currency Mint Inc., as a technology provider. This company provides hardware, software, and cryptographic security protocols needed by the Bank to issue, distribute and supervise CBDC.[466] Using its open API, E-currency Mint's platform seamlessly integrates in technology terms with the central bank's RTGS, instant payment and commercial payment system. Additionally, banks and financial intermediaries can easily integrate with CBDC technology.

5.59. In Project Ubin phase 1, related parties in the CBDC project were the MAS, R3 as a consortium specialising in DLT, commercial banks or leading blockchain consortia, some commercial banks that are non-members of R3, Singapore Exchange and BCS Information Systems as a technology provider.[467] In this project, MAS acts as a settlement agent, operator and overseer of payment, clearing and settlement systems and also as a trusted third party.

5.60. On a broader scale, the IMF conducted a study on six CBDC projects (Bahamas, Canada, China, ECCU, Sweden and Uruguay) and categorised actors in the CBDC environment based on their functions.[468] These functions include issuing, validation, ledger update,

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[463] ibid.

[464] Bank of England, 'Bank of England's Real-Time Gross Settlement Service: Service Description' (n 392) 20; Bank of England, 'RTGS Account Mandate Terms and Conditions,' <https://www.bankofengland.co.uk/-/media/boe/files/payments/rtgstandc.pdf> accessed 12 September 2025.

[465] See Bank Indonesia Regulation No. 23/7/PBI/2021 on the Payment System Infrastructure Providers, art 53.

[466] E-Currency Mint Inc, 'E-Currency Announced Centralized CBDC Capability' (2023) < https://www.prnewswire.com/news-releases/ecurrency-announces-centralized-cbdc-capability-301807093.html?tc=eml_cleartime > accessed 12 September 2025.

[467] Monetary Authority of Singapore and Deloitte, 'Project Ubin: SGD on Distributed Ledger' (2017) <https://www.mas.gov.sg/-/media/mas/projectubin/project-ubin--sgd-on-distributed-ledger.pdf> accessed 12 September 2025.

[468] Gabriel Soderberg and others, 'Behind the Scenes of Central Bank Digital Currency: Emerging Trends, Insights, and Policy Lessons,' (2022), FinTech Notes - Note/2022/004, 10 < https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4663923 > accessed 12 September 2025.

know your customers-anti money laundering/countering the financing of terrorism, User Interface, User Data and Customer Service, elaborated as follows.[469] The first function, 'issuing', which involves converting conventional money to CBDC, is typically carried out by a private company that owns the technical systems, as seen in Uruguay. The second function, 'validation', ensures the user's identity, the authenticity of money, and the availability of funds. This function is performed by the central bank, private entities or both. The third function, 'ledger update', has three options.[470] First, the central bank performs the function if it owns the infrastructure. Second, the central bank owns the ledger, but the private intermediaries update it. Third, a private intermediary owns the infrastructure and updates the ledger with the central bank's approval. The rest of the functions, such as the user interface, user data and customer service functions, are mainly handled by the private sector.

c. Layers in DLT

5.61. The actors in the DLT system have to perform their roles in the respective layers, although they can also undertake the roles of other actors in a different layer. The interaction of these layers – protocol layer, network layer and data layer – depicts how the DLT system works in general.[471] As mentioned earlier, the level of decentralisation in a DLT system may vary across its layers depending on its design.[472] This level can make a difference to the way control over the system is exercised. The network and data layers could be decentralised while the protocol layer remains centralised. Alternatively, the data layer may be decentralised while a single party controls the network and protocol layers.

5.62. The protocol layer is the first layer that creates an inter-system dependency and codebase as the foundation of the DLT system.[473] Then it defines the ruleset or 'constitution' that the DLT system will operate upon.[474] This protocol rule set is basically software that is implemented in the network layer.[475] As a result of the implementation of protocol rules, an interconnected group of actors in the network layer processes the data across the network to connected 'nodes' and initiates transactions. They then form a candidate record or block to be validated. Once confirmed with the protocol rules, the records are settled permanently. In the data layer, data is processed through computer scripts known as programmatically-executed transactions (smart contracts). After execution, the data is stored in a ledger. Furthermore, the DLT system can be linked to external systems, such as apps and proprietary enterprise databases, through gateways.

5.63. For DLT in Project Ubin, the parties involved in the network have their own 'nodes' that record a copy of all transactions on the network.[476] Each node works with the other

[469] ibid.
[470] ibid.
[471] ibid 38 – 39; Rauchs and others (n 426) 30.
[472] Ibid 44.
[473] ibid.
[474] ibid.
[475] Rauchs and others (n 426) 41.
[476] Monetary Authority of Singapore and Deloitte (n 467) 8.

node and creates a consensus to validate the transaction. Devices such as computers, smartphones or any device can function as a node in this network as long as it is configured to interconnect with the network.[477] A centralised server does not control the communication between nodes as an intermediary; therefore, a more secure system would be needed.[478]

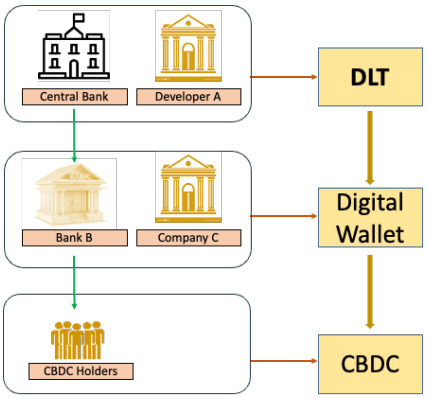
2. Legal Relationships in the CBDC Ecosystem

5.64. After identifying actors in DLT, it is important to analyse the legal relationships among them, including parties involved in the CBDC ecosystem, to apportion the responsibility of each actor for any kind of circumstances that occur, especially those that impact the CBDC holders as end-users. Identification of these actors, as well as the legal relationships among them, however, would depend on the structure of CBDC, which can be either one-tier, two-tier or other architectures, as elaborated in the previous chapter.

5.65. It is also important to analyse relevant agreements related to the existing system or technology in payment systems used by the central banks, such as RTGS. Even though they serve distinct purposes involving different schemes and actors, the nature of RTGS and the CBDC system is similar. The central bank utilises both technologies in the payment system for the public.[479] However, for CBDC, the central bank may keep a record of all retail CBDC holdings, allowing it to facilitate transfers from one payment service provider to another in case of any technical issues.[480] Their operation involves certain actors or participants and operates within the legal framework of the relevant jurisdictions. As a result, the legal relationships governing these systems are comparable in nature.

5.66. Figure 5 illustrates a simple scheme for a two-tier CBDC architecture, where the central bank, as the issuer of CBDC, issues CBDCs and distributes them through intermediaries to individuals as end users.

Figure 5. Illustration on Actors



(Source: Author)

[477] Guo and others (n 449) 12.
[478] ibid 13.
[479] Auer and Böhme, 'The Technology of Retail Central Bank Digital Currency' (n 21) 89-90.
[480] ibid.

In this scheme, the relevant actors and their roles can be identified as follows:

1. The central bank performs the roles of the developer and administrator of DLT;
2. Developer A performs the role of the developer of DLT as appointed by the central bank;
3. Commercial Bank B and Company C perform roles as intermediaries/participants in gateways or wallet providers connected to DLT; and
4. Individuals as CBDC holders who receive CBDC through digital wallets operated by Bank B, together with the wallet provider. The individuals who hold CBDCs are also customers of Bank B.

5.67. Under this scheme, the potential legal relationships that those actors fall into can be outlined as follows: First, as a regulator of CBDC, the central bank needs to enact regulations related to CBDC, among others, on its roles and authority as developer and administrator in the CBDC system, the legal status of the CBDC system, requirements for activities and participants in the CBDC system, and if necessary, acknowledging the legal relationship between actors in DLT and their relevant agreements.

5.68. Second, a legal relationship or agreement needs to be created between the central bank and Company A to define the rights and obligations concerning the creation of the software and hardware for DLT as part of the CBDC system. This agreement should cover intellectual property rights, ownership and operation of the CBDC system, including the system's rule of code or protocol, and any modifications that requires the central bank's approval.

5.69. Third, the central bank, Commercial Bank B and Company C establish a legal relationship through a participant agreement. This agreement should cover the legal position of the central bank, including its rights, liabilities and obligations, the scope of authority and undertakings of account holders, the event of default and confidentiality.

5.70. The analogy for the second and third legal relationships can be seen in the RTGS Account Mandate Terms and Conditions provided by the BoE and the currency participation agreement provided by the European Central Bank. For the RTGS system in the UK, the BoE set out terms and conditions for account holders that cover topics such as the legal position of the central bank, including its rights, liabilities and obligations, the scope of authority and undertakings of account holders, the event of default and confidentiality.[481] Under this agreement, the parties agree to comply with applicable laws and regulations and with any procedures set out in the RTGS reference manual published by the central bank.

5.71. To further understand the legal relationships between the central bank and the participants regarding the system/technology, the currency participation agreement in Europe can be analysed. The currency participation agreement is a crucial agreement made by the European Central Bank and other central banks as users in the operation

[481] Bank of England, 'Bank of England's Real-Time Gross Settlement Service: Service Description' (n 392).

of Target2-Securities.[482] This agreement establishes a legal relationship between the European Central Bank and other central banks that are participating in the securities settlement system (ie Target2-Securities), which is integrated with the RTGS system in Europe. Such an agreement outlines the rights and obligations of the parties, liability rules and network provider, intellectual property rights, confidentiality and data protection, and dispute settlement. Besides accommodating clauses related to compliance with relevant laws and regulations, the agreement also recognises the set of documents as the protocol for operating the system, as well as the service level agreement and licence agreement, which are relevant to the discussion in the first analysis.

5.72. Commercial Bank B and Company C, acting as gateways or wallet providers, and end-users of CBDC may enter into a user agreement that covers the liability of parties, services provided by the provider, confidentiality, operation of protocols, title and ownership of CBDC. To better understand the concept of a legal relationship between the central bank, as the developer/administrator, and participants within the existing payment system, the agreement between Bank Indonesia, as the operator of the RTGS system, and participants who use the system is elaborated below. The parties enter into a user agreement that covers the rights and obligations of the parties, legal liabilities, and consents from the participant to the operator to deduct necessary funds for settling obligations.[483] In blockchain systems involving wallet providers, digital services and individuals as end-users, user agreements govern the legal liabilities of each party, the scope of services, confidentiality, protocol operation, and compliance with applicable laws and data protection regulations.[484]

5.73. CBDC holders who are customers of Commercial Bank B must also have a legal relationship with the bank, as they agree to open accounts under the standard agreements between customers and banks. If CBDC were issued through banks as intermediaries, these agreements should include terms and conditions for obtaining and converting their funds into CBDC, as well as provisions addressing issues related to the device or digital wallet used to store and transact CBDC. Provisions regarding the legal responsibilities related to the distribution of CBDCs for each party can also be included in this agreement. For instance, in existing bank and customer agreements, the responsibilities of each party are outlined, such as the customer is responsible for incorrect instructions or mistakenly instructing the bank through the bank's online banking services to make duplicate payments.[485] This agreement can be extended to include issues related to CBDC.

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[482] European Central Bank, 'Currency Participation Agreement' (2020) <https://www.ecb.europa.eu/paym/target/t2s/profuse/shared/pdf/currency-participation-agreement-including-schedules.pdf> accessed 12 September 2025.

[483] See Annex III of Regulation of Member of the Board of Governor of Bank Indonesia No. 20/15/PADG/2018.

[484] See Bitcoin, 'User Agreement of Bitcoin' <https://www.bitcoin.com/legal/user-agreement> accessed 12 September 2025; See Coinbase, 'User Agreement of Coinbase' <https://www.coinbase.com/legal/user_agreement/payments_europe#:~:text=By%20using%20a%20Coinbase%20Account,register%20only%20one%20Coinbase%20account> accessed 12 September 2025.

[485] See Barclays, 'Terms and Conditions for Personal Customer' < https://www.barclays.co.uk/content/dam/documents/personal/site-hygiene/New_BAR_9910542_UK%2001.25.pdf> accessed 12 September 2025.

5.74. The legal relationships between parties, in general, can be stated or documented in agreements like contractual agreements that fulfil the basic requirements of the contract in the respective jurisdictions. In the UK, the contract should meet the principles of English contract law,[486] and in Indonesia, it should fulfil the fundamental criteria of contract under article 1320 of the Indonesian Civil Code (ie a consensus of relevant parties, the legal capacity of the parties, subject matters, and a legal cause). Furthermore, these actors should have the ability to freely enter into an agreement of their own choice on their terms.

5.75. Before committing to any agreements or legal obligations with third parties, the performance of tasks of the central banks should always adhere to their legal mandate and overall legal framework.[487] Establishing credibility and trust in the central bank, the market and the financial sector is vital, and this can be achieved through fulfilling the central bank's mandate, maintaining its independence, and being accountable and transparent in its operations and organisation.[488]

IV. Other Considerations in Designing DLT

5.76. The core features and principles in CBDC technology are not intended to be the entire elements of CBDC technology, but rather the absolute minimum. The decision regarding the technological aspect of CBDC must be adapted to its design and architecture. It should also meet policy goals determined by the central bank. As digital payments become increasingly prevalent, CBDC technology is likely to further advance to adapt to changing circumstances, particularly as more countries adopt it.

5.77. The CBDC system should consider at least the following core features: security, instant effect, resilient availability, throughput, scalability, interoperability, flexibility and adaptability.[489] Besides those features, the CBDC system should also conform to national

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[486] The general principle of English contract law is that the parties must reach agreement which offer given by one party has been accepted by other party. It must also be supported by consideration and intention to create legal relations; See Ewan McKendrick, *Contract Law: Text, Cases and Materials (*10th ed, Oxford University Press 2022) 4-5.

[487] Ashraf Khan, 'Legal Protection: Liability and Immunity Arrangement of Central Banks and Financial Supervisors' (2018) IMF Working Paper No 18/176, 9 <https://www.elibrary.imf.org/view/journals/001/2018/176/001.2018.issue-176-en.xml> accessed 12 September 2025.

[488] ibid.

[489] See Bank of Canada and others, 'Foundational Principles and Core Features' (n 61) 11. In this study, the core features of the CBDC system are viewed as follows:

- *Secure: both the infrastructure and participants of a CBDC system should be extremely resistant to cyber attacks and other threats. This should also include ensuring effective protection from counterfeiting;*
- *Instant: instant or near-instant final settlement should be available to end users of the system;*
- *Resilient: A CBDC system should be extremely resilient to operational failure and disruptions, natural disasters, electrical outages and other issues. There should be some ability for end users to make offline payments if network connections are unavailable;*
- *Available: End-users of the systems should be able to make payments 24/7/365;*
- *Throughput: The system should be able to process a very high number of transactions;*
- *Scalable: To accommodate the potential for large future volumes, a CBDC system should be able to expand;*

laws and consider incorporating features related to privacy, energy efficiency, recoverability, a recall feature, and offline capabilities if CBDC is intended for payment when the parties are not connected to the online system. In countries with lower levels of financial literacy and a growing number of digital payments, the CBDC system would benefit from applying high standards of security since the risks of cyber-attacks are greater in these countries. Furthermore, when determining technology for CBDC, there are some notorious attacks in the system, especially in DLT, that should be anticipated, such as the 51% Attack, Sybil Attack and DoS Attack.[490]

5.78. General transformations in technology have increased challenges to security, including the safety of digital data. As part of the National Cyber Strategy, the UK government plans to improve law enforcement technical capabilities over infrastructure, digital currency and payment systems, which can be implemented against other threats.[491] The systemically important payment system in the UK (ie RTGS and CHAPS) has been designed to be highly reliable and secure, where its security requirements must conform to laws and national principles, including the National Cyber Strategy.

5.79. Similarly, the Digital Pound, including its infrastructure and technology, should also adhere to the National Cyber Strategy and relevant national guidelines and laws. In addition to contributing to the national effort to prevent and detect cybercrimes, the regulator or central bank should have a series of protocols and guidance on security in place to ensure the security of technology in the CBDC system at a minimum level equivalent to the standards they impose for RTGS and CHAPS.

5.80. In addition to the core features mentioned above, another essential technological element for the CBDC system is 'privacy'. Trust and confidence are essential for the participants involved in the CBDC ecosystem, and the use of privacy-enhancing technologies can greatly support privacy and data protection.[492] The operation of the CBDC system should align or comply with existing laws and regulations of the host jurisdiction, including anti-money laundering. When it comes to environmental considerations, the technology underlying CBDC should be able to support the green policy of the central bank by being energy efficient and having a minimal environmental

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- *Interoperable: The system needs to offer sufficient interaction mechanisms with private sector digital payment systems and arrangements to allow easy flow of funds between systems;*
- *Flexible and Adaptable: A CBDC system should be flexible and adaptable to changing conditions and policy imperatives.*

[490] 51% attack happens when 51% of the control to validate nodes is taken by a party, such as an individual or group. The party is then enabled to reverse, cancel or change transactions. Similar to the 51% Attack, Sybil attack occurs when the attacker is able to control the transaction once multiple pseudonymous nodes have been created within a system. The malicious actor(s) can carry out wrongful actions by assuming fake identities. Lastly, a system might experience a Denial of Service (DoS) Attack when legitimate users are denied making transactions in the system or made to incur loss from payment. For instance, the malicious attacker makes withdrawals without consent causes a loss for some payments.

[491] HM Government, 'National Cyber Strategy 2022: Pioneering a Cyber Future with the Whole of the UK' (2022) 106 < https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1053023/national-cyber-strategy-amend.pdf > accessed 12 September 2025.

[492] Bank of England, 'The Digital Pound: Technology Working Paper' (n 448) 20.

impact.[493] A more detailed discussion on privacy and environmental impact in relation to CBDC will be discussed in Chapter 9.

5.81. In Indonesia, as DLT will be comparable with BI-RTGS, it is important to regulate DLT in the Bank Indonesia Regulation. Such regulation should provide the overall design of DLT used to process the Digital Rupiah, thereby giving legal certainty to the general public about the system that they will use to process their money. Bank Indonesia Regulation should also regulate the legitimacy of the use of DLT for the Digital Rupiah, business processes in DLT, the scope of participants in DLT, participants' roles and responsibilities. Compliance with DLT standards or ISO is also necessary to demonstrate the reliability of the system used to process the public's money. This compliance will depend on the level of adoption of the Digital Rupiah and whether such infrastructure is considered significant. If classified as significant infrastructure, similar to the BI-RTGS system, it should also comply with the principles that apply to SIPS.

V. Conclusions

5.82. As state-issued money, CBDC should have equal legal treatment as other forms of central bank money, such as banknotes and coins. The issuance must be based on the law. The system or infrastructure used to operate CBDC must also be legally valid to create a lawful CBDC. The design of technology or systems for CBDC must align with the rule of law, which may take precedence over the rule of code. Accordingly, the codes or protocols in the systems should be adaptable to ensure compliance with the law.

5.83. Given the state's authority in creating money and the significance of the CBDC system in the financial system, a key consideration in designing the technology for CBDC is ensuring that the state or central bank maintains its full control over the creation and issuance of money. If DLT were adopted to operate CBDC, then a permissioned DLT or similar option would be preferrable, provided the state or central bank retains complete control in a system that generates digital state-issued money.

5.84. The participants in the CBDC ecosystem, including those involved in DLT, will vary depending on the designated technology or system used for CBDC. The central bank must be able to identify these participants and their roles in the operation of CBDC. Legal relationships among these participants, including actors in DLT, must be analysed to understand the legal liabilities of those parties. This analysis is especially important in assigning responsibility for specific circumstances that may impact CBDC holders as end-users.

[493] ibid 44.

CHAPTER 6

FINALITY OF SETTLEMENT IN CBDC TRANSACTIONS

I. Introduction

6.1. The technology used in operating CBDC, as discussed in the previous chapter, plays a key role in determining how CBDC transactions are processed. This process also determines how the debts are paid and settled from a legal perspective, where time is a critical factor.

6.2. This chapter explores the finality of settlement in CBDC transactions, covering the function of the finality of settlement from a legal standpoint and designing the finality of settlement, focusing on offline payment for retail transactions. The discussion begins by differentiating between the concepts of payment, settlement, and settlement finality in the existing payment system, before discussing the application of these concepts in the context of CBDC transactions.

6.3. Regardless of the system used for processing CBDC, the legal function of settlement finality in CBDC transactions should align conceptually with that of the traditional funds transfer. The discussion aims to argue that the finality of settlement in CBDC provides legal certainty regarding CBDC payments, ensuring the irrevocability and finality of transfers within the CBDC system. This determination ensures that transactions are final, thereby granting the payee a full and unconditional right to use their account. Settlement finality also provides legal protection to the central bank and other parties, including both payees and payers, as well as banks acting as intermediaries, from being exposed to legal risk or liability.

6.4. Based on the discussion in this chapter, designing the finality of settlement in offline CBDC transactions would depend on various aspects, such as the design of the CBDC. Ideally,

the finality of payment and settlement finality occur simultaneously, marking the discharge of the financial obligation between the payer and the payee and confirming the transaction as final, unconditional and irreversible. However, in offline transactions, settlement finality can occur at a later time when the transactions are reconnected to the internet, due to a technological requirement.

6.5. In fully offline and intermittently offline designs, the payment that occurs offline can discharge the monetary obligation of the payer immediately after the payee accepts the payment. Even though the settlement occurs offline, the finality of settlement in CBDC transactions should be guaranteed by the central bank, meaning that the payee has the right to use the funds after they receive them from the payer. For a staged offline design, even though the payment occurs offline, the settlement occurs at a later time once the system is reconnected to the network. In this case, the payee can only use the funds once he is connected to the network. To give legal certainty to parties involved in the transactions, the central bank must set a time limit for settlement to occur. Noting the importance of settlement finality in CBDC transactions, the central bank should regulate these matters with detailed regulations.

II. Overview of Payment, Settlement and Finality of Settlement

6.6. To understand the legal functions of the finality of settlement, one must first grasp the concept of payment, settlement and the general payment ecosystem in the traditional payment system. These concepts are generally applied to transactions involving CBDCs. However, technology employed in the CBDC system might require a different implementation of these concepts, thus leading to distinct legal consequences for the parties involved in the transactions. These legal consequences encompass the timing of debt discharge and the payee's rights to use the received funds, which will be explored in the subsequent paragraphs.

6.7. The general overview explored in this section aims to provide foundational insights before discussing the payment, settlement and finality of settlement in CBDC transactions, especially in offline payment. This understanding should enable a complete equivalence among different types of money and payment.

A. Concept of Payment: Tender, Intent and Acceptance

6.8. In general, payment can be defined as the transfer of money from one party to another to settle a debt or financial obligation. This payment process can be carried out through physical means, such as using banknotes, and through a digital mechanism that involves a system or machinery. Typically, the elements of payment cover an act of tender by the payer, a clear intention and an act of acceptance by the payee.[494]

6.9. The process of payment is initiated by the act of 'tender', which is a unilateral action executed by the payer toward the payee.[495] For this tender to be able to discharge the

[494] Fox, *Property Rights in Money* (n 20) Par 1.88.
[495] ibid.

debtor's obligation or constitute a payment, it will need the consent of both the payer and the payee to intend the payment, thus creating a bilateral act.[496] To meet the element of 'intent' in payment, when the money is transferred from one party to another party for the purpose, the payer must explicitly communicate or share a mutual understanding with the payee that the payment is intended to discharge the payer's monetary obligation.[497] The payee's acceptance of the payer's tender of money is necessary to constitute a full payment, following the agreed-upon terms and conditions or those to which the payee is willing to consent.[498]

6.10. The process of payment in the existing payment system generally starts when the payer sends a payment instruction to intermediaries or banks to debit their account, and the transfer of such money is considered to happen after the payee's account is credited. If the payee does not accept the payment, then under English law, a payment to the account of the payee with a particular bank will not release the payer from its obligation.[499] The payee is deemed to accept the payment when the lender treats the transferred funds as his own and does not take any steps to reject the transfer within a reasonable timeframe after becoming aware of the incoming transfer.[500]

6.11. Payment using CBDCs should have the same meaning as payment of money or funds transfer, as CBDC represents a digital manifestation of money. Payment is a broad concept of private law, and its meaning must be the same, whatever the kind of payment medium used. However, the mechanisms of payment in online transactions are different from offline transactions as they vary depending on the technology, the selection of user devices and connectivity to the network.

6.12. Under English law, if the payee does not provide consent, a payment to the account of the payee with a particular bank will not release the payer from its obligation nor qualify as a valid tender.[501] This principle is recognised under *Commissioners of Customs and Excise v National Westminster Bank plc*.[502] An unaccepted tender, although it does not discharge the debtor's debt, still provides the debtor with protection regarding costs and any interest.[503] Yet, when a person makes a payment to another person due to a causative mistake of fact, then they are prima facie entitled to seek a refund.[504] This is a right in unjust enrichment, and the payer has only a personal right to restitution of the same amount as was received. In the context of payment by the payer through money transfer or bank transactions, the payee is deemed to accept the payment when the payee can treat the transferred funds as his own and does not take any steps to reject

[496] Proctor, *Mann and Proctor on the Law of Money* (n 47) para 7.09.
[497] ibid para 7.08.
[498] Fox, *Property Rights in Money* (n 20) para 1.100.
[499] Proctor, *Mann and Proctor on the Law of Money* (n 47) 181.
[500] ibid 186; Proctor argued that under *Suncorp Insurance & Finance v Milano Assicurazioni SpA* [1993] 2 Llyod's Rep 225, this is known as an implied acceptance, wherein the payee was notified about the payment but did not undertake any actions to reject such payment.
[501] ibid 181.
[502] *Commissioners of Customs and Excise v National Westminster Bank plc* [2003] EWHC 1822 (Ch).
[503] Proctor, *Mann and Proctor on the Law of Money* (n 47) 177; see *Malan v Tipton* 349 OR 638 (2011).
[504] See *Barclays Bank v WJ Simms & Cook* [1981] QB 677, 895.

the transfer within a reasonable timeframe after becoming aware of the incoming transfer.[505]

6.13. The basic form of payment mechanism involves the payer, payee and a third party, usually the payment authority, that has a role in taking payment instructions from the payer and paying the payee to obtain a discharge of the debt on behalf of the payer. The intermediary is thus an agent in the transaction, although there may be a question whether it is an agent for the borrower as the payer, or for the lender as the payee. The payment mechanism can expand from a three-party mechanism to a multiparty mechanism that involves, among others, exchangers and intermediary bankers.[506] Moreover, the mechanism of fund transfer occurs in a payment system.

B. Concept of Payment System

6.14. The definition of a payment system may vary across jurisdictions. For example, in the UK, under the Financial Services (Banking Reform) Act 2013, a payment system is defined as ‘A system which is operated by one or more persons in the course of business for the purpose of enabling persons to make transfers of funds, and includes a system which is designed to facilitate the transfer of funds using another payment system.’[507] Similarly, a payment system in Indonesia is ‘a system including a set of regulations, institutions, mechanisms, infrastructure, source of funds for payment, and access to a source of funds for payment, which are used to execute fund transfer to meet an obligation arising from economic activity.’[508] From these definitions, the defining characteristics of a payment system involve the transfer of monetary funds other than by means of physical delivery.

6.15. The constituent elements of a basic payment system comprise the institutions providing payment services, the various forms of money, the means of transferring them, including message instructions and communication channels, and the legal arrangement linking the relevant parties.[509] The transfer of funds makes the transferee the new owner of the funds received and is performed by intermediaries that receive and execute instructions to debit the payer’s account and credit the payee’s account, while the central bank mostly conducts the settlement.

6.16. The transaction in the payment system typically involves some form of exchange between two parties, and this covers two legs: (i) the payment leg, which includes the payment itself between the parties to the underlying debt and (ii) the settlement leg, which may involve offering a product or service or the transfer of ownership of a financial asset.[510] Furthermore, there are three possible sources of risk in these legs: any

[505] Proctor, *Mann and Proctor on the Law of Money* (n 47) 186.
[506] Geva, 'The Concept of Payment Mechanism' (n 258).
[507] See Financial Services (Banking Reform) Act 2013, s 41.
[508] See Bank Indonesia Regulation No. 23/7/PBI/2021 on Payment System Infrastructure Providers, elucidation of art 1.
[509] C E V Borio and P V Den Bergh, ‘The Nature and Management of Payment System Risks: An International Perspective’ (1993) BIS Economic Papers No. 36, 8 < https://www.bis.org/publ/econ36.pdf > accessed 12 September 2025.
[510] ibid 23-24.

delay that occurs between the time the trade is executed and each of its two legs is performed, any lag between the completion of the two legs of the exchange, and the possibility of default on the settlement medium.[511]

6.17. CBDC infrastructure may share similarities and may be categorised as financial market infrastructure (FMI), such as the RTGS system that facilitates the payment system.[512] In fact, the CBDC system could be interoperable with the existing payment system, which makes it reasonable to argue that the CBDC system will likely become part of a national payment system in the future.[513]

C. Concept of Settlement

6.18. In general, settlement occurs when the payment from the payer to the payee is conducted through a system. Settlement involves reconciling the effects of the payment in the ledgers of the central institution that issues or implements the means of payment, which, for bank money and online CBDC, means the banks in the payment system or the central bank. This contrasts with a payment made using coins or banknotes, in which settlement has almost no role at all, since there is no central ledger that records the payers' and payees' holdings of physical money. It is, in that sense, fully decentralised.

6.19. In an interbank payment system, settlement takes place through either multilateral netting or on a gross basis. Under multilateral netting, settlement happens periodically at the end of each clearing cycle, covering payment orders exchanged throughout the clearing period.[514] There is a possible source of risk because there is a delay between the time the trades take place and when each of the payment leg and settlement leg is performed. In contrast, a gross basis entails real-time settlement for each payment, occurring as each order is communicated and processed.[515]

6.20. Additionally, this gross settlement occurs either in real-time or on a deferred basis. In the latter, there is a delay between the completion of the payment leg and the settlement leg, which corresponds to the time for debiting the payer's account and crediting the payee's account. Thus, determining settlement finality is crucial as it helps to establish when the monetary obligation can be fulfilled, considering the time gap between trades and their completion, including any potential defaults by the parties.

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[511] ibid.

[512] See para 5.12.

[513] World Bank Group, 'Interoperability Between Central Bank Digital Currency Systems and Fast Payment Systems' (2024) 9 < https://openknowledge.worldbank.org/server/api/core/bitstreams/a6f91b4c-32ee-4962-b51f-e164fb046f6c/content#:~:text=Interoperability%20allows%20the%20CBDC%20to,payment%20service%20providers%20(PSPs) > accessed 12 September 2025.

[514] Benjamin Geva, 'Settlement Finality and Associated Risks in Funds Transfers - When Does Interbank Payment Occur' (2002) 22(1) Penn State International Law Review, 36 <http://elibrary.law.psu.edu/psilr/vol22/iss1/5> accessed 12 September 2025.

[515] ibid.

D. Dimensions of Settlement System

6.21. The payment and settlement process of funds or other monetary instruments often occurs within a traditional payment system framework, as mentioned earlier. However, for securities, commodities and derivatives, the payment and settlement process can be performed by financial intermediaries using payment systems, securities settlement systems, central securities depositories and central counterparties.[516]

6.22. In addition to these systems, the financial industry has started to utilise DLT or blockchain systems to facilitate payment and settlement in financial transactions. These DLT systems offer distinct mechanisms for data storage, record keeping and the transfer of digital assets. They consist of interconnected nodes that are designed to perform specific functions, enabling transactions to be facilitated through software. Furthermore, these systems can exist in permissionless systems like the one to process Bitcoin, as well as in permissioned systems that operate certain cryptocurrencies, such as Ripple and e-Naira, a CBDC issued in Nigeria.[517] Further discussion on the mechanism of settlement for CBDC will be explored in later paragraphs.

E. Settlement Risks

6.23. In general, when a payment cannot be processed or a settlement fails to occur in the traditional payment system due to credit risk, liquidity risk or operational risk, the failure of one participant to complete their settlement or fulfil its obligation will disrupt the anticipated flow of funds to other institutions. This disruption impedes their ability to settle on time.[518] Such chains of obligation lead to challenges because of the adverse effects exerted by the failed institution on the ability of an intermediary participant to process settlements. The interconnections among payment institutions have the potential to disseminate credit or liquidity problems widely, which could lead to situations where these institutions experience a shortage of funds or a decline in the value of their assets due to failure created by a distressed party.[519] Eventually, this circumstance may pose a contagion effect or a threat to the stability of the system or financial markets, and this is commonly referred to as systemic risk.[520]

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[516] David Mills and others, 'Distributed Ledger in Payments, Clearing and Settlement' (2016) Finance and Economics Discussion Series 2016-095, 5 < https://doi.org/10.17016/FEDS.2016.095 > accessed 12 September 2025; The central securities depositories (CSD) provides accounts for securities, central safekeeping services and asset services, including the administration of corporate actions and redemptions while securities settlement system (SSS) facilitates the transfer and settlement of securities by book entry according to a set of predetermined rules. In many cases, a CSD also serves as an SSS.

[517] Odunayo Ezekiel, 'What is eNaira? CBN Digital Currency Explain' (2021) < https://www.dignited.com/87013/what-is-enaira-cbn-digital-currency-explained/> accessed 12 September 2025.

[518] David Folkerts-Landau, 'Systemic Financial Risk in Payment Systems' (1990) IMF No. WP/90/65, 16 < https://www.elibrary.imf.org/view/journals/001/1990/065/article-A001-en.xml > accessed 12 September 2025.

[519] Borio and Bergh (n 509) 31.

[520] Systemic risk can be defined as a risk of disruption to financial services that is caused by an impairment of all or parts of the financial system and has the potential to have serious negative consequences for the real economy. The circumstances that can trigger systemic risk are failure in payment system, failure. See Jaime

6.24. Systemic events that can trigger systemic risk can be interpreted broadly. According to the IMF, the BIS and the Financial Stability Board, systemic risk is 'a risk of disruption to financial services that is caused by an impairment of all or parts of the financial system and has the potential to have serious negative consequences for the real economy.'[521]

From this definition, systemic risk can arise from any disruption in any aspect of financial services. There are three criteria for assessing systemic importance related to their potential to have a large negative impact on the financial system and the real economy: (1) size, (2) lack of substitutability and (3) interconnectedness.[522] The payment system's infrastructure poses a systemic risk to both the financial system and the wider economy, given the substantial volume of financial services it facilitates. Its pivotal role within financial systems underscores its systemic significance in the financial sector. Furthermore, the core payment system's infrastructures, such as clearing and settlement systems, concentrate liquidity risk and credit risk on a set of participants in the system.[523]

6.25. To prevent payment system infrastructures from becoming a source of systemic risk, authorities should oversee these infrastructures and take any necessary steps to ensure their smooth operation. These risks might also occur in CBDC transactions, especially if the CBDC infrastructure is categorised as systemically important payment system infrastructure, just like traditional payment systems.[524] CBDC systems can be designated as systemically important by the authority, as they may also face systemic risks, similar to traditional payment systems.[525] Therefore, the architecture of the CBDC system, including the implementation of the settlement finality principle within such a system, should be designed properly.[526]

F. Concept of Finality of Settlement

6.26. After conducting payment and settlement, settlement finality should then be achieved after the payment is accepted by the system and deemed final at the time the participant receives it.[527] Once the payee receives the payment, it cannot be reversed, recalled, or cancelled by a participant in the system, including any third party, from the moment determined by the rules of that system. Regardless of the solvency of parties

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Caruana, 'Systemic Risk: How to Deal with it?' (2010) <https://www.bis.org/publ/othp08.htm#P01> accessed 12 September 2025.

[521] International Monetary Fund and others, 'Guidance to Assess the Systemic Importance of Financial Institutions, Markets and Instruments: Initial Considerations' (2009) 8-9, <https://www.fsb.org/wp-content/uploads/r_091107c.pdf?page_moved=1> accessed 12 September 2025.

[522] ibid.

[523] Borio and Bergh (n 509) 31.

[524] Bank for International Settlement - Committee on Payment and Settlement Systems, 'Principles for Financial Market Infrastructures' (2012) 11 < https://www.bis.org/cpmi/publ/d101a.pdf > accessed 12 September 2025.

[525] ibid.

[526] ibid 64.

[527] Bank for International Settlement - Committee on Payment and Settlement Systems, 'Core Principles for Systemically Important Payments Systems' (2001) 29-30, < https://www.bis.org/cpmi/publ/d43.pdf> accessed 12 September 2025.

in the transaction, financial turmoil or crisis, the settlement remains intact and cannot be reversed.[528]

6.27. The implementation of finality settlement helps to achieve the central bank's mission of achieving a safe and efficient settlement. For instance, the BoE stated that settlements conducted in their RTGS and CHAPS are final, and this finality should be the lowest risk way for financial institutions to meet their payment obligations.[529]

6.28. Any systems that facilitate the clearing, settlement, and recording of monetary and other financial transactions play a critical role in maintaining financial stability. Thus, these systems must also comply with the Principles for Financial Market Infrastructures created by the Committee on Payment and Settlement Systems and the Technical Committee of the International Organisation of Securities Commissions. Principle 8 addresses settlement finality, where under this principle, the systems must have rules and procedures that clearly define settlement finality so that they ensure a clear and certain final settlement no later than the end of the value date, preferably intraday or in real-time.[530]

6.29. For European Union members and the UK, an example of the principle of settlement finality can be seen in Directive 98/26/EC of the European Parliament and of the Council of 19 May 1998 on Settlement Finality in Payment and Securities Settlement Systems.[531] Although this Directive applies to the settlement of securities, including commodity derivatives, certain principles regarding settlement finality are also important. For example, this system involves more than three participants, and the rules and agreements must be established for executing transfer orders among participants.[532] These rules and agreements are also needed for the CBDC system. This system should be governed by the law and formally designated as such. Once determined by the rules of the system, a transfer order cannot be recalled or cancelled by a participant within the system, including any third parties. DLT, as a possible technology employed in CBDC, would also apply this protocol, where a transfer order should not be recalled or cancelled once it is executed unless certain circumstances occur.[533]

6.30. In Indonesia, the finality of settlement in the existing payment system is regulated under Regulation of the Member of the Board of Governors of Bank Indonesia No 20/15/PADG/2018 on Fund Settlement through BI-RTGS and its amendment. If CBDC is adopted into the financial system, settlement finality in CBDC transactions should be regulated in a specific regulation to accommodate the principles discussed in paragraphs

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[528] Henri Pages and David Humphrey, 'Settlement Finality as a Public Good in Large-Value Payment Systems' (2005) 6 < https://papers.ssrn.com/sol3/papers.cfm?abstract_id=750786 > accessed 12 September 2025.

[529] Bank of England, 'Real-Time Gross Settlement (RTGS) System and CHAPS Annual Report 2021/2022' (2022) < https://www.bankofengland.co.uk/report/2022/rtgs-and-chaps-annual-report-2021-22> accessed 19 March 2025.

[530] Principle 8 of Principles for Financial Market Infrastructures. See Bank for International Settlement - Committee on Payment and Settlement Systems, 'Principles for Financial Market Infrastructures,' (n 518) 64.

[531] Directive 98/26/EC of the European Parliament and of the Council on Settlement Finality in Payment and Securities Settlement Systems [1998], art 5. This Directive has been amended five times, lastly in June 2019.

[532] ibid, art 2.

[533] This is important to guarantee legal certainty in payment using CBDC.

6.28 and 6.29. Besides incorporating those principles, the regulation should also define settlement finality in CBDC transactions and outline the technical procedures for processing the transaction and achieving settlement finality, especially when CBDC is designed to operate offline. Defining settlement finality would be the anchor in determining the moment of settlement finality for CBDC transactions, especially for offline CBDC that may have a variety of designs. The legal functions for settlement finality and mechanisms in offline CBDC transactions, including their variety of designs, are explored in the later paragraphs.

Finality of Settlement under Private Law

6.31. The discussion under private law concerning settlement finality of funds in a traditional payment system mostly deals with the moment of finality and also the legal process of transferring title or ownership of funds in a system, and determining when the proprietary interests of those funds are passed from one party to another.[534] This discussion explores the points of settlement finality in transactions of incorporeal money, as well as the legal title of such money before and after the settlement in the traditional payment system.

6.32. Funds in a traditional payment system are viewed as incorporeal money, and their transfer occurs when there is an adjustment of the debt liabilities owed by the parties' banks to the payer and recipient.[535] The transfer is initiated by the transfer instruction of the payer and followed by the settlement by the banks by adjusting the ledgers or accounts of the payer and the payee.[536]

6.33. Settlement finality should be strictly implemented regardless of any concerns from the relevant parties. For instance, the strict implementation of settlement finality should persist even in cases where a bank holds a doubt concerning the legitimacy of a payment transfer.[537] In *Tayeb v HSBC Bank Plc*,[538] the court found the bank liable for reversing the transfer due to its suspicion regarding the transaction. The bank should have adhered to the finality rules in CHAPS payment, according to which it must achieve finality in the accounting position between the payer and payee. However, under the Payment Services (Amendment) Regulations 2024, banks and other payment service providers may delay the payment if there are reasonable grounds to link the transactions to fraud or dishonesty by a person other than the payer.[539] When such a delay occurs, banks must then notify the payer of any information or action required of the payer to enable the banks to decide whether to execute the payment.[540] This regulation aims to delay suspicious authorised push payment fraud transactions and enable the service providers to investigate the suspected scams.

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[534] Hossein Nabilou, 'Probabilistic Settlement Finality in Proof-of-Work Blockchains: Legal Considerations' (2022) < https://pure.uva.nl/ws/files/189148826/ssrn-4022676.pdf > accessed 12 September 2025.
[535] Fox, *Property Rights in Money* (n 20) para. 1.100-1.104.
[536] ibid.
[537] ibid para. 5.57; See *Tayeb v HSBC Bank Plc*. [2004] EWHC 1529 (Comm), [2004] 4 Ell ER 1024.
[538] *Tayeb* (n 537).
[539] Payment Services (Amendment) Regulations 2024, Regulation 86.
[540] ibid.

6.34. The settlement may not be considered final if the following circumstances occur: an unauthorised transaction or an incorrectly executed payment transaction. Under the Payment Services Regulations 2017, for transactions where the payer is unaware, or the payment has not been authorised, the payer or payment service user has the right to seek redress by notifying the bank or payment service provider.[541] Similarly, if the payment service user or payer mistakenly submits payment orders to an incorrect account, they also have the right to redress, which includes refunding the amount of the unauthorised payment to the payer.[542]

6.35. For CHAPS payment, the fund as incorporeal money or commercial bank money can be processed in the RTGS system if the banks register as direct participants and hold a sterling settlement account at the central bank, which the central bank has agreed may be used for the purpose of settling CHAPS payment obligations. The ownership of the payee's money is represented by the record of debt owed to them by the bank, which is the balance in their account.[543]

6.36. The payment mechanism and settlement finality also rely on the system and the type of account registered. Regarding the account holders for CHAPS payment, the eligibility to possess accounts within the RTGS system is limited to commercial banks and certain financial institutions as direct participants. Only these parties can hold such accounts, known as the reserve account, at the BoE for maintaining reserves or settling net obligations from the payment system, which can also be used as a 'settlement account'.[544] In contrast, non-bank payment service providers can hold settlement accounts to facilitate settlement within the RTGS system by utilising the accounts held by direct participants. In the RTGS system, balances in accounts can be used to transfer money in real-time between holders, and such a transfer is a final and risk-free settlement. The mechanism of settlement for these accounts is important to understand, as the discussion will be linked to the context of settlement finality, particularly for offline CBDC for retail payment, as explored in the later paragraphs.

III. Legal Functions of Finality of Settlement in CBDC Transactions

6.37. Settlement finality is vital within the payment system and equally important for CBDC transfers or payments made using CBDC, where time is a crucial factor. Regardless of the system used for processing CBDC, the legal function of settlement finality in CBDC transactions should align conceptually with that in the traditional funds transfer.

6.38. Settlement finality for CBDC transactions serves at least three legal functions. First, it gives legal certainty on the CBDC payment, allowing the payee to execute his rights to use funds received in his account as payment, thus determining whether the payer's monetary obligations can be fully and unconditionally discharged. Second, it offers legal certainty to the involved participants in the system by ensuring the irrevocability and

[541] Payment Services Regulation 2017, s 74.
[542] ibid s 76.
[543] Fox, *Property Rights in Money* (n 20) para. 5.52.
[544] See Article 4.1 of CHAPS Reference Manual published by the Bank of England in January 2023.

finality of transfer orders and settlement within the CBDC system, especially when such orders originate from a payer facing insolvency or liquidity issues. Last, it serves as a protective measure to shield the central bank as a settlement agent or other parties as intermediaries from being exposed to risk or liability stemming from account holder issues if the transaction is not deemed as final. These legal functions are elaborated in detail as follows.

6.39. First, settlement finality assures the legality of payment using CBDC, so the payee can enjoy the unconditional right to the immediate use of CBDC credited to their account, meaning that there is legal certainty whether such payment by the payer has legally discharged their debts. In *The Brimnes*, the Court of Appeal acknowledged that the payment was considered effective or good payment if it allowed the payee to exercise such an unconditional right.[545] Furthermore, the payee must be able to reach a point where they could either withdraw physical cash or its equivalent.[546] Under English law, a payment with funds transferred to the payee is considered fulfilled when the payee's bank has the payer's actual or apparent authority both to receive and accept the transfer of funds on the payee's behalf.[547] To establish a complete payment, the payee, as a creditor, must accept the payer's tender of money.[548] The bank where it holds the payee's account does not have the authority to accept the payment in the discharge of the debt because such acceptance depends on the authority of the payee as an account holder.[549] After accepting the tender, the payee then discharges the payer's monetary obligation by granting a legal and partial equitable title to the payer in accordance with the specified terms of the contract.[550]

6.40. The same principle of tender by the payer and acceptance by the payee should also apply to CBDC transactions. The CBDC payment will be regarded as completed once the payer makes a tender with CBDC, which the payee then accepts as payment that discharges the payer's debt. A complete payment using CBDC is then shown by the updated ledgers of the payee and the payer, reflecting the transfer and acceptance of CBDC, where this shows that the settlement is final. Settlement finality plays a crucial role in determining whether the CBDC payment made by the payer is accepted by the payee, thus granting the payee complete rights to their money within the digital wallet or account.

6.41. Second, settlement finality offers legal certainty to the parties involved in the transfer of CBDCs during the insolvency process. In the traditional payment system, once transfer orders are entered into the system, they cannot be revoked or interfered with during insolvency proceedings faced by troubled banks or parties, including instances where

[545] Proctor, *Mann and Proctor on the Law of Money* (n 47) Par. 7.30; See *The Brimnes* [1975] QB 929, 948 and 963; and *The Brimnes* [1973] 1 WLR 386.
[546] ibid.
[547] See *Laconia* and Ellinger and others, *Ellinger's Modern Banking Law (*5th edn, Oxford University Press, 2011) 642.
[548] Fox, *Property Rights in Money* (n 20) par. 1.99.
[549] Ellinger and others (n 49) 640.
[550] Fox, *Property Rights in Money* (n 20) par. 1.99.

insolvency occurs to a foreign participant.[551] Regarding insolvency proceedings, 'zero-hour' rules apply in some countries, where an insolvent party loses its legal capacity from the moment the insolvency decision is handed down. Under 'zero-hour' rules, any transactions carried out by an insolvent institution after midnight on the day it is officially declared insolvent are automatically rendered legally void or ineffective by operation of law.[552]

6.42. If the rules above are applied to CBDC transactions without implementing settlement finality, any transfer orders initiated by the payer should be considered void or voidable or potentially reversible if such a transfer takes place during the first hour of the day of insolvency of the payee and the moment it is declared insolvent. This creates significant legal uncertainty for parties involved in the system. Any transfer orders, settlements, or redemptions made by the central bank as settlement agents and intermediaries may not be legitimate. Because these processes made on the insolvency day are not final, they result in the reversal of the transfer of CBDC, but in the context of law rather than the technical system. The payment may not be reversible at all once it is added to the blockchain. Such a reversal may also cause disruption because the payee would be restricted from enjoying their unconditional rights to use the CBDC credited to their account, including redeeming the CBDC and transferring it to other parties/participants in the system. The recipient would incur an additional obligation to reverse the initial transfer.

6.43. Moreover, in the absence of the implementation of settlement finality, the transfer orders that were processed and the settlement initially believed to be final may have already established specific net position balances for the payer as a participant, which could affect the balances for other parties/participants.[553] Similar to funds transfers, the reversal of CBDC would necessitate a recalculation of all net positions, possibly resulting in adjustments to the balances of the affected parties/participants.[554] The circumstances might be more complicated if the payee has redeemed the CBDC after it is credited to the account holders. Therefore, the implementation of the finality of settlement principle would be crucial in exempting the 'zero-hour' rules and thus provide legal certainty for the parties involved either to process the transfer of CBDC or for the payee to enjoy their rights to use CBDC.

6.44. Third, settlement finality prevents parties involved in CBDC transactions, such as central banks as settlement agents or banks as intermediaries, from being exposed to risk or liability related to account holders. This risk or liability may manifest as the potential loss of funds held in or transferred between accounts maintained with the central bank

[551] This is the purpose of the issuance of the Settlement Finality Directive as stated in Paragraph 2 of Article 3.1 of Directive 98/26/EC of the European Parliament and of the Council of 19 May 1998 on Settlement Finality in Payment and Securities Settlement Systems; See European Commission, 'Summary Report of the Targeted Consultation on the Review of the Directive on Settlement Finality in Payment and Securities Settlement Systems' (2021) 3 < https://finance.ec.europa.eu/system/files/2023-06/2021-settlement-finality-review-summary-of-responses_en_0.pdf > accessed 12 September 2025.

[552] See Bank for International Settlement - Committee on Payment and Settlement Systems, 'Principles for Financial Market Infrastructures' (n 524) 23.

[553] ibid 17.

[554] ibid.

as a settlement agent or intermediary.[555] In traditional fund transfers, when the settlement takes place as expected, the payment service providers or banks can credit the funds in the payee's account. In this circumstance, the risk or liability of the settlement agent or intermediaries is transferred to the account holder, who is the owner of the funds. The concept of settlement finality should be analysed as the substitution of the payer's obligation with the obligation of the settlement bank, which the payee's bank that maintains the settlement figures on its books.[556] In this context, the finality of settlement has a legal function to protect relevant parties involved in the transfer and settlement from any risk and liability and, thus, legally transfer such risk and liability to the recipient of CBDC.

IV. Legal Analysis on the Finality of Settlement in Offline CBDC

6.45. As discussed earlier, settlement finality occurs when the payment is credited to the payee's account and is deemed final at the time the payee receives it. At this point, the payee has full and unconditional rights to use the funds received.[557] This is an ideal condition commonly observed in existing payment systems or fund transfers, which also applies to online CBDC transactions. The online design enables CBDC to be used for remote usage with the support of internet access, such as accommodating online purchases, and its settlement process requires a connection to a third party for validation or recording. In online CBDC transactions, both payment and settlement take place subsequently or almost at the same time, supported by network or internet connectivity.

6.46. Noting that the nature of the finality of settlement in online CBDC would resemble the existing fund transfers, the following section focuses on settlement finality in offline transactions, specifically through the use of token-based CBDC for retail transactions. It elaborates on the concepts of payment and settlement in offline CBDC, analysing the sequence and timing of the transaction using a variety of offline designs. Understanding these fundamental concepts is pivotal in establishing the legal principles of settlement finality in CBDC payments during offline transactions.

A. Designs in Offline CBDC

6.47. A token-based CBDC for retail transactions can be configured to support online and offline payment. The primary difference between these models is their dependence on internet connectivity. Each model involves a distinct settlement process. The online design enables CBDC for remote usage with the support of internet access, and its settlement process requires a connection to a third party for validation or recording. For this to happen, both payment and settlement processes occur online using the support of networks or the internet.

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[555] Bank of England, 'Payment and Settlement' (2023) < https://www.bankofengland.co.uk/payment-and-settlement > accessed 12 September 2025.

[556] Geva, 'Settlement Finality and Associated Risks in Funds Transfers - When Does Interbank Payment Occur' (n 514) 41.

[557] Bank for International Settlement - Committee on Payment and Settlement Systems, 'Core Principles for Systemically Important Payments Systems' (n 527) 29-30.

6.48. In contrast, the offline CBDC is intended to behave like cash as a bearer payment instrument that operates without relying upon connection to the ledger system.[558] Nonetheless, in some designs of offline CBDC, while payment can still be made offline, a connection is still needed to ensure the finality of settlement at the last stage of the transaction.

6.49. In general, there are three different designs for offline payment using CBDC, namely fully offline, intermittently offline, and staged offline,[559] as explored in detail in the following paragraphs.

Fully Offline, Intermittently Offline and Staged Offline

6.50. In the fully offline design, the payment can be completed without the need for connectivity, allowing immediate exchange of value upon completion of the transaction, independent of any connection to the central ledger.[560] The settlement is conducted locally between the devices, as it does not need any third party to authorise or record the transaction. In this design, settlement finality takes place offline as the recipient has the full right to utilise the funds after they receive them.[561] Furthermore, any offline payments cannot be recorded by the central ledger except for top-ups and deposits from offline wallets.[562] This design does not require an online connection for its settlement.

6.51. For intermittently offline design, similar to the fully offline mode, the payment and exchange of value between wallets can occur offline.[563] However, this design is intended for temporary internet unavailability, requiring the payer or the payee to reconnect to the online system before continuing with the next transactions, especially after it reaches a set number of transactions or a certain amount of time spent offline.[564] This connection must be established with the central ledger to enable wallet synchronisation and proper functioning.[565] For this design, the settlement is considered pending until the internet connectivity resumes and the ledger is updated; therefore, the funds received by the payee cannot be used until the device is connected to the internet.[566] However, some argue that both payment and settlement for this design occur offline, where the funds received by the payee can also be utilised offline after reaching a certain amount of time.[567]

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[558] BIS Innovation Hub, 'Project Polaris: Part 1: A Handbook for Offline Payments with CBDC' (2023) 18 <https://www.bis.org/publ/othp64.pdf> accessed 12 September 2025.
[559] ibid 12 and 22.
[560] ibid 22 and 23.
[561] Cyrus Minwalla and others, 'A Central Bank Digital Currency for Offline Payments' 2023 < https://www.bankofcanada.ca/2023/02/staff-analytical-note-2023-2/#:~:text=An%20intermittent%20offline%20CBDC%20system,augments%20an%20online%20CBDC%20solution > accessed 12 September 2025.
[562] BIS Innovation Hub (n 558) 35.
[563] ibid 22-23.
[564] ibid 12.
[565] ibid.
[566] Minwalla and others (n 561).
[567] BIS Innovation Hub (n 558).

6.52. In the staged offline design, the payer and the payee can conduct transactions offline, but the settlement of this transaction occurs when the payee connects to the central ledgers.[568] After the payment, the funds are received by the payee, but they are unable to exercise their rights over the received funds until settlement finality occurs in the second phase.[569] Settlement finality takes place online because the settlement requires a connection to the central ledgers. Despite settlement finality occurring after the payment and acceptance of funds by the payee, it can be assumed that the debt between the payer and the payee is discharged.

6.53. Devices used for offline payment can vary depending on the scenarios and designs of offline payment. For example, if the jurisdiction is a developed country that prioritises privacy, offline devices can take the form of smartphones and cards, as these devices are not linked to user identity.[570]

6.54. However, the implementation of offline CBDC may vary depending on the underlying technology used in the transactions. Transactions with offline CBDCs can be completed through devices or instruments such as cards. For instance, the Digital Euro can be designed to operate offline, allowing for local settlements between devices. This offline functionality of the Digital Euro operates a pre-funded system to facilitate local settlement among devices. This system would require the secure storage of a specified Digital Euro with a certain holding limit per device. Within this pre-funded framework, individuals allocate a specific sum from their digital euro payment accounts onto their local storage devices for them to transact with it.[571] Moreover, individuals lacking access to bank accounts or digital devices can transact with Digital Euros via a card issued by a public body such as a post office.[572]

B. Timeline of the Payment, Settlement and Finality of Settlement in Offline Transactions

6.55. Elaboration on the sequence of payment, settlement and finality of settlement in offline transactions for CBDC is needed to observe the timing of this sequencing to determine that the transaction is final, irrevocable and unconditional. Understanding these sequences is pivotal in establishing the legal principles of settlement finality in CBDC payments. Some argue that settlement in funds transfer is a subsequent stage following the payment, while others contend that settlement encompasses the entire payment and transaction process, including recording the transaction. Therefore, a strict categorisation of payment and settlement might not always be possible in some countries, which is understandable.

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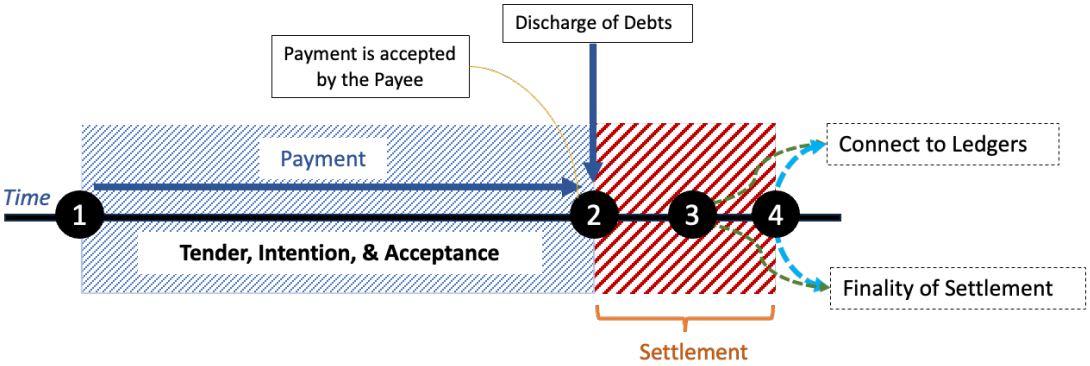
[568] ibid 22-23.
[569] ibid.
[570] BIS Innovation Hub (n 558) 29.
[571] European Commission, 'Proposal for a Regulation of the European Parliament and of the Council on the Establishment of the Digital Euro' (2023) 35 < https://eur-lex.europa.eu/resource.html?uri=cellar:6f2f669f-1686-11ee-806b-01aa75ed71a1.0001.02/DOC_1&format=PDF > accessed 12 September 2025.
[572] European Central Bank, 'The Digital Euro: A Digital Form of Cash,' (2023) 6 < https://www.ecb.europa.eu/press/key/date/2023/html/ecb.sp231117_1~cbdafd0d7c.en.pdf?8964b14201ceca7554e61e7b6c4e3f8e> accessed 12 September 2025.

6.56. Based on the offline transaction concept discussed earlier, a simplified illustration can be drawn, perhaps overly simple, depicting the general sequence of payment, settlement and settlement finality in offline CBDC transactions as follows.

Figure 6. Sequence in Offline CBDC Transactions



(source: Author)

6.57. In Figure 6, the CBDC transaction is initiated by the payer providing a payment order, which could be done on various forms of devices or technology. The validity of a payment relies on the payer's tender, a clear intention that the payment should discharge the debts, and the acceptance of this payment by the payee depicted in the blue area. The payment's completion in the system indicates the fulfilment of the payer's monetary obligations, known as the finality of *payment*. Following the payment process, the settlement in the banking system occurs, shown in the red area, in accordance with the payment system's rules, mechanisms, and any applicable technological requisites.

6.58. For online transactions where the ledgers are connected to the network, the settlement happens instantaneously at the same time or immediately after the payment, where, in this circumstance, the adjustment of the ledger can occur. Thus, the finality of the settlement also takes place instantaneously or immediately after the payment, showing that the transaction is final, unconditional and irrevocable. In Figure 6, steps 1–4 occur instantaneously or in rapid succession. The online transaction shows the ideal condition of the finality of settlement as shown in the current form of funds transfer through the commercial bank, where settlement finality is reached when the accounts of both the payer and payee are adjusted, entitling the payee to fully enjoy his right of funds transferred to his account.

6.59. The occurrence of settlement finality in offline transactions, however, can be complex, depending on the design, as explained earlier.[573] For fully offline transactions, both payment and settlement occur offline and thus, settlement finality also occurs offline. In intermittently offline transactions, designed for temporary outages, the payment and settlement also occur offline, where settlement finality can also be achieved offline. However, after reaching certain limits, reconnection is required for the devices to keep

[573] See paras 6.45-46.

operating. For both designs, settlement finality occurs offline, where the payee can utilise the received funds and use them for the next transactions.

C. Finality of Settlement in Offline CBDC Transactions

6.60. In offline transactions, some payments can be made offline, but the settlement happens at a later stage when the system or device is connected to the network. As a consequence, settlement finality is also delayed until the connection is restored. This is known as staged offline settlement of the CBDC owing to the time gap between payment and settlement. The analysis will focus on when the payment from the payer can discharge his debts and when the payee can use the received funds for the next transaction.

6.61. In this design, at the stage where the payer initiates a tender, it does not immediately constitute a payment to the payee that can discharge the payer's debts, as the funds have not yet been received. Therefore, the payment is not yet final. Settlement is only achieved once the system reconnects to the internet, at which point the payee receives the funds and can exercise their rights over them. This marks the completion of the second phase, during which settlement finality is achieved.[574] In the traditional payment system, this concept may resemble conditional payment, where tender has been made, but the payment is completed once a specific condition is met. In the CBDC transactions, this condition occurs when the devices reconnect to the network and the payee receives the funds.

6.62. An example of a staged offline mechanism in CBDC transactions is shown in the following paragraphs, which show when the payment is made, when settlement occurs, and when settlement finality is achieved.

1. Example of Mechanisms for Offline CBDC

6.63. In the discussion that follows, an example of offline CBDC payment methods is drawn from the e-Krona project, where payments were trialled using various means, including a mobile phone and a card facilitated by a point-of-sale (PoS) terminal linking to the network. This mechanism can be seen as a staged offline payment. In general, the project uses a permissioned DLT as an underlying technology. The technology enables money to be stored online within the network and offline, securely stored locally on users' mobile phones or cards.

6.64. Using the example of the e-Krona project, it is technically feasible for an offline CBDC to be transacted on a mobile phone through an application and a card-based payment system requiring a card as a user device that can interface with a PoS terminal.

[574] BIS Innovation Hub (n 558) 23.

6.65. The mechanism for offline CBDC payment through a mobile phone can be summarised as follows.[575] Users can add funds to their mobile apps by requesting a top-up from the online network. Once the tokens are added to the mobile phone, they are registered as consumed tokens within the CBDC network through certain technology, namely unspent transaction output (UTXO). When a transaction is created, tokens become spent or consumed, and the other tokens that are not consumed are marked as output, which can be used in the future. The user's mobile application then stores these tokens locally on the mobile phone, enabling offline transactions by transferring them to other devices facilitated by near-field communication (NFC) technology. The offline functionality in CBDC is performed by transferring tokens and validating transactions from the participant's node in the CBDC network to the user's mobile application. The settlement then occurs online when the transaction is synchronised with the CBDC network and the notary node.

2. Payment Mechanism in the First Phase

6.66. The tender is performed by the payer when the token is transferred to the payee using NFC technology. The legal nature of the tender made by this token may be similar to a cheque, where settlement may happen at a later time. Cheque or 'check' payments are classified as paper-based funds transfer systems. These paper documents function payment instruments that are physically delivered from one bank to another and undergo a clearing process within a designated clearing system, such as the cheque clearing system or credit clearing system in the UK.[576] A cheque is defined as an unconditional order to pay a fixed amount of money, payable on demand and drawn on a bank.[577] The cheque establishes a legal entitlement for the payee to claim a sum of money. In other words, the cheque can be viewed as an authorisation to the drawer's bank to debit its account and as a means of payment in itself.

6.67. In the concept of conditional payment, the acceptance of a cheque by the payee should not automatically discharge debts.[578] The payee retains the right to enforce the payment on the original debt if the cheque from the payer is dishonoured.[579] Therefore, in the context of this offline CBDC, the transfer of tokens by the payer does not automatically discharge their debts to the payee until the settlement and finality of settlement are achieved.

3. Settlement Mechanism in the Second Phase

6.68. Further discussion in the next phase, after the payment, is the settlement. In the existing payment system, a settlement can be a provisional or final. Under the Uniform

[575] Sveriges Riksbank, 'E-Krona Pilot Phase 2' (2022) 17-20, < https://www.riksbank.se/globalassets/media/rapporter/e-krona/2022/e-krona-pilot-phase-2.pdf > accessed 12 September 2025.
[576] D Fox and others, *Sealy's and Hooley's: Commercial Law Text, Cases and Materials* (6th edn, Oxford University Press 2020) 675-677.
[577] Benjamin Geva, 'Liability on a Cheque: A Legal History' (2016) 12 (9) Osgoode Legal Studies Research Paper Series, 12 < https://digitalcommons.osgoode.yorku.ca/olsrps/159/ > accessed 12 September 2025.
[578] Hugh Beale, *Chitty on Contracts* (35th edn, Vol 1, Sweet and Maxwell 2022) para 25-073.
[579] ibid.

Commercial Code (UCC), a set of rules and regulations that govern commercial transactions in the US, to 'settle' means 'to pay in cash, by clearing house settlement, in charge or credit or by remittance, or otherwise as agreed. A settlement may be either provisional or final'.[580] Settling transactions under the UCC can be done through a settlement system, such as a clearing house settlement, a remittance, or other agreed-upon mechanisms. For funds transfer via the banking system, a settlement may also be interpreted to cover all methods of payment in the discharge of an interbank obligation in the system.[581] The completion of settlement is based on the rules of a funds transfer system that offsets obligations among multiple participants.[582]

6.69. In the current bank payment system, a settlement may be performed immediately or at a later time due to the obligation that needs to be fulfilled by one or more parties. For the latter, this might be similar to 'provisional settlement', where the European Central Bank defines provisional settlement as the fulfilment of obligations through the transfer of funds or securities, depending on specific conditions that one or more parties could rescind.[583] If such conditions are not fulfilled, then the funds transfer may be cancelled or reversed. For CBDC transactions, a settlement should not be provisional, and the payment should be considered final in the first phase, even though it is offline. In any circumstances that prevent CBDC settlement from being achieved, then there should be an option to cancel or reverse the transfer of tokens in the first phase.

6.70. Ideally, the technology employed in the offline CBDC should be able to guarantee to that the settlement can occur in the second phase, as well as prevent issues like double-spending that may result in insufficient funds once the systems are connected to the ledgers. This also means that the central bank should guarantee the finality of payment in offline CBDC transactions in the first phase, although the connection to the network still needs to be achieved in the next phase.

6.71. When designing an offline CBDC, especially for staged offline systems, the central bank would want to consider a time limit for settlement to occur. Such a limitation is important to give certainty to the payer that his funds have been transferred to the payee, allowing for the immediate discharge of his debts. Consequently, the payer can only use the remaining funds available on their device. Determining the settlement time limit assures the payee that their debts have been paid, and thus, they can use the funds received by the payer. Such a limitation of time also protects the central bank or parties involved in the CBDC system by ensuring they are not held accountable for unsettled transactions, particularly in cases where interest calculations are applied to those debts.

6.72. An example of the time of settlement for current payment media is outlined in the UCC:

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[580] See U.C.C §4-104 (a) (11).

[581] See Benjamin Geva, 'Payment Finality and Discharge in Funds Transfers' (2008) 83 (2) Chicago-Kent Law Review, 653 < https://scholarship.kentlaw.iit.edu/cgi/viewcontent.cgi?article=3669&context=cklawreview > accessed 12 September 2025.

[582] See U.C.C §4A-403 (b); See Geva, 'Payment Finality and Discharge in Funds Transfers' (n 581) 652.

[583] European Central Bank, 'Glossary of Terms Related to Payment, Clearing and Settlement Systems' (2009) 22, <https://www.ecb.europa.eu/pub/pdf/other/glossaryrelatedtopaymentclearingandsettlementsystemsen.pdf> accessed 12 September 2025.

'a. Related to cash, a cashier's check or teller's check, is when the cash or check is sent or delivered;
b. Related to credit in an account in the Federal Reserve Bank, is when the credit is made;
c. Related to credit or debit to an account in a bank, is when the credit or debit is made or, in the case of tender of settlement by authority to charge an account, when the authority is sent or delivered; or
d. Related to a funds transfer, the time of settlement is when payment is made pursuant to section 4A-406(a)[584] to the person receiving settlement.'[585]

This provision shows that the time of settlement can be set to provide legal certainty on the settlement. However, for offline CBDCs, another approach might be taken, such as setting a maximum settlement time that can range from a few hours to days, depending on the amount of funds transferred. If the system fails to reconnect within this timeframe, then the offline payment should be cancelled.

4. Achieving the Finality of Settlement

6.73. Immediately after the settlement is made, the acceptance of tokens in the payee's device in accordance with the payer's instruction should be viewed as a discharge of the payer's monetary obligation. This is similar to the completion of a funds transfer or the finality of payment in the banking system, which is typically regarded as completed once it reaches the destination bank, according to the payment instructions.[586] The only exception, which must be rare, would be when the payee rejects the payment. Under English law, unaccepted payment to the payee will not release the payer from its obligation nor qualify as a valid payment.[587] If this non-acceptance payment happens despite the payer having made the tender as agreed, the payee should be responsible for any delay in the payer's performance. Moreover, the payee is deemed to have accepted the payment when the payee treats the transferred funds as their own and does not take any steps to reject the transfer within a reasonable timeframe after becoming aware of the incoming transfer.[588]

6.74. After the payee receives the funds, they should be able to exercise their unconditional rights to use such funds, as discussed in *Brimnes* and explained in paragraph 6.39. The central bank, as the governing body responsible for regulating CBDCs, may want to establish legal measures that guarantee the payee's ability to immediately use the CBDC once it is connected to the ledgers.

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[584] Under U.C.C §4A-406 (a), it is stated that 'the originator of a funds transfer pays the beneficiary of the originator's payment order (i) at the time a payment order for the benefit of the beneficiary is accepted by the beneficiary's bank in the funds transfer and (ii) in an amount equal to the amount of the order accepted by the beneficiary's bank, but no more than the amount of the originator's order'. This implies that the payment ha ppens when the payer pays the payee at the time a payment order is accepted by the payee's bank in the funds transfer, matching with the specified amount in the payer's payment order.

[585] See U.C.C §4-213 (2).

[586] Geva, 'Payment Finality and Discharge in Funds Transfers' (n 581) 637.

[587] Proctor, *Mann and Proctor on the Law of Money* (n 47) 181.

[588] ibid 186.

6.75. However, compared to fully offline and intermittently offline CBDC transactions, the acceptance of funds in the payee's device and the settlement occurring offline should immediately discharge the payer's monetary obligation to the payee. In both designs, the payee can utilise funds offline. In an intermittently offline design, the connection to the network should not hinder the payee's ability to utilise the received funds, and such a connection should be viewed as a technological necessity rather than a legal requirement.

V. Conclusions

6.76. Determining the moment of settlement finality in CBDC transactions is essential from a legal perspective, as it gives legal certainty to parties involved in the transactions, ensuring the irrevocability and finality of fund transfers. Besides giving the payee full and unconditional rights to use the funds received from the payer, settlement finality also protects the parties involved from being exposed to legal risk or liability arising from the time gap between the payment and settlement.

6.77. The time gap between payment and settlement is a critical factor affecting the legal analysis of settlement finality in both online and offline transactions using CBDC. In online transactions, where network connectivity is available, the payment and settlement can occur simultaneously or nearly at the same time. As a consequence, settlement finality can be achieved immediately or almost instantly. In this ideal condition, once the payee receives the funds from the payer, the payer's monetary obligations or debts are discharged, and the payee can utilise the funds without delay.

6.78. For offline transactions, payment can be made offline without the need to reconnect to the network. However, the settlement, including the finality of the settlement, may occur offline or at a later time after the systems reconnect to the network, depending on the designs and technology employed. Regardless of the designs of offline payment, the offline transaction is considered final and irrevocable once the payee receives the funds from the payer and can immediately use such funds.

6.79. The finality of settlement in CBDC transactions must be regulated specifically to give legal certainty for participants involved in the transactions, especially to determine the exact time at which the payer has discharged his obligations and the payee has acquired the rights to use the transferred money. The regulations on settlement finality in CBDC transactions should at least cover functions of settlement finality, key principles in settlement finality for online and offline transactions, momentum of the finality of settlement according to the designs of CBDC.

CHAPTER 7

PROPRIETARY RIGHTS IN AN ACCOUNT-BASED CBDC

I. Introduction

7.1. The discussion on settlement finality in CBDC transactions from the previous chapter explains when CBDC transactions are considered final and irrevocable. This finality determines the moment when the payer discharges their debts, and the payee is entitled to their unconditional rights to use the funds received in their accounts. Building on the analysis of the parties' rights in CBDC, the next two chapters scrutinise the legal aspects of CBDC from a perspective of personal property.

7.2. In the earlier discussion, it was seen that CBDC can take the form of an account-based and token-based system.[589] When discussing CBDC as an object, an account-based CBDC is analytically different from a token-based system since an account-based CBDC does not have elements of a digital object or a digital token. This chapter provides a general analysis of proprietary rights in CBDC, focusing on personal rights in an account-based CBDC, both in wholesale and retail payments. It also highlights the importance of regular accounts in determining the legal rights of the CBDC holders, especially in the context of CBDC transfers. The proprietary rights of token-based CBDC will be explored in Chapter 8.

7.3. The different approaches to analysing the proprietary rights in CBDC reflect the differences in the technical architectures of CBDC systems as kinds of central bank money. The analysis in this chapter shows that, in general, the rights in CBDC consists of mixed

[589] See Chapter 2.

statutory and contractual rights, enforceable against both central banks and intermediary entities. Arising from the contractual rights of the holders with the entities involved, these rights cover the right to payment of central bank money in other forms, enforceable against either the central banks or intermediaries, and the right to services related to accounts, enforceable against the entities managing the accounts.

7.4. Regarding the transfer of account-based CBDC from one holder to another, the existing principle of transferring commercial bank money applies, whereby the transfer is executed through the adjustment of the balance of the accounts between the payer and the payee.[590] However, additional legislation would be needed to ensure the rights of CBDC holders provide for the proprietary rights of CBDC holders in account-based CBDC transactions, particularly when CBDCs are transferred to a new holder.

7.5. The discussion in this chapter begins by providing an overview of CBDC as an object of property before exploring an account-based CBDC by examining the existence of financial accounts in such a system and their functions as proof of ownership. In the discussion, a transaction of an account-based CBDC would rely on the presence of financial accounts held at the central bank, commercial banks, or other institutions, depending on the design of the CBDC. Allowing for the variety of designs of CBDC, this chapter also gives illustrations of possible schemes in CBDC transactions and analyses the scope of proprietary rights using these illustrations.

II. Features of CBDC as an Object of Property

7.6. Depending on its design, CBDC can be used for wholesale or retail payment. Regardless of its purpose, CBDC exhibits at least two common features: it has a fully digital composition, and its holders have the right to enforce claims against the central bank, either directly or through intermediaries. These common features, at the very least, need to be considered in determining the status of CBDC as property.

7.7. Understanding various designs of CBDC is important before determining and scrutinising the scope of individual rights associated with CBDC as property. This involves determining whether CBDC is intended for wholesale or retail use, as well as whether retail CBDC involves direct or indirect claims against the central bank as issuer. Such designs are tailored to meet the specific needs or policy objectives of the central bank in issuing CBDC.

7.8. For transactional purposes, CBDCs can be designed for wholesale payment so that they are available only for financial intermediaries, and for retail payment, where they are intended for wider public usage.[591] Wholesale CBDCs may exhibit traits more akin to central bank money in reserve accounts, which are only available to financial institutions.[592] Meanwhile, retail CBDCs have functions similar to legal tender money and characteristics of traditional fiat money available to the public. Given this resemblance, the latter type has essential aspects to explore from the property view.

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[590] Fox, *Property Rights in Money* (n 20) para 1.100.
[591] Bank for International Settlements, 'BIS Annual Economic Report 2021' (n 22) 65.
[592] See para 2.38.

7.9. CBDC exists solely in a digital form, where its behaviour as property differs from traditional fiat money, while fiat money takes a tangible form of banknotes and coins. A CBDC is called 'digital' or 'electronic' because it is represented on a computer or similar device[593] and denominated in the national unit of account. It is a direct liability of the central bank.[594] It is an intangible thing that would need a supporting infrastructure, including systems to process it.[595] Furthermore, since it exists in digital form, all types of CBDC would require an infrastructure operating a core ledger, allowing a central bank to issue, redeem and settle CBDC. It would also require infrastructures in intermediaries enabling the processing of payment messages, reconciliation and interaction with the core infrastructure.[596]

7.10. Claims associated with CBDC can be enforced against the central bank as the issuer, either directly against the central bank or through intermediaries, or against the commercial bank as the issuer. The analysis of the rights of the CBDC holders to enforce the claims in these designs may vary depending on the mechanisms and intermediaries engaged. In a direct CBDC, retail payments or claims are directly managed by the central bank, whereas in hybrid and intermediated CBDCs, the claims are enforced through intermediaries.[597] Meanwhile, for a synthetic CBDC, claims are enforceable against the commercial bank as an issuer of tokens that are fully backed by the central bank.

III. The Existence of Accounts in CBDC Transactions

7.11. The legal analysis of the property rights in an account-based CBDC first requires the existence of financial accounts. These accounts record contractual relationships between the CBDC holders and the entities managing the accounts. The account-holder's right to enforce the contractual duty is itself a kind of property.

7.12. The existence of accounts distinguishes an account-based CBDC from CBDC tokens. The token is itself a digital object in which the holder has a proprietary right. The token does not, in itself, constitute the right to enforce a corresponding duty owed by the central bank or intermediary to the holder. Regardless of which entities maintain the account, the nature of an account-based CBDC as central bank money would allow the CBDC holder to assert their right to payment in some other form of central bank money.[598] The holder has the right to be paid in central bank legal tender if they so desire.

A. An Account as a Required Component in an Account-Based CBDC

7.13. An account-based CBDC is designed as money that necessarily requires the existence of financial accounts. Those account systems require verification of the identities of the

[593] See Bank of England, 'What is CBDC' (2023) < https://www.bankofengland.co.uk/explainers/what-is-a-central-bank-digital-currency > accessed 12 September 2025.
[594] See Bank for International Settlements, 'BIS Annual Economic Report 2021' (n 22) 65.
[595] Bank of Canada and others, 'Central Bank Digital Currency: System Design and Interoperability' (n 21) 2.
[596] ibid 2-3.
[597] See para 2.43.
[598] See paras 2.45-48.

holders,[599] such as cross-checking the account holder's name, account number and sort code,[600] or other methods provided by the bank or system. Examples of existing account-based money can be seen in reserve accounts and most forms of commercial bank money. An account-based CBDC shares the general characteristics of account-based money.

7.14. The form of verification in an account-based CBDC differs from that in a token-based CBDC, which relies on the existence of a token as a payment object. These different verification methods lead to distinct practical risks. For an account-based CBDC, the primary concern is identity theft, which could enable perpetrators to access the respective accounts and transact with the CBDC.[601] Identification of a correct account holder is important for all account-based systems since it determines who has the authority to issue payment instructions. Meanwhile, for a token-based CBDC, the primary concern is the validity of tokens and whether they have already been used or spent.[602]

7.15. Accounts for transacting with CBDC can be registered either with the central bank or with commercial banks, depending on the design. If CBDC is used for wholesale payment, the accounts for transacting CBDC can be registered directly with the central bank. An account-based CBDC may also be used for retail payment and for this transaction, the account holder would most likely need to set up their account at the commercial bank as an intermediary. In a single-tier architecture of a CBDC, individuals can open accounts directly at the central bank for retail payment purposes. However, this approach is generally less favoured by central banks due to the high risks associated with directly managing retail transactions.[603] Unlike wholesale payment, which relies on the central bank systems, the CBDC transactions for retail payment would rely on commercial bank infrastructures or networks to facilitate transactions between the holders.

7.16. The mechanism for opening accounts for transacting CBDC is the same as those currently available at central banks or commercial banks. The accounts held at the central bank are typically offered only to commercial banks or certain financial institutions, as determined by the central bank.[604] In contrast, accounts for commercial banks are usually accessible to commercial entities and individuals.

B. Legal Significance of Identities in Accounts

7.17. The identity recorded in the account is essential in creating transactions using an account-based CBDC for both wholesale and retail payments. The issuance and payment

[599] Bank for International Settlements, 'Central Bank Digital Currencies' (n 56) 4.
[600] See Llyods Bank, 'Helping You Make Safer Payment' < https://www.lloydsbank.com/help-guidance/everyday-banking/payments-and-transfers/name-checks.html > accessed 12 September 2025.
[601] Bank for International Settlements, 'Central Bank Digital Currencies' (n 56) 4.
[602] ibid.
[603] See para 2.43.
[604] Project Helvetia was a joint project between BIS Innovation Hub Swiss Centre, SIX and the Swiss National Bank to explore the settlement of tokenised assets in central bank money. See Project Helvetia Phase II Report at https://www.snb.ch/en/iabout/internat/multilateral/id/internat_multilateral_bisih#t4.

process of an account-based CBDC would rely on the verified identities in the accounts.[605] Conversely, in a token-based CBDC, the transaction relies heavily on the tokens as objects being available to spend.[606] The verification of identities in an account-based system is essential for both functional and compliance reasons, as it helps anticipate challenges in privacy and data protection contexts.[607] Furthermore, the identity provided for the transactions must match the information held by the parties involved in the transactions.

7.18. The person identified as the holder of the relevant account is treated as the owner of the CBDC, since it is they who have the personal rights against the issuer of the CBDC.[608] To achieve a successful account-based CBDC transaction, the system verifies the identities linked to the accounts. This determines who the parties are with the authority to send and receive funds. A payer may transfer his CBDC by instructing the bank to debit his CBDC account in the bank and credit the amount to the payee. Verification of account holders allows them to access the funds available in the account and to transfer or receive funds, with examples of methods explained in the earlier chapter.[609]

7.19. Similar to the function of identities in a bank account, where a claim to funds in the account can be distinguished by an account name and/or unique number, thus differentiating it from any other claims against the same bank,[610] the identities in CBDC accounts may also contain the account holder's name and unique numbers.

C. Rights Associated with an Account-Based CBDC

1. Recognising Proprietary Rights in an Account-based CBDC

7.20. Forms of property rights are dynamic, meaning that new forms can emerge as a result of the evolution of forms of assets. Account-based CBDC is one such example of a new form of property.

7.21. The basic rule of identifying a thing as property can be found in *National Provincial Bank v Ainsworth*,[611] where the court had to determine whether a wife had a property interest in the matrimonial home. In this case, Lord Wilberforce established the criteria for classifying a thing as a property as follows[612]: 'Before a right or an interest can be admitted into the category of property, or of a right affecting property, it must be definable, identifiable by third parties, capable in its nature of assumption by third parties, and have some degree of permanence or stability.'

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[605] EDPS TechDispatch (n 119) 9.
[606] Bank for International Settlements, 'Central Bank Digital Currencies' (n 56) 4; Auer and Böhme, 'The Technology of Retail Central Bank Digital Currency' (n 21) 88.
[607] EDPS TechDispatch (n 119) 9.
[608] CBDC holder should have an account to transact with his CBDCs.
[609] Toronto Centre, 'Central Bank Digital Currencies: Implications for Supervisors' (2023) 11 < https://www.torontocentre.org//videos/FINAL_TC_Note_Central_Bank_Digital_Currencies_Implicatons_For_Supervisors.pdf > accessed 12 September 2025; See paras 2.45-46.
[610] Fox, *Property Rights in Money* (n 20) para 1.108.
[611] *National Provincial Bank v Ainsworth* [1965] AC 1175 1247-8, H.L.
[612] ibid.

7.22. Things that are considered property must meet those qualifications. An account-based CBDC can be considered as type of property relatively easily. Most importantly, it consists of a legal right to enforce the performance of a legal duty by another person. By its very nature as a chose in action, it can be defined and identified by the law.[613] The primary purpose of a CBDC as a form of money is that it should be transferred from one holder to another, which is an essential characteristic of a thing to be considered as property.[614]

2. Rights Involved in Mixed Statutory and Contractual Relationships: Right to Payment and Right to Services

7.23. In general, the rights in CBDC should include (1) the right to payment of central bank money in other forms enforceable against the issuer or intermediary; and (2) the right to services related to accounts, or digital wallets as media or instruments storing CBDC, enforceable against the entities managing those accounts or digital wallets. These rights are a mixed contractual and statutory entitlement. The combined effect of all these rights in the account holder is the chose in action, which is itself regarded as a kind of property. Further details on the mechanisms for enforcing these proprietary rights may, moreover, be specified in regulations or specific documents provided by the institutions where the CBDC accounts are registered.

7.24. The rights in an account-based CBDC also arise from the combination of statutory and contractual relationships between the account holder and the central bank, or between the account holder and the commercial banks as intermediaries. The same analysis applies to the opening of digital wallets, media used to transact CBDC tokens, where they are created based on contractual relationships between the account holder and the entities managing the digital wallets. The benefit of these contractual rights is itself a kind of property. The following paragraphs explain the content of the holder's rights in CBDC in greater detail: right to payment from the central bank and right to service from the relevant entities.

7.25. First, the holder has a right to payment of central bank money in other forms. If a CBDC account is held at the central bank, then in the same way as a central bank reserves account, the commercial bank or financial institution, in its capacity as an account holder, has the right to payment or make a claim against the central bank or the intermediary bank for the amount indicated in its account balance.[615] The central bank or the intermediary bank discharges its liability by tendering cash, with the conversion to cash or converting to other forms of central bank money occurring at par value.[616]

7.26. In the same way as the funds held in a regular bank account, any deposits made into this account are considered commercial bank money. The account balance reflects the remaining undischarged debts in the account, thereby showing the liability of the

[613] Gleeson (n 20) 164.
[614] ibid.
[615] Fox, *Property Rights in Money* (n 20) para 1.46.
[616] ibid para 1.54 and 1.56.

commercial bank.[617] Commercial bank money in a financial account registered at a commercial bank is considered a legal claim to payment of a debt by tender of cash by the commercial bank, where the conversion of such commercial bank money to cash occurs at par value.[618]

7.27. The legal circumstances differ between conventional bank money held in a bank account and CBDC held in CBDC accounts held at commercial banks or other institutions. As discussed earlier, even though the commercial bank may maintain these accounts, the central bank would still owe a direct liability to pay central bank money to the account holder. It means that the account holder is entitled to payment of another form of central bank money from the central bank. For example, the account holder could, if it wished, exchange the account-based CBDC for banknotes. It could either enforce this liability at the central bank or at the commercial bank, but whichever procedure the account holder followed, the liability to pay would remain that of the central bank. This would be one of the defining differences between a CBDC held through an intermediary and conventional bank money held at an account with a commercial bank. In the case of conventional bank money, the account holder would only have direct rights against the commercial bank.[619]

7.28. Second, the holder of a CBDC has the right to services related to accounts or digital wallets used for transacting CBDCs. Under English law, any entity, including government, public authorities and financial institutions, providing services to customers through any contract must include a duty to perform the service with reasonable care and skill.[620] When the central bank or commercial banks provide account services to their holders, they must also owe a duty to perform the service with reasonable care and skill, in accordance with common law duties and those set by the Financial Conduct Authority (FCA). From the perspective of CBDC holders, these are the rights of the holders to receive necessary services to ensure the accounts opened at central banks or commercial banks function properly, and CBDC transactions can be achieved successfully.

7.29. For some CBDC designs, commercial banks may utilise a digital wallet for individuals to store their CBDC.[621] In other cases, this digital wallet may be provided by a third-party entity, such as a payment service provider, with the account in the digital wallet being linked to the individual's commercial bank account.[622] Under Consumer Duty issued by the FCA, for example, firms including banks are required to provide relevant information to the consumer through effective channel related to their account, which in this case

[617] ibid para 1.46.
[618] ibid para 1.54 and 1.56.
[619] Common practice for regular accounts in commercial banks.
[620] See Supply of Goods and Services Act 1982, s 13, and Consumer Rights Act 2015, s 49.
[621] Lewis McLellan and others, 'Unlocking the Potential of a CBDC Ecosystem' (2024) 7 < https://cloudpdf.io/view/9qq-JZQth > accessed 12 September 2025.
[622] European Central Bank, 'A Stocktake on the Digital Euro: Summary Report on the Investigation Phase and Outlook on the Next Phase' (2023) 18 – 19 < https://www.ecb.europa.eu/euro/digital_euro/timeline/profuse/shared/pdf//ecb.dedocs231018.en.pdf > accessed 12 September 2025.

also applied to digital wallet, before they make a decision to transact.[623] The providers of these digital wallets are also obligated under FCA's Consumer Duty to exercise a duty of care, among others, to ensure the proper functioning of their products.[624] Digital wallets may also be used for transactions using CBDC tokens, as these wallets can be designed similarly to conventional accounts, as explained in the next paragraph.

IV. Proprietary Rights in an Account-Based CBDC in Certain Designs

7.30. The essence of the account-based CBDC is the account holder's right to enforce the performance of a duty by the central bank as the issuer or the commercial bank as an intermediary to make a transfer on the CBDC payment ledger.

7.31. In addition to the rights of payment from the central bank, the account holders are also entitled to rights to services related to accounts that are enforceable against the institutions where such accounts are registered. The right of services in CBDC may be provided under a legally binding contract, and such right would be a feature of the accounts maintained by relevant entities. This right could not be transferred when the account-based CBDC is transferred from the previous holder to the new recipient. What the payee would obtain, however, is only a right to obtain an increased amount of conventional central bank money against the issuer or the intermediary.

7.32. In property law, both rights to payment of central bank money and rights to services related to a CBDC would be treated as choses in action. This concept is based on the idea that the rights in an account-based CBDC are a kind of property that also consists of a right to compel payment of other forms of central bank money, and also a right to services associated with such payment to ensure they can be executed. To understand the rights in connection with an account-based CBDC, various legal arrangements are elaborated below.

A. Possible Legal Arrangement in CBDC Transactions

7.33. Wholesale CBDC transactions involve only the central bank, commercial banks and other institutions designated by the central bank, such as government institutions or international organisations. Individuals would not hold a wholesale CBDC.[625] In this scheme, the central bank directly engages with those institutions as CBDC holders in the central bank networks, treating them as customers of the central bank with CBDC accounts. No intermediaries are involved in this arrangement, meaning these institutions can enforce their rights directly against the central bank as the issuer of CBDC and as the service provider of CBDC accounts.

[623] See Finalised Guidance, FG22/5 Final Non-handbook Guidance for Firms on the Consumer Duty (2022), 79 < https://www.fca.org.uk/publication/finalised-guidance/fg22-5.pdf > accessed 22 December 2025.
[624] ibid 38-39.
[625] Project Helvetia is a joint project between BIS Innovation Hub Swiss Centre, SIX and the Swiss National Bank to explore the settlement of tokenised assets in central bank money. See Project Helvetia Phase II Report at https://www.snb.ch/en/iabout/internat/multilateral/id/internat_multilateral_bisih#t4.

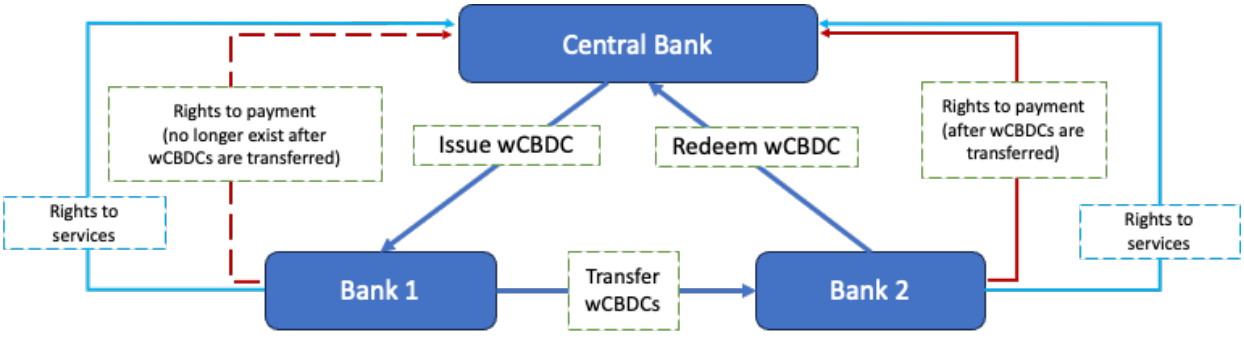
7.34. In contrast, retail payment would involve individuals in the transactions, where there are a number of possible architectures for these transactions, such as single-tier and two-tier architectures.[626] In a single-tier architecture, there is no involvement of a commercial bank as an intermediary; there is only a direct relationship between the account holder and the central bank. In this design, the central bank interacts directly with the general public. Meanwhile, in a two-tier architecture, the central bank issues CBDC to the general public through intermediaries, where, in accordance with their capacity, they are responsible for directly engaging with the general public.[627] They also have the option to involve the payment service providers to manage digital wallets, depending on the CBDC designs. A two-tier architecture may be better suited for retail transactions, as it could be more effective in mitigating various operational and policy challenges associated with retail payments.[628]

7.35. This section explores two possible legal schemes for CBDC transactions. The first scheme involves an account-based CBDC for wholesale payment with the accounts held directly at the central bank. Building on this model, the second scheme adopts CBDC for retail payments, where transactions involve conventional accounts, such as commercial bank accounts held at commercial banks as intermediaries, and digital wallets provided either by these intermediaries or third-party providers. These schemes serve as the basis for a more detailed legal analysis of proprietary rights in an account-based CBDC elaborated below.

B. Wholesale Transaction with CBDC Accounts Held at Central Bank

7.36. CBDC may be used for wholesale payment in which the CBDC accounts are directly held at the central bank. Assuming that the CBDC holder is a commercial bank, a possible legal arrangement related to this transaction is illustrated in Figure 7.

Figure 7. Possible Legal Arrangement for Wholesale Transaction



(Source: Author)

[626] BIS Innovation Hub and Hong Kong Monetary Authority (n 86) 5.
[627] See para 2.43.
[628] BIS Innovation Hub and Hong Kong Monetary Authority (n 86) 6.

1. Accessibility to Accounts held at the Central Bank

7.37. In Figure 7, Bank 1 and Bank 2, as commercial banks, open CBDC accounts at the central bank.[629] The mechanism for accessing accounts for CBDC transactions held at the central bank would most likely follow those presently available at the central bank. Under the current practice in the conventional central banking system, a central bank can provide account facilities to certain entities, such as financial institutions, through a financial account available to them, while the general public is usually restricted from opening such an account with the central bank.[630] For example, the BoE only allows the UK government, overseas central banks and commercial banks to open a bank account.[631]

7.38. Bank Indonesia also allows government institutions, overseas central banks, commercial banks and international institutions to open bank accounts with Bank Indonesia. The procedures and mechanisms to open such accounts are regulated under Article 2 paragraph 2 of Bank Indonesia Regulation No. 24/19/PBI/2022 on Current Account in Bank Indonesia. If Bank Indonesia launches the Digital Rupiah, it must also have a regulation on the CBDC account or the conversion of the current account to a CBDC account. This regulation should be able to address the criteria of institutions that can open a CBDC account to transact with wholesale payment, how to open a CBDC account or how the conversion between a current account and a CBDC account can occur.

7.39. Similar requirements for opening reserve accounts may also be applied to CBDC accounts.[632] When commercial banks open CBDC accounts at the central bank, they must adhere to the terms and conditions determined by law or set by the central bank. This includes adhering to clauses or provisions available in any agreements related to the opening and maintaining of CBDC accounts.

7.40. If CBDC is issued, central bank money will also cover bank reserves, banknotes that are 'in circulation' and CBDC as a digital form of fiat money, and this will be reflected in the central bank's balance sheet.[633] Deposits held by the commercial bank at the central bank, also known as bank reserve accounts, are considered central bank money, which can be converted into cash.[634] As central bank money, CBDC should also be fully convertible into other forms of central bank money, such as reserve accounts or cash.

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[629] Fabio Panetta, 'Demystifying Wholesale CBDC' (2022) Speech at the Symposium on Payments and Securities Settlement in Europe - Today and Tomorrow < https://www.ecb.europa.eu/press/key/date/2022/html/ecb.sp220926~5f9b85685a.en.html > accessed 12 September 2025.

[630] See para 7.8.

[631] See Bank of England, 'Banking Services' (2023) < https://www.bankofengland.co.uk/payment-and-settlement/banking-services > accessed 12 September 2025.

[632] See an example of the Bank of England that creates Sterling Monetary Framework Procedures, providing terms and conditions, among others, when opening reserve accounts in the Bank of England. See Bank of England,'The Bank of England's Sterling Monetary Framework - Operating Procedures' (2025) < https://www.bankofengland.co.uk/-/media/boe/files/markets/sterling-monetary-framework/operating-procedures.pdf > accessed 12 September 2025.

[633] Rule (n 70) 5.

[634] Bank for International Settlement - Committee on Payment and Settlement Systems, 'The Role of Central Bank Money in Payment Systems' (2003) 8 < https://www.bis.org/cpmi/publ/d55.pdf > accessed 12 September 2025; US Department of the Treasury Report, 'The Future of Money and Payments: Report Pursuant to Section

2. Acquiring CBDC from the Central Bank

7.41. In Figure 7, Bank 1 acquires CBDC by requesting it from the central bank. The issuance of this CBDC by the central bank begins by converting funds from the bank's reserve account to the central bank's technical account in the RTGS system.[635] While the size of the reserve account remains the same, the composition of the balance sheet is altered to include a portion of CBDC converted from reserve funds.[636] Regardless of this technicality, the fact that the account-based CBDC for wholesale payment is recorded in an account with the central bank, Bank 1, as a CBDC holder has a direct claim to the central bank since there is no intermediary involved in this mechanism.

7.42. After the central bank issues a CBDC to Bank 1, Bank 1 has the option to redeem its CBDC to the central bank for the remaining balance of CBDC available in its account. The bank can initiate this redemption by requesting the central bank to carry out the redemption or by the central bank in certain cases, such as limiting the existence of wholesale CBDC for a certain time.[637] The redemption may be exercised, among others, by converting the CBDC into other forms of central bank money with value at par.

3. The Right to Payment from the Central Bank

7.43. In Figure 7, upon issuing wholesale CBDC to Bank 1, Bank 1 becomes a CBDC holder. It has the right to receive payment of central bank money enforceable against the central bank as the issuer of CBDC. This payment would be recorded in the CBDC payment ledger, rather than the conventional ledger system, as CBDC would be stored in a specific account for CBDC. Suppose Bank 1 transfers its CBDCs to Bank 2, then Bank 2 should acquire an identical kind of right of payment against the central bank as Bank 1 previously had.

7.44. Following the transfer of CBDC, just like an ordinary conventional transfer of commercial bank money,[638] there is a simultaneous extinction of the right of payment of Bank 1 enforceable against the issuer, and the creation of the new right of payment of Bank 2 enforceable against the issuer. Although a CBDC is associated with the contract between the holder and the intermediary, the right to payment in an account-based CBDC is not, in fact, assigned from Bank 1 to Bank 2.[639] Thus, after Bank 1 transfers CBDC to Bank 2, Bank 2 has a new right to payment against the central bank.

4(b) of Executive Order 14067' (2022) 3 < https://home.treasury.gov/system/files/136/Future-of-Money-and-Payments.pdf > accessed 12 September 2025.

[635] See Phase I and Phase II Report on Project Helvetia.

[636] Phase I Project Helvetia: Settling Tokenisation Assets in Central Bank Money, 18, 2020, https://www.bis.org/publ/othp35.pdf

[637] See Banque de France, 'Wholesale Central Bank Digital Currency Experiments with the Banque de France: New Insights and Key Takeaways' (2023) 39 < https://www.banque-france.fr/system/files/2023-08/Banque_de_France_stabilite_financiere_rapport_mnbc_2023.pdf > accessed 12 September 2025.

[638] See Fox, *Property Rights in Money* (n 20) para 1.61.

[639] Ewan McKendrick, *Goode and McKendrick on Commercial Law* (Penguin Books, 2020) para 2.54.

7.45. Regarding the transfer of CBDC between CBDC accounts, transactions with account-based CBDC would involve transferring CBDC balances from one account holder to another, following verification that the payer was a legitimate account holder and had adequate funds in their account to execute the transaction.[640] The current explanation of a conventional bank account should still apply to a CBDC account, where the transfer of CBDC through accounts should be referred to as an adjustment of banks' debts to both the payer and payee.[641] Consequently, after such a transfer, the central bank now has payment obligations to Bank 2, which can be fulfilled by redeeming CBDC at the central bank as requested by Bank 2.

7.46. Transfers between CBDC accounts operate similarly to regular commercial bank accounts. When Bank 1 transfers its CBDCs to Bank 2, the legal right to claim such CBDCs of Bank 1 is extinguished, and the new legal right is then created for Bank 2 to claim the same quantity of CBDCs enforceable against the central bank.[642] In such a transfer, there is no assignment of legal rights between Bank 1 and Bank 2.

7.47. In an account-based CBDC, the right to payment should be enforced under the condition that the holders are the rightful CBDC holders with accounts maintained at the issuer. The verification of the legitimacy of CBDC holders relies on their identities. While in a token-based CBDC, the right to payment can be exercised against the issuer of CBDC for the specified amount on the tokens.[643]

4. The Right to Services from the Central Bank

7.48. After opening CBDC accounts at the central bank, the commercial banks, both Bank 1 and Bank 2, have the right to services from the central bank, as shown in Figure 7. For a wholesale payment where an account is registered at the central bank, the account holder should be given services related to CBDC accounts from the central bank, just like those given to the existing reserve accounts in the central bank.

7.49. In practice, the central bank provides services to the account holders related to, among others, foreign reserves management, international relief and assistance, and financial stability.[644] However, these services may vary from one central bank to another, depending on the activities performed it. The Federal Reserve Bank of New York, for example, provides safekeeping services, payment services, and investment services and facilities to its account holders, including other central banks, monetary authorities, and

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[640] Bank for International Settlements, 'Central Bank Digital Currencies' (n 56) 4; Auer and Böhme, 'The Technology of Retail Central Bank Digital Currency' (n 21) 88; Reserve Bank of Australia, 'Retail Central Bank Digital Currency: Design Considerations and Rationales' (2020) < https://www.rba.gov.au/speeches/2020/pdf/sp-so-2020-10-14.pdf > accessed 12 September 2025.

[641] See Fox, *Property Rights in Money* (n 20) para 1.61.

[642] ibid.

[643] See also para 7.14.

[644] Federal Reserve Bank of New York, 'Central Bank and International Account Services' <https://www.newyorkfed.org/markets/central-bank-and-international-account-services> accessed 12 September 2025.

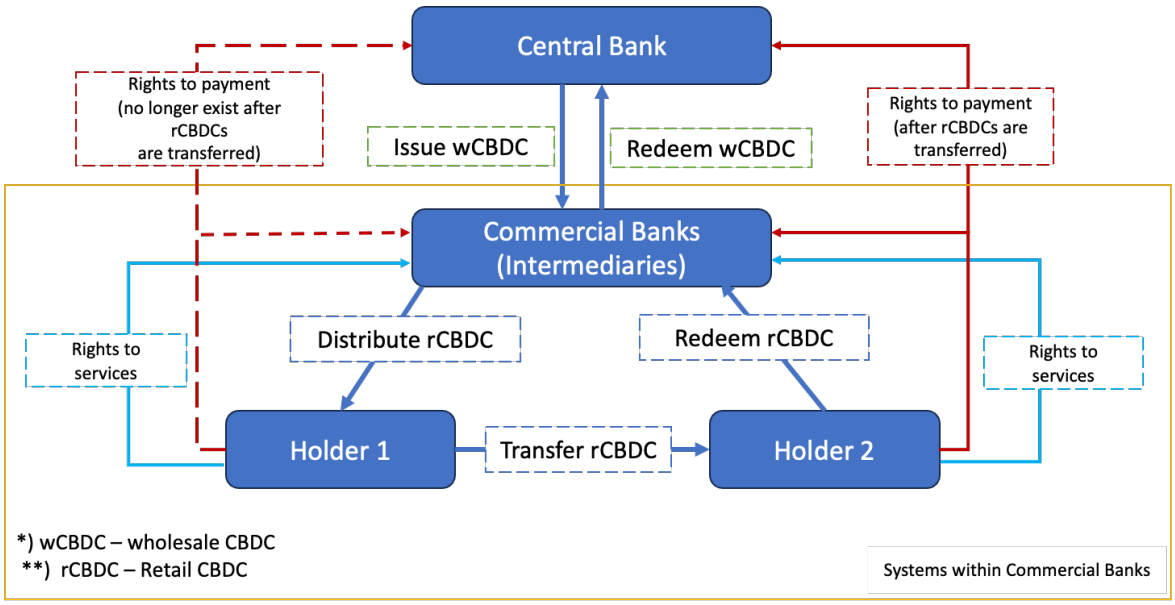
international organisations.[645] Services provided to the account holders may vary depending on the relevant legal framework, as well as the purpose and design of CBDC.

7.50. When Bank 1 transfers its CBDCs to Bank 2, the right to services held by Bank 1 should remain unaffected by such transfer. These rights are associated with the account rather than an account-based CBDC as a fund. Even if the CBDC account has zero balance, the account holder should still be entitled to the right to services from the central bank.

C. Retail Transaction with Accounts Held at Commercial Banks

7.51. CBDC may also be used for retail transactions where a two-tier architecture would be adopted by the central bank, such as in the e-Krona project. In this design, in the first layer, the central bank issues wholesale CBDC to commercial banks by converting their funds into the conventional reserve accounts held in the central bank's settlement system.[646] The mechanism for this layer was explained in Figure 7. In the next layer, individuals with accounts at those commercial banks can then acquire retail CBDC by exchanging their commercial bank deposits for CBDCs that the banks have obtained. The CBDCs are stored in the CBDC account and transacted through digital wallets operated by the banks.[647] Although the issuance of CBDC utilises token-based technology, the existence of conventional accounts in bank accounts and digital wallets shapes the legal arrangement in this retail CBDC. A possible legal arrangement related to this architecture is illustrated in Figure 8.

Figure 8. Possible Legal Arrangement for Retail Transaction



(Source: Author)

[645] ibid.

[646] Sveriges Riksbank, 'E-Krona Pilot Phase 2' (2022) 8 < https://www.riksbank.se/globalassets/media/rapporter/e-krona/2022/e-krona-pilot-phase-2.pdf> accessed 12 September 2025.

[647] ibid 9.

1. Accessing Accounts Held at the Commercial Bank

7.52. An individual or entity can open a regular bank account at the bank in accordance with the bank's policies, including any specific agreements related to it. The existence of this account is crucial in a two-tier architecture as it functions to convert funds deposited in the commercial bank into CBDCs.

7.53. For CBDC transactions, the conventional bank accounts are linked to digital wallets managed either by the commercial bank or by a third-party entity, such as a payment service provider, depending on the CBDC design and systems. These digital wallets can facilitate the interoperability of CBDCs with existing payment infrastructure.[648] To achieve interoperability of CBDC with existing infrastructure, this wallet could have aliases that may include phone numbers, sort codes and account numbers, card numbers and wallet identities.[649] In the e-Krona project, this digital wallet is designed the same way to a regular account for customers,[650] although the issuance of CBDC uses token-based technology.

2. Acquiring CBDC from the Commercial Bank as an Intermediary

7.54. In Figure 8, Holder 1, as an individual with a bank account maintained at a commercial bank, requests CBDC from his bank by exchanging his commercial bank money for CBDC through a digital wallet.[651] The conversion from commercial bank deposits to CBDC would follow the technical mechanisms applied to the bank, such as the use of a digital wallet that is interoperable with the bank account.

7.55. After receiving a request for CBDC from Holder 1, the bank then distributes CBDC to him. After such issuance, Holder 1 has the right to claim such money by redeeming its CBDC. Acknowledging that the account balance reflects the account-based CBDC owned by the account holder, the amount of central bank money that can be redeemed by Holder 1 should not exceed the balance available in the account registered with the commercial bank. The redemption of CBDC may occur by exchanging CBDC for other forms of central bank money directly at the central bank and through an intermediary. The commercial bank, as an intermediary, may be given roles to facilitate the exercise of rights of the account holder by redeeming CBDC through designated mechanisms and policies, even though the nature of an account-based CBDC is central bank money, where the liability is on the central bank instead of the commercial bank.[652]

7.56. A model for the CBDC redemption mechanism for retail transactions was elaborated by the European Central Bank under the Digital Euro project.[653] Holder 1 initiates the process of redeeming CBDC by requesting the commercial bank to convert CBDC into

[648] See Bank of England, 'The Digital Pound: Technology Working Paper' (n 448) 54.
[649] ibid.
[650] Sveriges Riksbank, 'E-Krona Pilot Phase 2' (n 646) 5.
[651] ibid 9.
[652] See paras 2.55-60, 3.69-70.
[653] European Central Bank, 'Exploring Anonymity in Central Bank Digital Currencies' (n 121) 8.

commercial bank money. When the bank receives such a request, it follows up by deducting the requested amount of CBDC from the digital wallet and marking the CBDC as spent. The bank sends a request to the central bank to reclaim funds in the RTGS system and then updates the balance of Holder 1's bank account held at the commercial bank.

3. The Right to Payment from the Central Bank

7.57. Considering the nature of CBDC, all kinds of forms of CBDC, including tokens, can be redeemed or exchanged for other kinds of central bank money at par value.[654] Redemption may be possible directly at the central bank if the central bank's systems, infrastructure, and procedures support such an exchange.

7.58. In Figure 8, Holder 1 is entitled to payment of central bank money in other forms, where this right remains enforceable against the central bank and against the commercial bank where it holds his account through a digital wallet. Similar to the payment mechanism in Figure 7, the payment would affect the CBDC payment ledger rather than the conventional ledger system since CBDC would be stored in a specific account.

7.59. When the CBDC is transferred from Holder 1 to Holder 2, the principle of an ordinary conventional transfer of commercial bank money applies, where the balances of accounts of Holder 1 and Holder 2 are adjusted.[655] After such a transfer, Holder 1's right to payment against the commercial bank and the central bank is reduced by the amount of the transfer. Regarding the rights of Holder 1 and Holder 2, the same analysis in paragraph 7.44 also applies where the right of payment of Holder 1 is diminished, while a new right of payment is established to Holder 2, which is enforceable against the central bank through a commercial bank.

7.60. Upon transfer of the CBDC, Holder 2 should have the identical kinds of rights in the CBDC that were previously owned by Holder 1, meaning that it should have similar rights that carry the same value as the earlier ones. The legal analysis in the transfer between Bank 1 and Bank 2 in Figure 1 applies to the transfer of CBDC between Holder 1 and Holder 2 in Figure 2.[656] After the transfer of CBDC, Holder 1's right to claim the money is reduced, and Holder 2 now has the 'new' right to receive payment in other forms of central bank money. This means that Holder 2 can enforce his right to receive payment using the process of CBDC redemption, as explained earlier in paragraph 7.55.

7.61. In Figure 8, CBDC tokens available in the holders' digital wallets can also be exchanged for commercial bank money. Interoperability between digital wallets and commercial bank accounts would allow this exchange to occur. During the conversion process, the tokens intended to be converted would be extinguished or rendered unspendable. The corresponding amount would be credited to the holder's account at the commercial bank, reflecting a claim against the bank. Following this transaction, the balances in both the digital wallet and the account holder will be adjusted accordingly.

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[654] See para 2.66.
[655] See Fox, *Property Rights in Money* (n 20) 5.20; See para 7.43.
[656] See paras 1.37-38.

7.62. In Figure 8, during the transfer of CBDC tokens between Holder 1 and Holder 2, the specified amount of tokens from Holder 1 will be extinguished or become unspendable. Holder 2 will then acquire new tokens equal in value to the amount of tokens of Holder 1 that are extinguished. Consequently, the balances in both Holder 1's and Holder 2's digital wallets will be updated to reflect their respective token holdings.

4. The Right to Services from the Commercial Bank

7.63. When the commercial bank provides account facilities to individuals as CBDC holders, it would have a contractual account management relationship with them. The bank would be bound to offer basic services related to CBDC. It must fulfil its duty to perform these services with reasonable care and skill. Under the scheme in Figure 8, Holder 1, as a customer of the commercial bank, is entitled to receive account services based on the contractual relationship between Holder 1 and the bank where the account is held. If such a commercial bank also manages the digital wallet of the CBDC holder for CBDC transactions, then Holder 1 is also entitled to the right to services from the commercial bank related to the digital wallet.

7.64. Examples of the content of services provided by the commercial bank are explained in the Digital Euro project.[657] The bank or intermediary would be expected to provide services to the CBDC holders related to account opening, apply KYC procedures, provide customer support related to transactions, manage issues related to transactions in the digital wallet, and facilitate the exchange of account-based CBDC for cash, other forms of money, or bank products as agreed by the CBDC account holder. Furthermore, the Digital Euro project explored services that should be provided by the intermediaries when maintaining accounts for an account-based CBDC. These services cover basic services related to user management, liquidity management and transaction management.[658] In transaction management, for example, the intermediaries provide services related to authentication, refunds, and dispute solutions for CBDC holders.[659]

7.65. The use of a digital wallet to transact with CBDC funds shows some differences in analysis from a traditional bank account. Only the CBDC holder can access, use or transact with their CBDC through their digital wallet. CBDC stored in this digital wallet is not the bank's or provider's money and therefore cannot be accessed, used, or transacted with by any party other than the CBDC holder. When money is deposited with a traditional bank account, it becomes the bank's money, where the bank can lend or transact with such funds. Although it is viewed as a bank's money, there is also a debt which the bank is obliged to pay when its customer requests it. When the customer's account is in credit, then the bank can make a payment or transfer as instructed by the customer, reducing its debt to the customer. The principle that a bank is bound to make payment or transfer when instructed by its customer was demonstrated in *Lipkin*

[657] European Central Bank, 'A Stocktake on the Digital Euro: Summary Report on the Investigation Phase and Outlook on the Next Phase' (n 622) 18 – 19.
[658] ibid.
[659] ibid.

Gorman v Karpnale Ltd and *Westminster Bank Ltd v Hilton*.[660] This principle is one of fundamental obligations of a bank to its customer and when its customer instructs the bank to make payment from or receive payments into his account then the bank is under the duty to obey such mandate.[661]

7.66. A further role of commercial banks as intermediaries in CBDC transactions may be specified under regulations or legislation that elaborate further on the scope of roles of commercial banks as intermediaries. These roles may include managing retail transactions of CBDC and providing customer services to CBDC holders.

7.67. Similar to the arrangement in Figure 7, Holder 1's right to receive account services remains unaffected by the CBDC transfer, as this right is associated with the account rather than the account-based CBDC as a form of money. Even when the account holder does not have a CBDC in their account, they still retain the right to services from the commercial bank that manages their account.

7.68. For commercial banks, the bank must also follow the customer's instructions as mandated by the customer, such as performing the customer's instructions to make payments.[662] In *Phillipp v Barclays,* Lord Leggatt summarised the basic duty of a bank to comply with the customer's instructions as follows:

> It is a basic duty of a bank under its contract with a customer who has a current account in credit to make payments from the account in compliance with the customer's instructions. This duty is strict. Where the customer has authorised and instructed the bank to make a payment, the bank must carry out the instructions promptly. It is not for the bank to concern itself with the wisdom or risks of its customer's payment decisions.[663]

Judgment in *Phillip* narrowed the scope of *Quincecare* duty, under which a bank is required to refrain from acting on payment instructions issued by its customer's agent if it has reasonable grounds to believe that the agent is defrauding the customer.[664] However, as discussed in para 6.33, the Payment Services (Amendment) Regulation 2024 has empowered payment service providers, including banks, the ability to delay the execution of certain payment orders, for a certain period of time, where they have reasonable grounds to suspect that the order is connected to fraud or dishonesty by a third party, including the payee.

7.69. The right of services, both related to the CBDC account and the account for the digital wallet, would not be transferred from Holder 1 to Holder 2 as the new recipient when

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[660] See *Lipkin Gorman v Karpnale Ltd* [1989] 1 WLR 1340, 1353*; See Westminster Bank Ltd v Hilton* (1926) 43 TLR 124, 126 (Lord Atkinson). In *Lipkin Gorman*, the relationship of bank and customer is deemed as debtor and creditor where it is prima facie bound to meet its debt when customer asked to do so. This was Lord Atkinson said in *Westminster Bank*.

[661] Iris H Y Chiu and Joanna Wilson, *Banking Law and Regulation* (Oxford University Press 2019) 2.4.

[662] *Bowstead & Reynolds on Agency*, 22nd ed (2021), art 36.

[663] See *Phillipp v Barclays* [2023] UKSC 25.

[664] See *Barclays Bank Plc v Quincecare* [1992] 4 All ER 363.

the account-based CBDC is transferred from the previous holder to the new recipient. The right of services should be personal to the contracting parties.[665]

D. The Need for Legislation

7.70. Legislation is necessary for CBDC to function effectively as a means of payment. It would need to grant the legal status of an account-based CBDC as central bank money, which would confer the right on the account holder to receive payment in other forms of central bank money. The right to payment would be exercised directly at the central bank for wholesale transactions and also through both the central bank and an intermediary for retail transactions, regardless of whether the accounts are maintained at the central bank or an intermediary. Providing status as central bank money would be crucial for determining the legal liabilities of the central bank as the issuer of CBDC and the entitlement of conversion of other forms of central bank money at par value.[666]

7.71. The general principles of private law ensure that, in the two-tier architecture, the CBDC holder has the right to payment from the central bank through a commercial bank as the entity managing their account or digital wallet. The CBDC holder who holds an account at the commercial bank has all the rights conferred by the contract between the commercial bank and the holder.

7.72. The transfer of account-based CBDC would follow the existing mechanisms used for commercial bank money. Notably, in the transfer of account-based CBDC, there is no assignment of rights from the payer to the payee.[667] Legislation is crucial to guarantee that the payee acquires the identical kinds of rights in the account-based CBDC as those held by the payer prior to the transfer.

7.73. If account-based CBDCs were to be adopted, either in Indonesia and the UK, there should be a specific regulation for the CBDC that outlines clear mechanisms to acquire and redeem account-based CBDC. The scope of rights of CBDC holders, including both the right to payment and the right to services, should be identified in this regulation to give legal certainty for the public and guarantee the effective enforcement of their rights. The regulation should also require intermediaries and other relevant parties to prepare the mechanisms to enforce the rights of CBDC holders. All in all, given that CBDC is a kind of central bank money with ultimate liability resting on the state or central bank and the need to protect the rights of CBDC holders, banks and other parties involved in CBDC transactions should be required to perform a higher degree of duty of care and their obligations to their customers. For the UK, such regulation can be made specific to complement the duty of the service providers and the rights of consumers that are already set out under common law duties and Consumer Duty, as explained earlier.

[665] McKendrick, *Goode and McKendrick on Commercial Law* (n 639).
[666] See paras 2.66, 3.69-70.
[667] See para 7.43.

V. Conclusions

7.74. Both account-based and token-based CBDC may be viewed as a chose in action, where it has both the right to payment of central bank money and the right to services from the entities managing the accounts. The right of payment of central bank money consists of a right to demand payment of another kind of central bank money, while the right to services is associated with this payment and is necessary to ensure that the payment can be achieved.

7.75. These rights arise from the combination of statutory and contractual rights resulting from the existence of accounts held at entities such as central banks and intermediaries. However, the enforceability of these rights varies depending on whether CBDC is used for wholesale payment or retail payment.

7.76. Similar to other forms of central bank money, the holder of CBDC has the right to payment enforceable against the central bank as the issuer of money, including the ability to convert CBDC into other forms of money at par value. In the transfer of CBDC that depends on the existence of accounts, including account-based CBDC, there is no assignment of rights to payment of the central bank money from the payer to the payee. Rather, the payer's right is extinguished after such transfer, and a new right to payment, enforceable against the central bank, is created for the payee. Related to this transfer, legislation is essential to guarantee that, upon transfer, the new holder acquires similar rights in the CBDC as those held by the previous holder.

7.77. For an account-based CBDC to be an effective means of payment, a detailed regulation is needed in some jurisdictions, such as Indonesia, to provide legal certainty to CBDC holders. Regulation on an account-based system is expected to guarantee the execution of the rights of CBDC holders.

CHAPTER 8

PROPRIETARY RIGHTS IN A TOKEN-BASED CBDC

I. Introduction

8.1. The previous chapter demonstrated that the CBDC holder's rights consist of the right to payment from the central bank and the right to services from the entities managing the accounts. For account-based CBDC, these rights stem from a combination of statutory and contractual relationships between the account holders and those entities. During the transfer of account-based CBDC, it can be observed that there is no assignment of a right to payment enforceable against the central bank as the issuer. Rather, the right of the payer as the previous holder is extinguished, and a new right is created for the payee as the new holder.

8.2. In contrast to an account-based CBDC, where the existence of accounts is significant in determining the holder's rights, a token-based CBDC can be viewed as an intangible object that is the object of proprietary rights. This chapter aims to provide a legal analysis of a token-based CBDC as an emerging form of intangible thing in which property rights can be created. Property law matters to token-based CBDCs as it provides a legally recognised basis for the holders of tokens to own and transact with their money in the format of a digital token, including enforcing their rights against the issuer of tokens. Having a clear view of proprietary rights within CBDC tokens allows for the effective functioning of these CBDCs as a means of payment if such tokens were recognised as legal tender.

8.3. This chapter argues that a CBDC token satisfies the characteristics of a digital object as it is rivalrous and has an independent existence. Proprietary rights are recognised in this thing. For a token-based CBDC, the right to payment from the central bank would arise from statutory rights, where the right to services stems from the contractual relationship between the CBDC holders and entities managing the media for tokens. Furthermore, CBDC tokens can be seen as operating somewhat like documentary intangibles, in that the right to payment is enforceable against the central bank as the issuer of the CBDC and is linked to the digital token. When the token is transferred, the rights linked to it are also

transferred. Legislation would need to guarantee that such tokens remain linked to the same right to payment previously held by the payer, which is enforceable against the central bank as the CBDC issuer. Existing rules of private law would not be sufficient to create this legal link.

8.4. The discussion in this chapter begins with the resemblance between CBDC tokens and banknotes before discussing the tokens as digital objects. It then talks about the nature of documentary intangibles in the tokens, where they are linked to the right of payment enforceable against the central bank. When the transfer of CBDC tokens occurs, legal consequences of the rights of the CBDC holder and the need for legislation are also analysed.

II. CBDC Tokens Resemble the Characteristics of Banknotes

8.5. A token-based CBDC shares similarities with traditional fiat money issued by a central bank, but it differs in its material composition. The terms 'token-based CBDC' and 'CBDC tokens' are often used interchangeably in the discussion.

8.6. Both token-based CBDC and fiat money serve as a medium of exchange issued by the central bank. CBDC would always have the same value as, and be interchangeable with, direct claims on the central bank.[668] Moreover, such a CBDC could be exchanged for cash or bank deposits and vice versa.[669] Maintaining the uniformity of money is crucial for the central bank to guarantee trust in money by ensuring equal value between bank deposits and cash.[670]

8.7. The right to claim in a token-based CBDC can be enforced against the issuer through a procedure set by the issuer, such as through regulation. This differs from traditional fiat money, where the right to claim payment in a certain amount is clearly expressed in fiat money, as shown in the writing on the banknote, which reads: 'I promise to pay the bearer on demand the sum of £X'. In principle, the holder of a banknote or coin is entitled to claim such payment from the issuing bank after such a note is transferred hand to hand from the previous holder. The right to redeem the banknote from the issuer is then passed to the new holder of the note upon delivery.[671] It is the transferability of the right against the issuing bank which ensures that the note effectively carries its value when it is transferred in a payment transaction.

8.8. CBDC tokens would be linked to the right of payment enforceable against the central bank, and a legal mechanism needs to be designed to ensure that during the transfer of tokens, where the payee of CBDC has the same rights against the issuing central bank as the payer did when the money was under the transferor's control. The writing on the UK banknotes, as mentioned earlier, is also evidence that the banknotes are linked to another asset. These notes were once linked to a right to payment of gold, as this writing has been

[668] See paras 2.55-60.
[669] See para 4.91.
[670] Bank of England and HM Treasury, 'Digital Pound: A New Form of Money for Households and businesses?' (n 57) 25.
[671] Fox, *Property Rights in Money* (n 20) para 1.36.

in use since banknotes represented deposits of gold.[672] During that period, the holders of banknotes could exchange them for gold of equivalent value to the pound as pound's value was linked to gold.[673] Nowadays, the holders can only exchange them for other banknotes of the same face value.[674] The right to redeem the banknote from the issuer is then passed to the new holder of the note upon delivery.[675] It is the transferability of the right against the issuing bank which ensures that the note effectively carries its value when it is transferred in a payment transaction.

8.9. The rights in and linked to CBDC tokens may encompass a blend of proprietary rights found in traditional fiat money and commercial bank money, presenting a complex subject to explore within property law.

III. Proprietary Rights in a Token-Based CBDC

8.10. A token is a thing in which proprietary rights can be created by legislation and to which other enforceable rights against the issuer can be linked. Similar to proprietary rights in a general commercial transaction, a discussion of these rights determines how the assets, including tokens, should be kept and transacted, including when a person seeks to recover such assets when they are stolen or unlawfully taken.[676] The fact that the holder's rights are proprietary in character and enforced against a specific thing becomes significant in insolvency cases. They typically have priority over claims by general creditors. The existence of the holder's rights of property is also significant in legal matters pertaining to inheritance and cases of fraud, including theft.[677]

8.11. In a CBDC token, there are rights to payment linked to the token. While these are essentially personal in nature, they can also be conceptualised as intangible things. But unlike the rights in account-based CBDC, they are linked to tokens. The holder, therefore, has a cluster of different rights, some proprietary and others personal in nature. The right in a CBDC token has three essential elements. First, this right to payment is a 'chose in action'. Second, this right entitles the holder to receive payment from the issuer, thereby making a CBDC token something like a documentary intangible containing the issuer's payment obligation. Last, the right to payment on central bank money, or the issuer's payment obligation, is actually linked to the CBDC token itself, where such a link creates an element of a linked asset in the CBDC tokens, a similar trait in promissory notes or banknotes.

8.12. It is important to consider how all these rights to payment are linked to the digital token. Only if they are linked in this way, the right to payment in the token will be transferred when the token is transferred. Separate legislation would be needed to establish the

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[672] Bank of England, 'General Banknote Questions' < https://www.bankofengland.co.uk/faq/banknote#:~:text=What%20is%20classed%20as%20legal,value%20coins%20as%20legal%20tender > accessed 12 September 2025.
[673] ibid.
[674] ibid.
[675] Fox, *Property Rights in Money* (n 20) para 1.36.
[676] Law Commission, *Digital Assets: Final Report* (Law Com No. 412, 2023) 1-2; Law Commission, *Digital assets as personal property: Supplemental report and draft Bill* (Law Com No. 416, 2024) 3.25.
[677] ibid 2.

link. It should clearly state that the right to payment from the bank is transferred when the token is transferred. This is because CBDC tokens would fall outside the existing law of negotiable instruments, where the link between the document and the chose in action linked to it is already accepted in the case law and statutes.

8.13. The discussions of proprietary rights in CBDC tokens cover CBDC tokens as digital objects, choses in actions and the kinds of rights in CBDC tokens consist of right to payment and right to services, elaborated below.

A. CBDC Tokens as Digital Objects

8.14. As an object of property, a token-based CBDC fulfils the criteria of a digital object as proposed by the UK Law Commission. Such a token is composed of data consisting of an electronic format, exists independently of individuals and the legal framework, and is rivalrous,[678] with the arguments elaborated below.

8.15. A CBDC token is a digital object, where the holder has a proprietary right in the token. The holder also has rights by way of chose in action, which are linked to the token. A CBDC token has specific characteristics that make it a workable object of proprietary rights. Although it consists of data, it exists regardless of a person or legal system and is rivalrous.[679]

8.16. Digital tokens as emergent forms, including CBDC tokens, might not easily fit into the two traditional classifications of objects of property under English laws. These are tangible things in possession and intangible things in action.[680] This classification can be found in *Colonial Bank v Whinney*,[681] which does not recognise a third or intermediate category between the two.[682] In contemporary legal practice, a new third type of property needs to be recognised, which includes digital assets and digital tokens.

8.17. If CBDC were to be property in English Law, then it would need to be a variety of personal property. The UK Law Commission has broadly introduced digital assets as property and viewed a digital asset as 'any asset that is represented digitally or electronically', but certain assets, such as a crypto-token, can be 'capable of attracting property rights on an application of existing legal principles and indicia of property'.[683] In modern society, digital assets serve as a mode of payment or a digital representation of things or rights. The proliferation of technology, including the growing use of DLT and electronic signatures, has contributed to the increasing volume of digital assets.

8.18. The UK Law Commission has noted, however, there are many types of digital assets and not all of them can be suitable objects of personal property rights, such as social media

[678] Law Commission, *Digital Assets: Final Report* (n 676) 51.
[679] ibid; *Tulip Trading v Van der Laan* [2003] EWCA Civ 83, [2023] 4 WLR 16 at [24], by Birss LJ.
[680] Law Commission, *Digital assets as personal property: Supplemental report and draft Bill* (n 676) 16.
[681] *Colonial Bank v Whinney* (1885) 30 Ch D 261, 285, by Fry LJ.
[682] ibid.
[683] Law Commission, *Digital assets as personal property: Supplemental report and draft Bill* (n 676) 28.

pages with passwords and an Excel file with password protection.[684] To address this, the UK Law Commission proposed certain characteristics of digital assets that would satisfy the nature of objects of property rights, referred to as the 'third category of property'. The concept of third category of property is necessary to accommodate emergent forms of intangible things to which personal property rights can relate, including forms of tokens,[685] such as milk quotas in *Swift v Dairywise*[686] and crypto tokens, among others, in *LMN v Bitflyer Holdings Inc* and *Tulip Trading Ltd v Van Der Laan*.[687]

8.19. Any asset can be viewed as a third category if 'it is functionally analogous to those things that attract property rights and is itself capable of attracting property rights (in terms of existing indicia) but is not comfortably either a thing in possession or thing in action'. [688] In light of recent cases concerning tokens such as in *Tulip Trading v Van Der Laan*, a narrow perspective on a third category asset view a token as: '(1) It is composed of data represented in an electronic medium, including in the form of computer code, electronic, digital or analogue signals; (2) It exists independently of persons and independently of the legal system; and (3) It is rivalrous.'[689] The legal analysis on whether a token-based CBDC fulfils these narrow characteristics is elaborated below.

8.20. First, a token-based CBDC is indeed an intangible thing which serves as an object in a digital form representing value expressed in the national unit of account, functioning as a claim on the respective central bank.[690] In its research, the Sveriges Riksbank found that a token-based CBDC consists of a serial number and a ciphertext related to this serial number.[691] In this research, a token-based system would need a 'private key of the central bank' belonging to the central bank and a 'public key of the central bank' that is available for the public as the holder.[692] The private key then produces the ciphertext that the public key can decrypt. On that view, the CBDC token is a virtual object consisting of a serial number and the ciphertext related to this serial number.[693]

8.21. Second, a token-based CBDC exists independently of persons and the legal system. The continued existence of a token-based CBDC relies on a set of systems involving a private key and a public key,[694] rather than relying on a person. While an individual may control the private key, the existence of a token-based CBDC itself is primarily due to the underlying technology set by the central bank. A token-based CBDC would exist

[684] International Institute for the Unification of Private Law (UNIDROIT), *Principles on Digital Assets and Private Law* (C.D. (102) 6, 2023) para 2.17.
[685] Law Commission, *Digital Assets: Final Report* (n 676) 33.
[686] See *Swift v Dairywise (No 1)* [2000] 1 WLR 1177, [2000] BCC 642
[687] Law Commission, *Digital Assets: Final Report* (n 676) 33.
[688] Law Commission, *Digital assets as personal property: Supplemental report and draft Bill* (n 676) 40.
[689] See *Tulip Trading v Van der Laan* [2003] EWCA Civ 83, [2023] 4 WLR 16 at [24], by Birss LJ; See characteristics of digital objects are proposed by the Law Commission in 2023. Law Commission, *Digital Assets: Final Report* (n 676) 51.
[690] Armelius and others (n 256) 7.
[691] ibid.
[692] ibid.
[693] ibid.
[694] ibid.

regardless of the persons who transacted with it. The existence of a token-based CBDC does not rely on the legal system.

8.22. Third, a token-based CBDC is rivalrous. CBDC tokens meet this criterion because the private key prevents another person or entity from using it at the same time. Since each CBDC token has its unique serial number, the use or consumption of such money by a person or a specific group necessarily prejudices the use or consumption of that thing by one or more other persons.[695] The protection against double-spending of a token ensures that it has this functionality. Regarding rivalrousness in crypto-tokens, *Tulip Trading v Van Der Laan*[696] recognised that crypto-tokens can be things to which personal property rights can relate, that they can be rivalrous and that their characteristics are manifested by the active operation of the software. In this case, it was recognised that for a transferable thing to be rivalrous, the holding of it by one person necessarily prevents another from holding that very thing at the same time.

8.23. Similar to this case, a token-based CBDC cannot be consumed twice, even though it is intangible in nature. Once the holder of the CBDC token uses it for payment or to discharge debts, the token becomes spent, and the digital functionality of the system prevents it from being used in another transaction. Likewise, the technology deployed for transactions using a token-based CBDC must be able to anticipate double-spending.[697]

B. CBDC Tokens as Choses in Action

8.24. As a thing, it is capable of ownership, which can be transferred to a new holder when the coin is spent in payment transactions. However, in addition to these basic rights associated with ownership of things, the rightful owner of CBDC tokens also has the right to claim from the issuer the right to payment of central bank money in a different form.[698]

8.25. Although CBDC tokens exist digitally, they are in some sense like fiat money, in that both types of money contain rights against the issuer. A CBDC token is linked to a right to make claims against the token issuer. Furthermore, such a link would affect the rights of the holder, especially when the tokens are transferred to another holder.[699] This aspect of the token is a chose in action in that it is a right against the issuer that is enforceable by action.[700] In this respect, it operates like traditional fiat money, where a right to payment is linked to physical coins or banknotes.[701]

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[695] ibid 65.
[696] *Tulip Trading* (n 689).
[697] See para 6.70.
[698] Bank of Canada and others, 'Central Bank Digital Currency: System Design and Interoperability' (n 21) 3.
[699] One of the criteria in assessing whether a token is linked to another asset is whether the link materially affects the rights of the holder. See International Institute for the Unification of Private Law (UNIDROIT) (n 684) para 4.4.
[700] Law Commission, *Digital Assets: Final Report* (n 676) 33.
[701] Fox, *Property Rights in Money* (n 20) para 1.76.

8.26. As a documentary intangible, a banknote physically represents the payment obligation because such obligation is clearly expressed on the banknote, enabling holders to physically deliver it to discharge debts to the payee without any additional act of settlement or reconciliation of ledgers to complete the payment. Banknotes allow the holder to claim from the central bank as the issuer for the specified amount mentioned on such money.[702] The Currency and Bank Notes Act 1954 also clearly states a connection where banknotes are payable to the holder and such holder is also entitled to receive in exchange for the banknotes of a lower denomination.[703] Furthermore, possession of the notes is the strongest evidence of entitlement to the money it signifies.[704] In practice, these banknotes are treated as things whose delivery constitutes the settlement of monetary obligations.

8.27. The payment obligations in CBDC tokens are specified in monetary amounts denoted in national currency and equivalent to the country's traditional fiat currency, as supported by the cryptography technology in the system. Similar to the nature of a bearer instrument, a token-based CBDC can be used to make payments without the need for a third party or ledger reconciliation.[705] Furthermore, the private key used for a token-based CBDC can be regarded as a digital signature, which is crucial for completing the payment.

8.28. The link established between money and the right to payment from the central bank can be seen from the implementation of the negotiability principle in banknotes; an analogous principle should also apply to CBDC tokens. This negotiability principle enables the transfer of legal ownership of a banknote through simple delivery from the previous holder to the new recipient.[706] Legally owning banknotes means that the holder is entitled to the right to payment from the central bank. Thus, when banknotes are tendered to a new recipient as payment, the legal ownership of the banknotes, which is associated with the right to payment or claims against the central bank, is also transferred from the previous holder to the new recipient.

8.29. Transfer of control over the token through the private key transaction constitutes the transfer of CBDC. Once the transfer of the token to the payee is complete, the payment between them is considered complete, resulting in the discharge of the debt.

8.30. Depending on the design, retail token-based CBDC may constitute claims or contain payment obligations that can be enforceable against the central bank or commercial bank as the issuer. The discussion in this section examines CBDC in a two-tier

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[702] ibid para 1.34.

[703] Article 1 paragraph 3 of Currency and Bank Notes Act 1954 states: "Bank notes shall be payable only at the head office of the Bank of England unless expressly made payable also at some other place"; Article 1 paragraph 4 of Currency and Bank Notes Act 1954 states: "The holder of bank notes of any denominations shall be entitled, on a demand made by him during office hours at the head office of the Bank of England or, in the case of notes payable also at some place other than the head office, either at the head office or at that other place, to receive in exchange for the notes bank notes of such lower denominations, being bank notes which for the time being are legal tender in the United Kingdom or in England and Wales, as he may specify."

[704] McKendrick, *Goode and McKendrick on Commercial Law* (n 639) para 19.02.

[705] Armelius and others (n 256).

[706] Fox, *Property Rights in Money* (n 20) para 8.03.

architecture, where claims linked to tokens are enforceable against the central bank through commercial banks, and compares it with synthetic CBDC, where claims are directed against the commercial bank as an issuer of tokens, even though the latter would not qualify as the true meaning of CBDC as central bank money.

8.31. Legislation related to tokens should be established to recognise the liabilities associated with the issuance of tokens and the transfer of rights of token holders when tokens are transferred between holders.

The Need for Legislation to Create Links in CBDC Tokens

8.32. Currently, there is no existing common law rule to recognise the status of CBDC tokens as negotiable instruments. The link between the tokens and the right to payment of central bank money would need to be conferred by legislation, including determining the legal implications of token transfers. Once it is recognised under legislation, the payee of the token would have the same right to payment as the payer previously had. In case of the insolvency of the transferee, the insolvency administrator would benefit from the same right to payment.

8.33. The concept of linked assets bears a resemblance to promissory notes and traditional banknotes.[707] In these notes, there are links to central bank money or other assets and the designs of the notes to express such links, including the claims or rights of the bearer of the notes, are recognised under the legislation.[708] An example of legislation showing such linked asset is given under s 83 and s 84 of the Bills of Exchange Act 1882, stating that 'A promissory note is an unconditional promise in writing made by one person to another signed by the maker, engaging to pay, on demand or at a fixed or determinable future time, a sum certain in money, or to the order of, a specified person or to bearer' (section 83) and 'A promissory note is inchoate and incomplete until delivery thereof to the payee or bearer' (section 84).

8.34. This legislation clearly indicates that a note, as an object or a thing, is linked to a specific amount of money, in some form of central bank money, payable to a specified person or the bearer. The key point is that the legislation makes the promise to pay enforceable by the bearer, which contemplates that the benefit of the promise is transferable with the note from one person to another. Such a note would take legal effect once it has been physically delivered to the payee, the person to whom the payment is promised.

8.35. Drawing from the example above, acknowledging that CBDC tokens function as a means of payment, similar to the concept of linked assets in promissory notes and banknotes, there should be legislation that can establish the link between tokens and the right to payment of central bank money against the issuer of the tokens.

8.36. Under Indonesian law, creating a legal link between CBDC tokens and the right to payment is also needed and should be clearly stated through regulation. To protect

[707] See para 8.8.
[708] ibid.

CBDC holders, the regulation must ensure that holders of CBDC tokens are entitled to receive payments, with the transfer of such tokens entitling the new holder to the rights to payment from the previous holder.

C. Rights to Payment and Rights to Services in CBDC Tokens

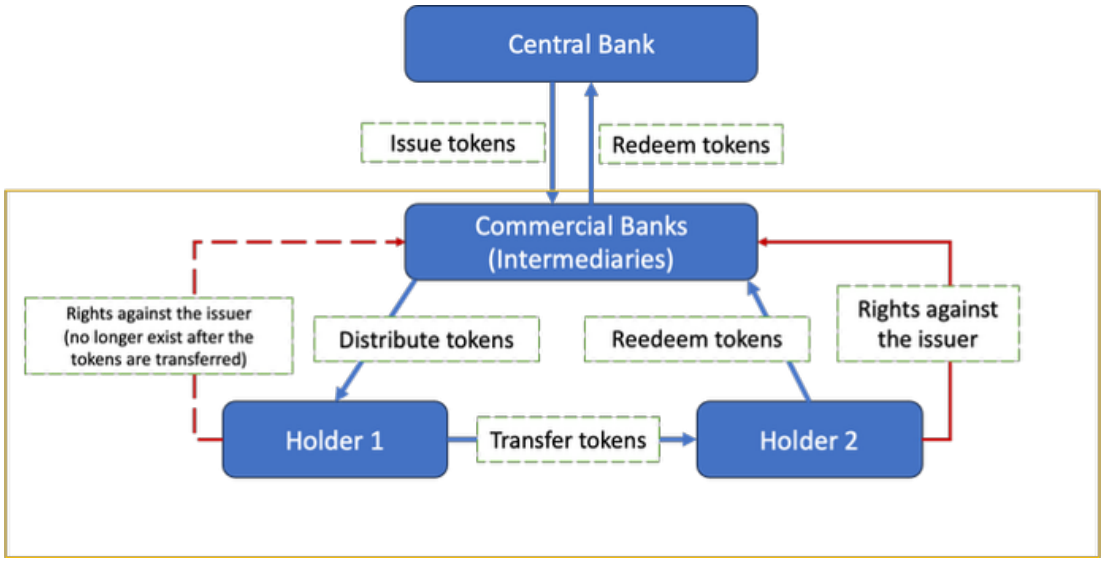
1. CBDC Token Transactions in a Two-Tier Architecture

a. Right to Payment from Central Bank

8.37. The proprietary rights in CBDC tokens in a two-tier architecture CBDC scenario would cover the right to payment from the central bank as the issuer of CBDC tokens and the right to services from entities managing the media for tokens. There are various legal schemes for CBDC token transactions that can be explored to analyse the rights of CBDC holders, including the impact of these rights when the transfer of CBDC tokens takes place.

8.38. In a two-tier architecture, CBDC tokens can be issued within the DLT system by the central bank and distributed to the public by the commercial banks.[709] Moreover, CBDC tokens are stored in a digital wallet system. This wallet may be part of a bank-based wallet network, in which participants include commercial banks, bank customers, and validators operated by a commercial bank on a bank server, or part of a payment system for non-bank companies.[710] Figure 9 below illustrates possible legal arrangements in CBDC token transactions explored in several CBDC projects, such as in Project Aurum and Project Polaris.

Figure 9. Possible Legal Arrangement in CBDC Token Transactions



[709] BIS Innovation Hub and Hong Kong Monetary Authority (n 86) 17.
[710] BIS Innovation Hub (n 558) 31.

(Source: Author)

8.39. In Figure 9, the commercial bank must maintain a wholesale CBDC account with the central bank to exchange it for CBDC tokens. The central bank then distributes the tokens to the commercial banks through the DLT system, allowing them to use the tokens to pay other banks or distribute them to the public.[711] Holder 1, as a customer of the commercial bank, can acquire CBDC tokens by loading his funds available in his savings account at the bank into the CBDC device, which is then recorded as CBDC tokens in that device.[712] For offline payments using CBDC, various devices can be employed, including smartphones, cards, and wearable devices such as watches.[713]

8.40. The discussion in this figure focuses on the rights of payment that are linked to the CBDC tokens stored on offline devices managed by commercial banks, and how such rights can be transferred to another holder after the transfer of the tokens. In essence, CBDC tokens grant Holder 1 rights in CBDC tokens, which are payable or redeemable against the central bank and can be exchanged for other forms of central bank money. When Holder 1 transfers his tokens to Holder 2, the specified amount of tokens from Holder 1 will be extinguished or become unspendable. Consequently, the right of payment of Holder 1 linked to those tokens will also be reduced. Holder 2 will then acquire new tokens equal in value to the amount of tokens of Holder 1 that have been extinguished. After the transfer, Holder 2 should acquire similar rights in the CBDC tokens as previously held by Holder 1. As a consequence of the token transfer, Holder 1 no longer owns the tokens and can no longer enforce the rights to payment linked to them. They are all now in Holder 2, where the central bank has payment obligations to Holder 2. Devices in both Holder 1 and Holder 2 should then update their balance accordingly, depending on the settlement designed for such offline payment.

8.41. The liabilities on these tokens are designed to be binding on the central bank as an issuer of tokens. Therefore, the holders of these tokens have the right to enforce claims against the central bank through the bank that is given authority by the central bank to handle retail payments, including managing the digital wallet system.

b. Digital Wallet to Control CBDC Tokens

8.42. The law defines proprietary rights in CBDC tokens, including the impact of these rights when the tokens are transferred between holders. However, practical control over the use and expenditure of CBDC tokens can be exercised directly through a digital wallet that stores them. Having access to this digital wallet means that the holder of CBDC tokens has effective control over them.

8.43. The exclusive ability to control CBDC has a similar effect to the possession of movables.[714] By having full control of a CBDC through a digital wallet, the holder is in a

[711] ibid 19.
[712] BIS Innovation Hub and Hong Kong Monetary Authority (n 86) 17; BIS Innovation Hub (n 558) 20.
[713] ibid 31.
[714] See International Institute for the Unification of Private Law (UNIDROIT) (n 684) para 6.1-6.2.

legally equivalent position to a possessor of CBDC. It can require the bank to pay tokens into its wallet, redeem and exchange tokens, as well as transfer and receive them.

8.44. Controlling access to a digital wallet should be deemed as a factual ability rather than a legal entitlement to CBDC ownership. Controlling tokens is not the same thing as owning them.[715] Whether the person in control of the tokens in the digital wallet also has a legal right of ownership in them depends on ordinary principles of property law. For example, when the tokens were illegally acquired or hacked from the original holder and transferred to a new holder, they do not become the property of the wrongdoer.

c. The Need for Legislation for CBDC Tokens in a Two-Tier Architecture

8.45. Earlier analysis on the need for legislation[716] also applies in a two-tier architecture, where, to ensure the effective function of CBDC tokens, there should be legislation that provides the scope of the rights to payment from the CBDC that is linked to. It should also provide that these rights are transferred when the tokens linked to rights are transferred from one holder to another.

8.46. Currently, the law governing documentary intangibles is not broad enough to ensure this result, as it only applies to paper tokens in the form of negotiable instruments. Legal status as a negotiable instrument depends on the law's recognition and adoption of an existing customary practice, as seen in *Goodwin v Robarts*.[717] As things now stand, no such custom has formed, or it would take too long for it to earn legal recognition. Therefore, legislation is needed. In addition to this, as discussed earlier, legislation is also needed to ensure that the tokens can function as traditional fiat with claims against the issuer, equivalent to the country's traditional fiat currency and exchangeable to traditional fiat money. Although the commercial bank handles the distribution and retail transactions, this should not affect the liabilities of the CBDC owned by the central bank.

8.47. In a civil law jurisdiction, the terminology of choses in action is not commonly used in the context of property. In general, rights can be categorised as rights over a tangible object or an intangible object, such as intellectual property. In some other civil law countries, new laws are created to classify new types of assets, such as digital assets or tokens.[718] For example, the Liechtenstein 2019 Act on Tokens and Trustworthy Technologies Systems Service Providers (also known as 'Blockchain Act'). Under this Act, a token is generated from trustworthy technology that can represent claims or rights again a person, rights to property and other absolute or relative rights.[719] In Indonesia, under the existing regulation on property, a token-based CBDC can be generally

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[715] See the principle of 'Control' of digital assets proposed by UNIDROIT (See International Institute for the Unification of Private Law (UNIDROIT) (n 684) para 6.9-6.10).

[716] See para 8.32.

[717] *Goodwin v Robarts* (1875) LR 10 Exch 337.

[718] See Marianne Bechara and others, 'Private Law Aspects of Token-Based Central Bank Digital Currencies' (2025) Fintech Notes NOTE/2025/003, 12 < https://www.imf.org/en/Publications/fintech-notes/Issues/2025/03/14/Private-Law-Aspects-of-Token-Based-Central-Bank-Digital-Currencies-565165 > accessed 12 September 2025.

[719] Article 2 (c) and 4 of the Blockchain Act. See unofficial translation of the Blockchain Act < https://www.regierung.li/files/attachments/950-6-tvtg-250201-en.pdf > accessed 12 September 2025.

categorised as a movable and intangible object.[720] The right over this object can be transferred from one holder to another through authentic documents.[721] Movable and intangible objects, such as intellectual property rights, can also be transferred to another holder through any mechanism as long as it is stated under regulation, as ruled in Article 16 of the Copyright Law 2014. A specific regulation should be created to classify the Digital Rupiah in the form of a token-based CBDC. This regulation should further determine the scope of rights of a token-based CBDC and the mechanism for how they can be transferred from one holder to another. This regulation is needed to give legal certainty for the public and to ensure the effective enforcement of their rights, regardless of the media used for storing token-based CBDCs.

8.48. Furthermore, the regulation should also outline clear mechanisms for acquiring, redeeming, and transferring token-based CBDCs. Designs for token-based CBDC might vary, including the media or devices used to store the token-based CBDCs. As a consequence, regulations on the Digital Rupiah should be able to set the standard requirements for those media or devices. In addition, the regulation should also require intermediaries and other relevant parties to prepare the mechanisms to enforce the rights of CBDC holders.

2. Synthetic CBDC Token Transactions

Right to Payment from the Commercial Bank

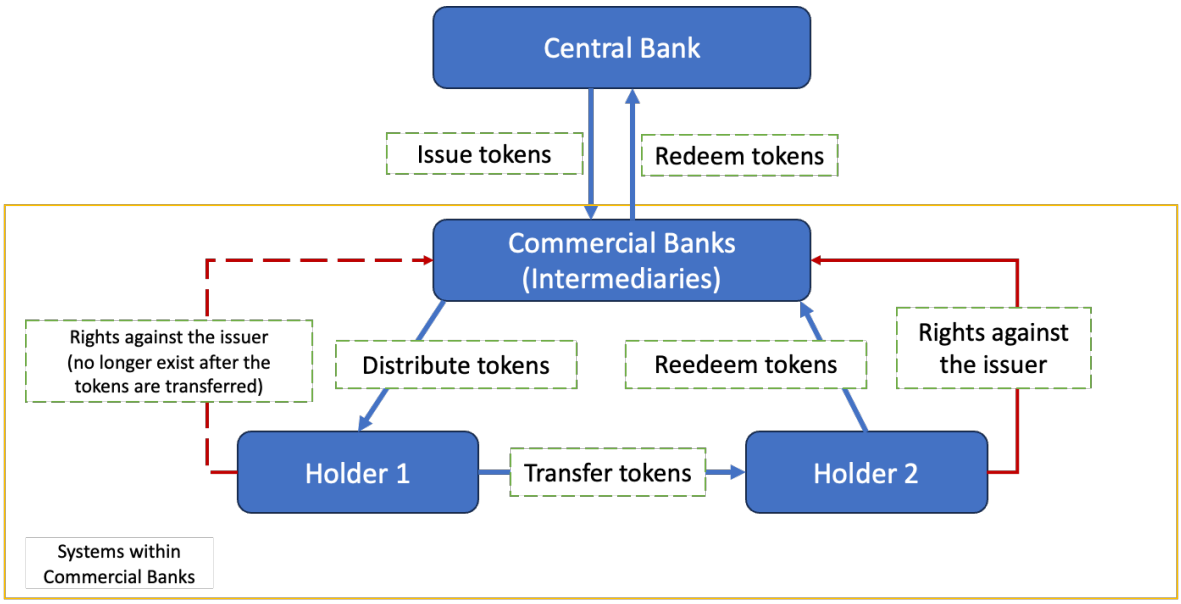
8.49. In a synthetic CBDC, a token-based CBDC issued by the commercial bank should not be regarded as central bank money, but it still can be used as a means of payment, with certain requirements such as the need for backing assets. This concept is similar to banknotes issued by the Scottish commercial banks, where this money is not considered as central bank money, and the banks must have backing assets to issue this money as required by legislation.[722]

8.50. These tokens in synthetic CBDC are designed to constitute claims or payment obligations that can be enforceable only against the commercial bank as the issuer. In this scenario, the tokens are issued within the DLT system by the central bank and distributed to the commercial banks. However, the commercial bank, as an intermediary, issues a claim to consumers, but such a bank is required to have full backing for each claim with a CBDC holding at the central bank.[723] The tokens issued by the commercial bank to the public do not constitute central bank money as they are not a liability of the central bank. In this respect, they exhibit some similarities with e-money or stablecoins, and for this

[720] See definition of movable and intangible object in Article of 511 of the Indonesian Civil Code.
[721] Indonesian Civil Code, art 613.
[722] Bank of England, 'Scottish and Northern Ireland Banknotes' < https://www.bankofengland.co.uk/banknotes/scottish-and-northern-ireland-banknotes > accessed 12 September 2025; See Scottish and Northern Ireland Banknote Rules 2017, arts 1.1 and 2.2 < https://www.bankofengland.co.uk/-/media/boe/files/banknotes/scottish-northern-ireland/scottish-and-northern-ireland-banknote-rules-2017.pdf > accessed 12 September 2025.
[723]BIS Innovation Hub and Hong Kong Monetary Authority (n 86) 4-5.

reason, some authors have argued that they should not be analysed as CBDCs at all.[724] Figure 10 illustrates a simplified legal arrangement in a synthetic CBDC.

Figure 10. Legal Arrangement in a Synthetic CBDC



(Source: Author)

8.51. In this scenario, the distinct elements that differentiate it from Figure 9 are the rights or claims within CBDC tokens that are directed against the commercial bank as the issuer of tokens. The legal analysis in Figure 9 also applies to this design, except that the holders possess rights that are enforceable against the commercial bank. Consequently, following the transfer of tokens from Holder 1 to Holder 2, Holder 1 should no longer maintain rights in the tokens, as these rights now belong to Holder 2. The commercial bank, as the issuer, now has payment obligations to Holder 2.

8.52. Similar to the legal analysis of the law and legislation in Figure 9, the scenario in Figure 10 would require legislation regarding the scope of rights within CBDC tokens that are enforceable against commercial banks, including the transfer of these rights upon token transfer from one holder to another.

8.53. The mechanism designed in synthetic CBDC resembles that used for banknotes issued by some commercial banks in Scotland and Northern Ireland. Six commercial banks in Scotland and Northern Ireland, such as Bank of Scotland plc, Clydesdale Bank plc and the Royal Bank of Scotland plc, are authorised under the law to issue banknotes that can be used in payments.[725] The holding and issuance of such banknotes is subject to the rules of the BoE.[726] For example, the notes issued by the Scottish Banks are claims on

[724] See para 7.10.
[725] Bank of England, 'Scottish and Northern Ireland Banknotes' < https://www.bankofengland.co.uk/banknotes/scottish-and-northern-ireland-banknotes > accessed 12 September 2025.
[726] See Scottish and Northern Ireland Banknotes Regulations 2009, reg 3(1).

those banks only, but the value of those claims is limited to 1:1 against a reserve of other money, which does create direct claims by the Scottish Banks on the central bank. To issue banknotes, these commercial banks must have backing assets that are worth at least the value of all of the banknotes they have in circulation, which can be in the form of a backing account placed at the BoE.[727]

8.54. In principle, the holders of banknotes issued by commercial banks enforce their rights against the commercial banks, not the central bank. However, in the case of insolvency of the commercial banks, the BoE has the right to satisfy the claims of the holders by exchanging the notes with central bank money, such as banknotes and coins belonging to the BoE, and then obtain reimbursement from the backing assets of the commercial banks.[728] The holders also have the right to have the bank's backing assets for the purpose of satisfying their claims.[729]

8.55. Mirroring the legal scheme governing the banknotes issued by commercial banks in Scotland and Northern Ireland, as explained above, it can be argued that commercial banks may also issue CBDC tokens in a synthetic CBDC design. However, legislation is needed as a legal basis and to confirm the validity of these tokens as a means of payment. The scope of regulation should cover, among others, the rights of the holders against the issuer, the involvement of the central bank in satisfying claims of the token holders in the event the commercial bank becomes insolvent, backing assets required for commercial banks, and the rights of the holders in case of the insolvency of the commercial banks. The wholesale accounts held by the commercial bank at the central bank would serve as backing assets, enabling the central bank to fulfil the claims of token holders in the event of insolvency of the commercial bank as the issuer of tokens.

3. Rights to Services from Commercial Banks

8.56. As shown in Figures 9 and 10, the commercial bank plays a role in handling retail payments and might use technology such as a digital wallet. Where a digital wallet or e-wallet is used, or what may be termed a 'bank-based wallet network', in which commercial banks, bank customers and validators are involved as participants.[730] To use a digital wallet, the holders of CBDC must be bank customers who have a savings account and a digital wallet account within such a bank.[731] Through this digital wallet, CBDC holders can interact with the bank server system, including conducting all activities, such as payment using CBDC through the bank, as this digital wallet also stores CBDC tokens.[732]

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[727] Bank of England, 'Scottish and Northern Ireland Banknotes' (n 713); See Scottish and Northern Ireland Banknote Rules 2017, arts 1.1 and 2.2 < https://www.bankofengland.co.uk/-/media/boe/files/banknotes/scottish-northern-ireland/scottish-and-northern-ireland-banknote-rules-2017.pdf > accessed 12 September 2025.

[728] See Scottish and Northern Ireland Banknote Regulations 2009, reg 21 (3).

[729] Ibid reg 22 (1).

[730] BIS Innovation Hub and Hong Kong Monetary Authority (n 86) 15.

[731] ibid.

[732] ibid.

8.57. There are many functions associated with the digital wallets, such as generating an identity (which consists of the keypair and user name) and storing account information.[733] With a digital wallet, the holder of token-based CBDC can request tokens from the bank, redeem tokens and place them in their savings account, pay tokens to other CBDC holders or receive tokens from other CBDC holders.[734]

8.58. Similar to the rights involved in the contractual relationship in an account-based CBDC, the CBDC token holders are also entitled to the rights to services from entities managing the digital wallets. These services should be provided to customers through any contract and must include a duty to perform the service with reasonable care and skill.[735]

IV. Conclusions

8.59. The holder of a CBDC token has the right to payment from the central bank as the CBDC issuer because the tokens link to such a right. In this respect, a token-based CBDC resemble banknotes. As negotiable promissory notes, the bearer can enforce a claim for payment of legal tender money from the issuing bank. Because of the rights to payment associated with them, CBDC tokens should be analysed as linked assets, and they function very like documentary intangible.

8.60. As seen with account-based CBDC, legislation is also needed for CBDC tokens to effectively function as a means of payment. Legislation would be needed to link the right to payment of the central bank money to the token. Only in this way would the right to payment be transferred when the token itself was transferred from one holder to another.

8.61. In a two-tier architecture, the right to payment is enforceable against the central bank through the commercial banks that are given authority by the central bank to handle retail payments, including managing the digital wallet system. Additionally, when digital wallets are used in transactions that require the existence of bank accounts, the CBDC holder is also entitled to the right to services from banks or the relevant entities to ensure that payments using tokens can be made. Their services are usually carried out through wallets.

8.62. CBDC tokens used in retail payments may also adopt a synthetic architecture. A key difference between intermediated and synthetic models lies in the status of tokens, where in the synthetic design, the tokens do not qualify as the 'real' CBDC, with a status equivalent to central bank money. As a result, any claims in this model are enforceable by the commercial banks as the issuer of the tokens, rather than the central bank.

[733] ibid 20.
[734] Ibid.
[735] See Supply of Goods and Services Act 1982, s 13; See Consumer Rights Act 2015, s 49.

CHAPTER 9

FOUNDATIONAL PRINCIPLES IN DESIGNING CBDC TO PROTECT ITS HOLDERS

I. Introduction

9.1. The previous chapters have explored the legal dimensions of CBDC in relation to money in terms of settlement finality, technology and proprietary rights. The chapter now turns to the question of how CBDC should be designed at the very least to protect the rights of its holders. The answer to this question will be drawn from synthesising the analysis in the previous chapters to create principles for designing CBDC that relate to public interest, economic freedom, privacy and sustainability.

9.2. This chapter proposes foundational principles in designing CBDC that mainly aim to protect the rights of CBDC holders, if CBDC were introduced as a means of payment for retail transactions, both in account-based and token-based forms. It is also intended to be a core consideration for regulators when designing a regulatory framework for CBDC. The foundational principles are grounded in recognising CBDC as a means of payment, the participants' responsibilities in the CBDC ecosystem, and the systems used for CBDC transactions. While each topic has been discussed in earlier chapters, the discussion in this chapter explores regulatory principles as guidance for adopting CBDC into the financial system.

9.3. The discussion begins by analysing theories and best practices regarding money and payment systems, along with conceptual theories and insights about CBDC introduced by

international financial organisations and central banks, based on from various research and CBDC projects. The first foundational principle is related to CBDC as a monetary instrument, where any policies issued by the authority related to CBDC must prioritise and protect the public interest. CBDC can be issued as a monetary policy tool to support financial inclusivity. Depending on the policy's aims and considerations, CBDC may or may not be designed to be interest-bearing. Nonetheless, the public interest must remain the main consideration for the authority when issuing any policies related to CBDC, such as those related to monetary policy, interest rate policy, and financial inclusion, especially given that CBDC also represents a direct liability of the central bank.

9.4. The second principle is that when CBDC is intended as a means of payment, the holders of CBDC must have autonomy and should not be restricted to using CBDC as a means of payment for any retail transaction they wish to use. It is the state that defines the ultimate means of discharging debt and provides its population with the means of doing so. This principle is in line with the aspects of economic freedom related to the use of money, where, in the case of CBDC, the public should be given options on whether to use CBDC in their transactions. This principle is also essential in addressing concerns related to programmability in CBDCs and the potential violation of individual rights, as concerns may arise in some countries, such as the UK and Nigeria. However, given that payment services that process CBDC are public goods, there is also concern that private payment providers should not have a monopoly on the provision of payment services. It should be the role of the state, or central bank, to provide and manage the system to protect the public interest. As the issuer of CBDC can promote economic freedom through regulations, they are the first step towards protecting property in CBDC.

9.5. The next foundational principle is associated with designing the responsibilities of the main participants in the CBDC ecosystem, where the discussion of those participants is limited to central banks, intermediaries, and the public as end-users of CBDC. As an issuer of CBDC, the central bank should not limit the issuance of CBDC to only certain entities or parties, especially when the CBDC is designed for retail use, which should be available to the public for general-purpose transactions. However, for the issuance of CBDC to be effective, creditors, merchants or retailers must accept this kind of money as a valid method of payment.

9.6. Another concern in implementing CBDC is data protection and privacy. The central bank should aim to strike a balance between the need for protection and preventing illicit and fraudulent activities using CBDC in the financial system. The central bank, as issuer and commercial banks, as intermediaries of CBDC, must ensure the protection of data relating to any information and the protection of privacy in CBDC transactions. In this context, holders should be given preferences in choosing the types of CBDC, which might have different levels of privacy. They are responsible for protecting their data and devices or media that store their CBDC. As part of data protection and combating anti-money laundering transactions, it is important for the intermediaries to apply adequate KYC procedures tailored to the necessity of the CBDC designs.

9.7. The last foundational principle is related to the sustainability of systems used in CBDC. Once CBDC is introduced to the financial system, it must be made sustainable for the

public as CBDC holders. This sustainability focuses on environmental and durability concerns, including the security of the systems for the users. Besides creating an eco-friendly CBDC, it must also be capable of preventing any risks associated with its use.

II. Principle 1 - Policies related to CBDC as a Monetary Tool Should Consider Public Interest

9.8. The first principle proposed in this section is that any policies related to the issuance and distribution of CBDC as a monetary tool should consider the public interest. An example of such policies discussed in this section is monetary policy, which relates to money supply, interest rates and financial inclusion. The central bank must consider the public interest in enacting monetary policies related to CBDC since, just like traditional money, it is a public good to some extent,[736] and it could be used widely by the public as a means of payment, which would be a direct liability of the central bank as recorded in its balance sheet. Thus, any policies that can harm the rights of CBDC holders should be avoided.

A. CBDC as a Monetary Policy Tool Issued for Public Welfare

9.9. Many studies have discussed the issuance of CBDC and its implications for monetary policy and transmission. The discussion in this chapter complements such studies by ensuring that the first principle in the issuance of CBDC is that any policies, especially monetary policy, related to CBDC must consider and protect the public interest. This section emphasises the importance of protecting the public interest in relation to CBDC, including the rights of individuals who might be affected by policies issued by the central bank.

9.10. The state has the power to control the emission of money, including CBDC, through fiscal policy rather than monetary policy.[737] To ensure coherence with these policies, CBDCs should be readily convertible into other forms of central bank money (eg banknotes). In terms of money supply, when CBDCs are at all times readily convertible into central bank money, the amount of CBDCs issued can and should be added to the overall quantity of fiat money circulating in the economy. In relation to monetary policy, the central bank is the sole monetary authority within a jurisdiction, serving as the anchor of the financial system in a modern economy.[738] Its main function as a monetary authority is open-ended and dynamic, including conducting monetary policy, issuing money, serving as a lender of last resort, and ensuring a smooth payment system.[739]

9.11. Monetary policy is important for the central bank as it can be used to control economic fluctuations and achieve price stability, including managing low and stable inflation.[740] This policy can be implemented by adjusting the supply of money and conducting open market operations like buying or selling securities.[741]

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[736] Christian Felber, *Money - The New Rules of the Game* (Springer International Publishing 2017) 29-30.
[737] Wray (n 252) 18.
[738] Lastra (n 18) para 2.08.
[739] ibid.
[740] International Monetary Fund, 'Monetary Policy and Central Banking' (n 304).
[741] ibid.

9.12. Monetary stability may be defined as the stability of the internal value of money and the external value of the currency, but it can be viewed as the mere absence of instability.[742] External stability of money, including CBDC, should depend on the national currency's parity in the global markets, while internal stability depends on the rate of inflation. Under the theory of monetarism developed by Friedman and Schwartz, the money supply is considered the primary factor influencing inflation or deflation in an economy.[743] The central bank, as a monetary authority, can expand or contract the supply of money by implementing interest rate policies. Moreover, under the theory of monetarism, controlling the money supply by the monetary authority would be an effective way to create monetary stability.[744]

B. Possible Interest Rate Policies on CBDC

9.13. As mentioned earlier, the central bank has the power to control the money supply, among other ways, by setting interest rates that can also apply to CBDC if necessary. When the central bank lowers the interest rate, monetary policy is eased, whereas raising interest rates reflects a tightening monetary policy. Related to the interest policy for CBDC, the central bank may design CBDC to be interest-bearing. If CBDC were intended as a form of investment instead of a means of payment, interest-bearing features could be attractive to the public.[745] Conversely, if it were designed as a means of payment, it may be more appropriate to implement a non-interest-bearing design, or, alternatively, to apply negative interest rates to CBDC.[746]

9.14. The decision whether or not to design CBDC as interest-bearing brings distinct implications. Studies show that many jurisdictions consider issuing a non-remunerated CBDC just like traditional banknotes, while a remunerated CBDC could be attractive for the public as a substitute for cash and bank deposits.[747] However, the interest rates will be affected by the base rate set by the central bank to meet its inflation targets. For a non-remunerated CBDC, where no interest is paid on the CBDC, a similar circumstance to that offered by cash today could help the central bank set interest rates to stimulate spending and investment. For a remunerated CBDC, besides allowing the central bank to compete with commercial banks, this condition would bring complexity when determining the interest rates, as CBDC would be directly linked to them. When CBDC becomes more attractive with its remuneration, it may trigger a reduction in commercial bank deposits as people shift their deposits to CBDC, which in turn causes disintermediation from commercial banks.[748] In general, disintermediation in the banking sector could have negative impacts as it would reduce banks' funding and their

[742] Lastra (n 18) para 2.85.
[743] Milton Friedman and Anna Jacobson Schwartz, *A Monetary History of the United States, 1867–1960,* (National Bureau of Economic Research, 1963) 299-407.
[744] Milton Friedman, *Capitalism and Freedom* (The University of Chicago Press, 1962) 49-50.
[745] Bank of Canada and others, 'Central Bank Digital Currencies: Financial Stability Implications' (2021) 4 < https://www.bis.org/publ/othp42_fin_stab.pdf > accessed 12 September 2025.
[746] ibid.
[747] ibid
[748] Rhys Bidder and others,' CBDC and banks: Disintermediating fast and slow' (2025) BIS Working Papers No 1280 < https://www.bis.org/publ/work1280.pdf > accessed 12 September 2025.

ability to lend.[749] In the end, it might negatively affect the financial stability if the impact on the banks becomes systemic to the financial system.

9.15. Negative interest rate policies (NIRP), which could also be applied to CBDC, are not a new tool in monetary policy. Several central banks, such as the European Central Bank, the Bank of Sweden, and the Bank of Japan, have implemented NIRP in their economies as unconventional monetary policy tools in the past, targeting a low-inflation environment.[750] Implementing NIRP by the central bank may be done by lowering the deposit facility rate below zero.[751] This policy results in the central bank imposing charges on commercial banks and financial institutions for their excess reserves, which incentivises banks to increase loans and disperse money into the economy.[752] When the central bank sets negative interest rates, it expects banks to lend at low rates to attract businesses or individuals to borrow money from the banks.[753] This policy is intended to stimulate economic activity. However, it may also lead banks to charge negative interest rates to their customers.[754] Instead of earning interest from banks, customers must pay interest to the bank for placing their money in the bank's deposits.

9.16. NIRP and other interest rate policies should not harm or reduce the rights of the CBDC holders. If the negative interest rate applies to CBDC, this type of money would become less attractive than banknotes or other forms of central bank money. Applying the negative interest rate would then cause the holders of CBDC to either consume or exchange their CBDC for another form of central bank money,[755] to which the negative interest rate does not apply, such as cash. Although the monetary authority can still apply the NIRP, these policies should not restrict the rights of the holders to consume or exchange CBDC for another form of central bank money. If the holders of CBDC choose to keep the CBDC with the NIRP, that would be the holders' rights as well.

C. CBDC as a Tool for Financial Inclusion

9.17. To support the implementation of the first foundational principle, the issuance of CBDC should consider the public interest. Therefore, the central bank should guarantee that

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[749] Huiefang Chang and others, 'Central Bank Digital Currency and Bank Disintermediation in a Portfolio Choice Model' (2023) 3 < https://www.imf.org/en/Publications/WP/Issues/2023/11/18/Central-Bank-Digital-Currency-and-Bank-Disintermediation-in-a-Portfolio-Choice-Model-541607 > accessed 12 September 2025.

[750] European Parliament, 'Low for Long: Side Effects of Negative Interest Rates' (2021) 8 < https://www.europarl.europa.eu/cmsdata/235693/02.DIW_formatted.pdf > accessed 12 September 2025.

[751] ibid.

[752] Spencer Feingold, 'Japan Ends Era of Negative Interest Rates: a Chief Economist Explains' (2024) < https://www.weforum.org/agenda/2024/03/japan-ends-negative-interest-rates-economy-monetary-policy/ > accessed 12 September 2025.

[753] European Central Bank, 'Decisions, Statements and Account' < https://www.ecb.europa.eu/mopo/decisions/html/index.en.html > accessed 12 September 2025.

[754] Henrike Michaelis, 'Negative Interest Rate Policy Led to Negative Interest Rate on Corporate Deposits and Higher Fees' (2023) Research Brief 56th Edition< https://www.bundesbank.de/en/publications/research/research-brief/2023-56-negative-interest-rate-policy-665708 > accessed 12 September 2025.

[755] Pengfei Jia, 'Negative Interest Rates on Central Bank Digital Currency' (2020) MPRA Paper No. 103828, 5 < https://mpra.ub.uni-muenchen.de/103828/1/MPRA_paper_103828.pdf > accessed 12 September 2025.

CBDC is available in every area, including remote areas within the jurisdiction, if it is designed as a tool for financial inclusion.

9.18. CBDC should be made available to a large share of the population, including low-income populations, so their use by all manner of people and businesses could support financial inclusion. Individuals living in remote areas and below the poverty line are most likely to encounter barriers when accessing financial services. In many cases, these areas are unattractive to commercial banks or other private financial institutions because they do not find it profitable to expand their financial services in these areas.[756] However, this partly depends on the proportion of banked people in the country and the general availability of banking services. Therefore, by ensuring the availability of CBDC to all households, including those who live in remote areas, the state will be directly involved in providing financial access through systems or platforms to the broader economy. This argument has been explicitly recognised in China, where the CBDC system would enable unbanked people residing in rural areas to access basic financial services, thereby eliminating the costs associated with travelling to commercial banks.[757] The services for CBDC could even be offered at no cost, as the central bank may recover the operating expenses of the system through its seigniorage income.[758]

9.19. However, the successful implementation of CBDCs in rural areas requires careful consideration of technical challenges. One such challenge pertains to issues surrounding data connectivity and the reliability of electricity. The design and infrastructure of CBDCs must be effective in overcoming these geographical and technical barriers by, among other things, incorporating features that support offline transactions. Offline features in CBDCs would enable peer-to-peer payments without an internet connection, with settlement occurring in real-time.[759]

III. Principle 2 - CBDC Should be Freely Used as a Means of Payment

9.20. The second foundational principle argues that CBDC holders should have the freedom to use CBDC as a means of payment for any retail transaction they choose. This principle is in accordance with the economic freedom that primarily safeguards personal choice, voluntary exchange, freedom to compete in markets, and protection of person and property.[760] The discussion on implementing economic freedom in the adoption of CBDC

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[756] Auer and others, 'Central bank digital currencies: a new tool in the financial inclusion toolkit' (n 126) 17; In the UK, many commercial banks have closed their branches as a result of declining use of cash and other physical payments activities, as banks have shifted their operations online to improve efficiency. However, recognising that some group of people still need the access to banking services and to cash, the UK government has taken steps to preserve this access, including expanding the role of post offices to provide cash services and proposing legislation to guarantee free access to cash (see Abbas Panjwani, 'Access to cash and banking services' (2025) 11-12, and 31 < https://researchbriefings.files.parliament.uk/documents/CBP-9453/CBP-9453.pdf> accessed 22 December 2025.

[757] People's Bank of China (n 124) 5.

[758] Auer and others, 'Central bank digital currencies: a new tool in the financial inclusion toolkit' (n 126) 17.

[759] Minwalla and others (n 561).

[760] See Robert A. Lawson, 'Economic Freedom' < https://www.econlib.org/library/Enc/EconomicFreedom.html > accessed 12 September 2025; James Gwartney and Robert Lawson, 'Ten Consequences of Economic Freedom' (2004) 1 < https://www.ncpathinktank.org/pdfs/Economic-Freedom.pdf> accessed 12 September 2025.

should at least cover the personal choice of the individual in choosing CBDC as a means of payment, as well as the creditor's acceptance of CBDC as a method of payment to discharge debt and freedom to exchange CBDC to another form of central bank money.

9.21. The implementation of economic freedom in the adoption of CBDC should be guaranteed by regulations.[761] The discussion on regulations also covers the legal system and property rights, as they are closely related. Regulations play an important role in promoting the economic freedom related to CBDC and protecting CBDC as property, including the rights associated with it. All in all, regulations must clearly define CBDC as a means of payment and its ability to discharge debts. After legally recognising CBDC through regulations, the protection of CBDC as property, including its associated rights, may be created depending on the approach of the legal system in a jurisdiction. By protecting CBDC's status as a property, it also means protecting the rights of the holders by bringing it within existing regimes of enforcement and recovery.

A. Implementing Economic Freedom in the Adoption of CBDC

9.22. In general, economic freedom has a positive impact on the wider economy by boosting investment productivity, strengthening democracy as political rights and civil liberties are also enhanced, and leading to reduced corruption in both business and government.[762] In fact, economies that rely on private property, free markets, and free trade tend to grow more rapidly than those with less economic freedom.[763] This explains why economic freedom, including in the adoption of CBDC as a means of payment, is important for economies.

9.23. The economic freedom in the use of CBDC can be implemented by (i) guaranteeing personal preference for the holders to use CBDC as a method of payment, (ii) freedom to exchange CBDC for another form of central bank money, and (iii) ensuring the merchant's acceptance of CBDC as a means of payment. These three points are elaborated upon below.

1. Personal Preference in Transacting with CBDC

9.24. The adoption of CBDC seems closely associated with the economic freedom of holding property, as this freedom allows individuals to use, exchange, or transfer property freely, provided that there is no violation of the identical rights of others.[764] The issuance of CBDC to the public should ensure the freedom of use of CBDC for any kind of retail transaction as preferred by the holders. Personal choice, as one of the key ingredients in economic freedom, should be implemented in the adoption of CBDC. This freedom to

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[761] See Fraser Institute, '*Economic Freedom of the World: 2023 Annual Report*' (2023) v <https://www.fraserinstitute.org/studies/economic-freedom-of-the-world-2023-annual-report > accessed 12 September 2025. In this report, economic freedom can be measured in five areas consisting of the size of government, legal system and property rights, sound money, freedom to trade internationally, and regulations.
[762] Gwartney and Lawson (n 760) 2 and 16.
[763] ibid 2.
[764] Fraser Institute, 'Economic Freedom Basics,' < https://efotw.org/economic-freedom/economic-freedom-basics > accessed 12 September 2025.

have a personal preference in using CBDC could address concerns about programmability in CBDC.

9.25. The concept of 'programmability' may be understood in a number of different ways, and misperception about this concept in CBDC could lead to controversy. A transaction is considered programmable when it occurs automatically when a specified set of conditions is fulfilled, which is no different from the technical controls that already exist, such as creating standing orders in commercial banking transactions.[765] However, programmability can be built into CBDC by the authority if it is designed specifically for conditional payments using smart contracts. For instance, CBDC could be programmed only for spending in government household relief subsidies,[766] and it can also have a maximum transfer limit of CBDC between parties to avoid double-spending and enforce anti-money laundering measures.[767] However, this programmability would depend on the design of CBDC and how the approach is taken by the authority in the adoption of CBDC.

9.26. The programmability of CBDC, however, could be understood in different ways, such as controlling the use of CBDC and restricting the use of CBDC for certain transactions. Earlier chapter discussed a petition submitted to the government that aimed at preventing any implementation of programmable CBDC because it was feared that the government would control the use of CBDC.[768] Controlling the use of CBDC would mainly be in the hands of the holders.

9.27. However, in this UK petition, the petitioners argued that the adoption of CBDC as programmable money should not violate legal rights and freedoms under articles 8 and 14 of Human Rights Act, as follows[769]:

- *Every person has the entitlement to have the right to respect for his private and family life, his home and his correspondence* (article 8);
- *The enjoyment of the rights and freedoms set forth in this Convention shall be secured without discrimination on any ground such as sex, race, colour, language, religion, political or other opinion, national or social origin, association with a national minority, property, birth or other status* (article 14).

From the petition, it seems that the petitioners fear that the programmability of CBDC would violate an individual's rights regarding their private life, including the privacy of how and why they spend money. Responding to this petition, as discussed earlier, the HM Treasury stated that the government would not have the capability or plan to program including control CBDC.[770]

[765] See Petition – UK Government and Parliament (n 111).
[766] Soderberg and others, 'How Should Central Banks Explore Central Bank Digital Currency?: A Dynamic Decision-Making Framework' (n 120) 22.
[767] European Central Bank, 'Exploring Anonymity in Central Bank Digital Currencies' (n 121) 5-6.
[768] See para 2.62.
[769] See para 2.63.
[770] ibid.

9.28. Programmability in CBDC might also be associated with the systems embedded in an infrastructure that enables CBDC to be processed and settled. These CBDC systems most likely have characteristics that could lead to their classification as FMI, which have a function to facilitate the clearing, settlement, and recording of monetary and other financial transactions.[771] Examples of the existing FMIs are the RTGS system to handle the payment system, Securities Settlement Systems to handle the settlement of securities, and the Central Counterparty system that can facilitate securities trading in the market.

9.29. If CBDC systems were classified as FMI, just like existing FMIs, then they should comply with the standards and principles outlined in international best practices, such as those determined by the BIS. CBDC systems can be determined by the authority as systemically important, as they can face systemic risks, just like traditional payment systems.[772] In principle, FMI can be operated either by central banks or the private sector.[773] However, since CBDC systems would be highly exposed to systemic risks that affect public interests, ideally, such systems should be fully controlled or operated by authorities such as the central bank. This also addresses any concern about a monopoly on the provision of payment services by the private sector.

2. Creditor's Acceptance of CBDC as a Means of Payment

9.30. The use of CBDC as a means of payment is related to its status as legal tender, as discussed in Chapter 4. This also means that creditors must accept CBDC as payment for debts. A status as legal tender should be granted by the state through legislation; through this status, CBDC can be used for any transaction according to the preference of its holder. From the creditor's perspective, including merchants, they cannot refuse any payment using CBDC because of the doubt in CBDC's function as a legal tender.

9.31. If CBDC were declared as legal tender, then it would be mandatory for the creditor to accept CBDC as a means of payment at its full-face value, unless both parties agree to use another method of payment. In this context, the creditor is obliged to accept the legal tender value rather than any discounted value. However, in reality, it is not possible for a creditor to prefer a certain method of payment. In an earlier chapter,[774] it was discussed that the creditor must accept legal tender in discharging debts unless there is a valid reason(s) why the creditor or merchant refuses it.

9.32. It was discussed previously that the creditor or merchant may refuse legal tender as payment if he doubts the quality of money or there are conditions of the payment, such as being too late, too early or insufficient.[775] In this case, such refusal is based on disagreement with the debtor regarding the quality of the money or the conditions of payment, but not on the status of such money as legal tender. In the context of CBDC,

[771] Bank for International Settlement - Committee on Payment and Settlement Systems, 'Principles for Financial Market Infrastructures' (n 524) 5.
[772] ibid 11.
[773] ibid 8.
[774] See Chapter 6.
[775] See Chapter 4.

there are examples of conditions that might be considered valid reasons for the creditor to refuse CBDC as a means of payment, as follows:

a. limited or unavailability of infrastructure or devices to support CBDC as a means of payment, both for offline CBDC and online CBDC; or
b. low networking or reception might hinder the system's ability to receive CBDC as payment, which can furthermore cause the payment to violate the agreed-upon terms and conditions, such as being too late.

9.33. The creditor or merchant cannot refuse CBDC as payment because they doubt that CBDC would be regarded as a legal tender that has the same value as other forms of central bank money. However, to encourage general adoption of CBDC by the public, the infrastructure, including systems, devices and connections needed to perform CBDC transactions, has to be made easy for the creditors or merchants.

3. Freedom to Exchange CBDC to Another Form of Central Bank Money

9.34. When CBDC is issued to the public, then this money should be able to be exchanged with other central bank money at the option of the CBDC holders. In earlier chapter, it is argued that the CBDC holder should have the right to exchange CBDC for another form of central bank money.[776] When a person is the rightful holder of CBDC, it means that they should be able to exercise their economic freedom among others by exchanging their CBDC for another form of central bank money.

9.35. Since CBDC is a form of central bank money that can function as traditional money, then CBDC must have the same value as physical notes or coins that can be used to discharge debts or pay for retail transactions. Furthermore, exchanging CBDC for another form of central bank money should be free from any deduction for any cost.

9.36. The public should be able to exchange CBDC for other forms of central bank money, as substituting CBDC for those kinds of money would not make any change to the liability of the central bank represented in its balance sheet, as discussed in paragraph 2.55-2.60. It also means that CBDC and other forms of central bank money have the same value, and therefore, the public should have the freedom to exchange them.

9.37. If CBDC were designed for cross-border transactions, the economic freedom in CBDC should also cover the freedom to exchange other currencies, with a reasonable exchange rate, as well as to use it for payment in international transactions.[777] However, such freedom should be supported by infrastructure, including compatible systems that can facilitate such exchange.

B. Measuring the Implementation of Economic Freedom in the Adoption of CBDC through Regulations

[776] See Chapter 4.
[777] Fraser Institute, 'Economic Freedom of the World: 2023 Annual Report' (n 761) v.

9.38. Economic freedom in the adoption of CBDC can generally be ascertained from legal aspects such as regulations. A regulation can be used as a tool to assess whether an individual's economic freedom has been impacted.[778] For instance, the restriction on entry into markets and interference with voluntary exchange.[779] Regulations in a legal system are important for the government to protect property and individual rights associated with the property.[780]

9.39. This section discusses regulations as a tool to measure the implementation of economic freedom in the adoption of CBDC. The discussion covers the functions of regulations and their relevance to economic freedom, and the essential coverage for CBDC to be included in regulations.

9.40. As discussed in the previous chapters, ordinary private law principles in English law would provide for the protection of CBDC as property.[781] However, regulations can provide further protection for CBDC by legally recognising it as a means of payment that the public can use for retail transactions. The lawful recognition of CBDC in the regulations acknowledges the existence of CBDC and, therefore, some parts of ordinary private law would follow from such recognition. However, its property status would follow from its recognition in private law. For example, a token-based CBDC is a thing or a right to performance in an account-based CBDC.

9.41. The legal framework for CBDC is expected to cover areas of law related to, among others, private law that also covers property law, payment systems and settlement finality law, and privacy and data protection law,[782] which have been discussed in earlier chapters.[783] Although there may be differences in the legal framework applied to CBDC depending on its designs and how it is treated legally in each jurisdiction, regulations related to CBDC should be able to cover essential topics that would most likely promote key ingredients of economic freedom in the use of CBDC. The essential topics for CBDC to be included in regulations are elaborated below.

9.42. First, a regulation must clearly define CBDC as a means of payment that the public can use for general-purpose transactions. For some jurisdictions that require detailed regulations, such as those in civil law jurisdictions, their regulation may cover the features of CBDC, including its associated rights and obligations, as explained in the earlier chapter. Providing a clear definition of the features of CBDC would promote public understanding of CBDC as a means of payment that can discharge debts. Refusing to accept CBDC as a means of payment might have legal consequences. Furthermore, clear provisions on CBDC as central bank money would provide the public with an understanding of how CBDC differs from other digital currencies issued by the private sector, including why CBDC would receive different legal treatment and protection from other private digital currencies.

[778] ibid 5.
[779] ibid.
[780] ibid v.
[781] See Chapters 7 and 8.
[782] Bossu and others (n 313) 5.
[783] See Chapters 6, 7, and 8.

9.43. Second, regulation on CBDC must be able to guarantee that individuals have the freedom to choose their preferred method of payment for their retail transactions, whether it is cash, CBDC, or another method like card payment or transfer. This provision relates to personal choice as one of the elements of economic freedom, as discussed earlier. In some studies, CBDC is issued as an alternative means of payment for the public to boost financial inclusion, which offers certain benefits to its holders, like lower transaction costs and direct settlement.[784] However, before the regulations on CBDC take effect, the designs of CBDCs and the existence of payment infrastructure must be considered to ensure that is feasible for people to use CBDCs, especially in remote areas. In China, for example, a dual-offline payment function of e-CNY, China's CBDC, can be an option for people living in remote areas with poor telecom network coverage.[785] Nonetheless, the rights of CBDC holders utilising offline features must also be guaranteed, as settlement finality in this kind of transaction might not occur at the same time as payment finality.[786] By providing a clear explanation of their options, individuals can decide on their preferred method of payment. Besides having the freedom to choose their preferred method of payment, the provisions in the regulation must also guarantee that CBDC holders can exchange CBDC with other types of central bank money, such as banknotes. For the Digital Euro, the holder of CBDC is also given the freedom to choose their preferred service providers.[787] Although individuals should have a preferred method of payment, such a method should be agreed upon by the creditor or merchant to discharge the debt or perform the payment. This discussion is closely related to the acceptance of a creditor or merchant on CBDC as a means of payment, as discussed in paragraphs 9.30-9.33.

9.44. Regulations should not override the public's personal choice, as one of the key ingredients of economic freedom, in selecting the type of money as their preferred means of payment, whether cash, CBDC or other method of payment. Imposing limitations on an individual's preference for their payment method can have negative impacts on the economy, as demonstrated in the case of Nigeria. When the e-Naira, a Nigerian CBDC, was first introduced, the government restricted cash withdrawals up to a certain amount. This was implemented to create a total cashless economy, which indirectly also pushed the use of its CBDC.[788]

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[784] See Sepil Bouza and others, 'Central Bank Digital Currencies Can Boost Middle East's Financial Inclusion Payment Efficiency' (2024) < https://www.imf.org/en/Blogs/Articles/2024/06/18/central-bank-digital-currencies-can-boost-middle-easts-financial-inclusion-payment-efficiency#:~:text=CBDCs%20can%20advance%20financial%20inclusion,and%20making%20them%20more%20accessible > accessed 12 September 2025.

[785] Changchun Mu, 'Theories and Practice of Exploring China's e-CNY' (2022) 181 < http://www.pbc.gov.cn/en/3935690/3935759/4749192/2022122913350138868.pdf > accessed 12 September 2025.

[786] See para 6.4.

[787] European Central Bank, 'A Stocktake on the Digital Euro: Summary Report on the Investigation Phase and Outlook on the Next Phase' (n 622) 11.

[788] See Luke Huigsloot, 'Nigeria Bans ATM Cash Withdrawals Over $225 a week to Force Use of CBDC' (2022) < https://cointelegraph.com/news/nigeria-bans-atm-cash-withdrawals-over-225-a-week-to-force-use-of-cbdc > accessed 12 September 2025; See Reuters, 'Nigeria Central Bank Increases Withdrawal Limits Aimed at Curbing Cash' (2022) < https://www.reuters.com/world/africa/nigeria-central-bank-increases-withdrawal-limits-aimed-curbing-cash-2022-12-22/#:~:text=ABUJA%2C%20Dec%2021%20(Reuters),6 > accessed 12 September 2025;

9.45. Third, regulations related to CBDC must be able to protect individual rights related to the transfer of CBDC. Regulation must guarantee that holders of CBDCs can exercise their rights in accordance with the spirit of economic freedom. One of the rights that should be protected is the right to payment enforceable against CBDC issuers or intermediaries, as explained in an earlier chapter.[789] Besides this right to payment, when the transfer of CBDC from one holder to another occurs, the new holder of CBDC then must be guaranteed by regulation to have identical rights as the previous owner had before the transfer occurred.[790]

9.46. Last, the private law rules on CBDC must be able to protect CBDC as property from any interference from third parties, including the state. In general, ordinary property law principles can be seen as an optimal instrument to guarantee rights of exclusion and rights of control over things.[791] If private law methods of protection prove inadequate, specific regulation on CBDC must be able to create a recognition of CBDC as property, as well as a reasonable balance between the interests of CBDC holders and the rights of third parties.[792] The holder's proprietary rights in CBDC should be protected against any third party, where the enforcement of these rights covers the rights of the holder to payment against CBDC issuers or intermediary banks,[793] which should represent an 'absolute' legal position of CBDC.[794] Legal rules should be able to prevent any unacceptable interference by any party. For example, any policy or technical configuration limiting CBDC from being exchanged for another form of central bank money, such as cash. This policy should not be allowed in any circumstances as it interferes with individual rights to derive the full benefit from CBDC. The reason is that the right of CBDC holders to receive payment or exchange for cash is a fundamental aspect of the operation of CBDC.

9.47. If CBDC as a property cannot be legally protected, then it would be challenging to enforce the individual rights related to CBDC, which may lead to a decrease in economic freedom.[795] Furthermore, failure to protect CBDC and its rights may also cause difficulties in implementing other economic freedoms related to CBDC, such as a preference for using CBDC as a means of payment. This can cause a decrease in economic freedom, which leads to a negative impact on economies.

IV. Principle 3 – Responsibilities of Participants in the CBDC Ecosystem Should be Adequately Designed to Protect CBDC Holders

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Ebele Monye, 'Why Nigeria's Controversial Policy Hasn't Met its Objectives' (2024) < https://carnegieendowment.org/research/2024/01/why-nigerias-controversial-naira-redesign-policy-hasnt-met-its-objectives?lang=en > accessed 12 September 2025.

[789] See Chapter 7 and 8.

[790] See para 7.76.

[791] Christian von Bar, *Foundations of Property Law: Things as Objects of Property Rights* (UOP 2023) para 1.18.

[792] ibid.

[793] See Chapters 7 and 8.

[794] Bar (n 779) 2.9.

[795] Fraser Institute, 'Economic Freedom of the World: 2023 Annual Report' (n 761).

9.48. The third foundational principle focuses on designing the responsibilities of the participants in the CBDC ecosystem and how these responsibilities should be properly exercised for the public's benefit. The participants discussed in this section are limited to the central bank as issuer of CBDC, commercial banks as intermediaries, and the public as end-users of CBDC. Each participant is also responsible for safeguarding privacy and data, which will be analysed in accordance with their responsibilities in CBDC transactions.

9.49. The central bank, as an issuer of CBDC, has the role of designing CBDC, its relevant infrastructure, and regulations, including the rulebook needed for CBDC to be used as a means of payment. The central bank must ensure the availability of CBDC for the public within its jurisdiction. It must also guarantee that CBDC holders can exercise their rights related to CBDC.

9.50. Commercial banks have a role in enrolling the public to open accounts at the banks, enabling them to transact with CBDC. At this entry point, banks would need to implement their KYC procedures for new customers. Another role that the banks have is to ensure that CBDC holders can exercise their rights related to CBDC, such as the right to payment and the right to services.

9.51. In CBDC transactions, individuals or entities who hold CBDC must ensure the transparency of their identities and transactions when required by the law. This transparency would help other parties, such as central banks and commercial banks as data processors, to be able to identify and verify the legal persons involved in transactions, as well as to understand the beneficial owners in the transactions.[796] In general, this would help create a risk profile of customers and their transactions, which is necessary to ensure the safety of transactions.

9.52. The designs for mechanisms and procedures for protecting privacy and data in CBDC transactions might be similar to the existing mechanisms and procedures applied in the banking industry, or they might be adjusted to fulfil the needs of the central bank. Whatever the designs they choose, the central bank should be able to balance the need for protection while preventing illicit and fraudulent activities involving CBDC. However, it is the central bank's duty to determine how the protection of data and privacy should be designed to meet its purposes in the issuance of CBDC, as well as the necessity of preventing illicit and fraudulent activities in the financial industry.

9.53. Nonetheless, the protection of data and privacy should be the responsibility of all participants involved in CBDC ecosystems, which should be adjusted according to their involvement and responsibilities in CBDC transactions. Participants who need to process data for CBDC transactions, such as the central bank and commercial banks, must be bound by laws and regulations. Individuals, as end-users, must also take responsibility for protecting their data and privacy to a certain degree. For example, when using a token-based CBDC through a digital wallet, individuals must use strong passwords to

[796] Basel Committee on Banking Supervision, 'Consultative Document: General Guide to Account Opening' (2015) 5-9 < https://www.bis.org/bcbs/publ/d331.pdf > accessed 12 September 2025.

transact with CBDC and protect their passwords from being accessed by any authorised party.

A. Designing Responsibilities of the Central Bank as Issuer of CBDC

1. Responsibilities of the Central Bank

9.54. In the issuance of CBDC to the financial system, the central bank, as the public authority, is likely to play a key role in designing the entire ecosystem and in constructing regulations to support the use of CBDC.[797] The design and adoption of this CBDC typically involve government authorities, such as the Treasury in the UK and the US.[798] They create strategies on how CBDC can be adopted by the public, including updating the development and research on CBDC.

9.55. The issuance of CBDC by the central bank must take into account the nature of CBDC as central bank money, which means that for retail transactions, CBDC must be accessible to the public without limitation on any entity or group. The central bank, as the issuer of CBDC, must ensure the availability of CBDC to the public within its jurisdiction. The central bank can create access points[799] and develop technology to cover remote areas, including providing offline features in CBDC, just as it has done with e-CNY.[800]

9.56. The traditional responsibilities of the central bank are commonly related to monetary policy and financial stability. These responsibilities include providing market liquidity, acting as lender of last resort, ensuring financial stability, and, for some countries, also providing resolution of failing institutions.[801] The issuance of CBDC is believed to have positive impacts on the effectiveness of monetary policy and financial stability. When the central bank issues CBDC as a monetary tool, it would allow direct implementation of monetary policy, impacting the core of the intertemporal decisions of households and entities rather than relying on the traditional banking channel.[802] Although any regulations related to CBDC would aim to support those traditional roles of the central bank, such regulations must still include elements of the protection of individuals as end-users. This is a fundamental principle that commonly applies to government institutions when creating regulations. In the UK, for instance, a regulatory body such as the BoE must uphold public interest without ignoring its statutory functions, which may include defending consumers' rights.[803] Similar to the UK, in Indonesia, protecting public

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[797] See Auer and others, 'Central bank digital currencies: a new tool in the financial inclusion toolkit' (n 123) 12.
[798] The White House, 'Technical Evaluation for a US Central Bank Digital Currency System' (2022) 5 < https://www.whitehouse.gov/wp-content/uploads/2022/09/09-2022-Technical-Evaluation-US-CBDC-System.pdf > accessed 12 September 2025.
[799] See Auer and others, 'Central bank digital currencies: a new tool in the financial inclusion toolkit' (n 123) 9.
[800] Mu, 'Theories and Practice of Exploring China's e-CNY' (n 785) 181.
[801] See Nier (n 340).
[802] Auer and others, 'Central Bank Digital Currencies: Motives, Economic Implications and the Research Frontier' (n 342) 19.
[803] Committee on Standards in Public Life, 'Striking the Balance: Upholding the Seven Principles of Public Life in Regulation' (2016) 12 < https://assets.publishing.service.gov.uk/media/5a8099fced915d74e33fb5bf/Striking_the_Balance__web__v3_220916.pdf > accessed 12 September 2025.

interest must be at the heart of regulations issued by the regulatory bodies, including the central bank.[804]

9.57. The central bank plays a main role in creating regulations for CBDC. The designs and characteristics may not be stated or regulated in writing, but what is important for the public interest is that the central bank needs to ensure that the CBDC is available for public use and that the holders of CBDC are guaranteed that they can exercise their rights. Through the characteristics, designs and infrastructures of CBDC, along with mechanisms and procedures that they design related to CBDC, the central bank must be able to guarantee the privacy of the holders of CBDC, including protecting any data and information associated with CBDC.

9.58. The issuance of CBDC should be supported by a robust and resilient system supported by the central bank. Server back-ups should be prepared to avoid loss of data related to pending transactions (ie transactions that have not yet been finalised and settled), as well as to protect the data most affected in the event of a system outage.

2. Responsibility in Protecting Data and Privacy

9.59. In principle, privacy can be seen as a natural right that the law should protect.[805] Privacy in CBDC transactions may cover any personal data and information in this transaction, such as personal identities of parties, including profiles of the parties in CBDC, amounts and purposes of transactions. As discussed in an earlier chapter,[806] privacy related to CBDC, especially in the UK, must comply with the Data Protection Act 2018, which is also aligned with the General Data Protection Regulation (GDPR). In Indonesia, protection of data and privacy is regulated under Law No. 27 of 2022 on Personal Data Protection. This law is a general rule for the protection of data and privacy applicable in Indonesia. The issuance of CBDC by the central bank and all participants in the CBDC ecosystem must also comply with this Law.

9.60. Under this Act, there are six data protection principles that must be obeyed by the central banks, commercial banks and other relevant participants in CBDC systems that process or handle personal data. First, the legal rights of individuals on their personal data should be processed lawfully and fairly.[807] Processing data lawfully and fairly means that the central bank and any parties in the CBDC ecosystem responsible for processing data must process data based on an appropriate lawful basis and fairness, meaning that such processing is not unduly detrimental, unexpected or misleading to individuals concerned.[808] This rule ensures that any mechanism utilised in the data processing should be legally recognised and compliant to maintain a lawful process.

[804] This is one of principles regulated in art 6, Law No. 12 of 2011 on the Establishment of Laws and Regulations.
[805] Glenn Negley, 'Philosophical Views on the Value of Privacy' (1966) Law and Contemporary Problems Vol 31 No 2, 319.
[806] See Chapter 2.
[807] See Data Protection Act 2018, s 86.
[808] ibid.

9.61. Second, the Data Protection Act 2018 requires that the collection of any personal data must have specified, explicit, and legitimate purposes. Data must not be processed if the intended use deviates from those purposes.[809] Third, this data must be adequate, relevant and not excessive in relation to the purpose for which it is processed.[810] Fourth, the personal data that is processed must be accurate and up to date, where necessary.[811] Fifth, personal data must be kept for no longer than is necessary for the purpose for which it is processed.[812] Last, the personal data must be processed by taking appropriate security measures to avoid risks that arise from processing personal data.[813] Related to these data protection principles, when the central banks or commercial banks require personal data from the CBDC holders, then they should explain the coverage of personal data that will be taken, the purpose of such data collection, and how long they are going to keep the personal data including what security measures that will be taken to protect personal data to avoid any risks arising from processing personal data.

9.62. The central bank's role in protecting data and privacy is essential to maintain the trust in central bank money, primarily related to CBDC that might pose risks arising from events such as: (i) data leakages like identity theft and financial frauds, (ii) data abuse that occurs when there is unauthorised use of personal data by third parties, issuing authority and governments, and (ii) cyberattacks in the systems such as hacking, phishing and malware.[814]

3. Categorising Data and Level of Privacy in CBDC Transactions

9.63. In designing the protection of data and privacy for CBDC, it is essential to understand the classification of data available in CBDC transactions before deciding on the approach that the central bank will use. It can design mechanisms and procedures for protecting data and privacy based on the classification of data, the value of transactions, and the degree of privacy in CBDC transactions.

9.64. Data in the CBDC transactions can be categorised into payer's and payee's identity, payer's and payee's pseudonymous identifiers, transaction data, payer's additional transaction data, and payee's additional transaction data.[815] For large value transactions, the central bank may require high data intensity that is related to identity for anti-money laundering or combating the financing of terrorism purposes, while for small value transactions, some central bank approaches require low data intensity, privacy-enhancing features in CBDC designs, where, in this context, less information is needed related to identity and transactions.[816]

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[809] ibid s 87.
[810] ibid s 88.
[811] ibid s 89.
[812] ibid s 90.
[813] ibid s 91.
[814] Kieran P Murphy and others, 'Central Bank Digital Currency Data Use and Privacy Protection' (2024) Fintech Notes Note/2024/004, 13 < https://www.elibrary.imf.org/view/journals/063/2024/004/article-A001-en.xml > accessed 12 September 2025.
[815] ibid 5.
[816] ibid 8.

9.65. The central bank should design the accessibility to data and the protection of the privacy of the CBDC holders. Depending on the design of CBDC and the central bank's approach, for wholesale payment or large-value transactions, the central bank may be able to access the identity and transaction data of both the payer and payee. For wholesale design of Rupiah Digital, implementing the KYC procedure[817] for its holders, for both account-based and token-based designs, should be mandatory to prevent anti-money laundering transactions.

9.66. In contrast, for small-value transactions, the transaction data may be designed to be available only between the payer, payee and the ledger administrator. This means that for these types of transactions, the central bank may not have access to identity and transaction data. Minimal personally identifiable information may be required for the customer due diligence process. For example, in China, the central bank only requires a phone number to open an account, which prevents the central bank and payment service providers from accessing the personally identifiable information.[818] In Indonesia, for retail transactions using Digital Rupiah with a certain threshold, especially a token-based CBDC system, the KYC procedure may not be necessary to apply. However, for an account-based system, at least basic consumer information would still be required for account opening.

9.67. Determining the KYC procedure and threshold in CBDC transactions for both wholesale and retail designs, especially in Indonesia, would require further research. For retail CBDC, the central bank might want to consider using a similar consideration and calculation for retail transactions using electronic money funds. Based on article 22 paragraph 1 and 2 of Regulation of Member of the Board of Governor of Bank Indonesia No. 24/7/PADG/2022 on Operation of Payment Systems by Payment Service Providers and Payment System Infrastructure Operators, the maximum fund deposited in an electronic money account is 2,000,000 IDR (approximately 100 GBP) for an unregistered account, and 20,000,000 IDR (approximately 1,000 GBP) for a registered account. The monthly transactions threshold is capped at 20,000,000 IDR (approximately 1,000 GBP) for an unregistered account and 40,000,000 IDR (approximately 2,000 GBP) for a registered account. The identification recorded for an electronic money account must comply with the anti-money laundering law, whereby for an unregistered account, the minimum identification should cover at least the electronic money card number and phone number.

9.68. Ensuring that CBDC is available to the public can also be implemented through legislation. To achieve this, the central bank must have a strong understanding of CBDC-

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[817] According to Swift, KYC shall mean 'a set of processes that allow banks and other financial institutions to confirm the identity of the organisations and individuals they do business with, and ensures those entities are acting legally.' See Swift, 'The KYC Process Explained' < https://www.swift.com/risk-and-compliance/know-your-customer-kyc/kyc-process#:~:text=Financial%20institutions%20start%20the%20KYC,Index%20lists%20from%20Transparency%20International > accessed 12 September 2025. KYC procedure can be imposed by banks and financial institutions in accordance with rules issued by the authority. In Indonesia, banks are obliged to impose KYC procedure based on regulations issued by the Financial Services Authority.

[818] See para 4.90; See Murphy and others (n 814) 8.

related issues such as correlation between threshold of CBDC and privacy levels of the holders.

9.69. Privacy can be categorised into different levels such as confidential, pseudonymous and anonymous.[819] In confidential payments, an individual's identity is only available to a certain trusted party, like banks or payment system providers.[820] In pseudonymous payments, the individual's identity is not directly disclosed, but there may be identifiers that can link the payment to the individual,[821] such as the account number or token address used by the individual.[822] Meanwhile, in anonymous payments, the individuals are unidentifiable in a payment transaction.[823] The BoE has stated that its Digital Pound would not be anonymous because identification and verification of users are needed to prevent financial crimes and comply with regulatory obligations.[824] Thus, it will be confidential or pseudonymous.

B. Designing Responsibilities of Commercial Banks as Intermediaries

1. Responsibilities of Commercial Banks

9.70. Commercial banks, as intermediaries, have a function in handling retail payments, covering customer enrolment, requesting CBDC on behalf of customers, and facilitating CBDC transactions between payers and payees. Commercial banks may also provide digital wallets as a medium in CBDC transactions that serve the function of generating the identity of the CBDC holders.[825] When commercial banks are given the responsibility to provide these services, they are supposed to be responsible for ensuring that the CBDC holders can exercise their rights related to CBDC transactions, covering the right to receive payment and the right to services.

9.71. When acting as intermediaries, the bank will most likely manage the customer enrolment, including implementing KYC procedures and dealing with regulatory compliance related to transfers or payments using CBDC.[826] When enrolling new customers to transact using CBDC, banks may be required to implement several approaches for KYC through customer due diligence (CDD), as follows.

9.72. First, banks are to carry out general CDD measures in accordance with existing laws and regulations, such as the Money Laundering, Terrorist Financing and Transfer of Funds (Information on the Payer) Regulations 2017 for banks in the UK. In addition to these general CDD measurements, banks must perform enhanced CDD to certain individuals, such as those with a high risk of money laundering or terrorist financing and those

[819] BIS Innovation Hub and Swiss National Bank (n 221) 7.
[820] ibid.
[821] ibid.
[822] Murphy and others (n 802) 5.
[823] BIS Innovation Hub and Swiss National Bank (n 221) 7.
[824] Bank of England, 'The Digital Pound: Technology Working Paper' (n 448) 20.
[825] See Chapter 5.
[826] Emilios Avgouleas and William Blair, 'A Critical Evaluation of Central Bank Digital Currencies (CBDC): Payments' Final Frontier?' (2024) Capital Markets Law Journal, 110 < https://doi.org/10.1093/cmlj/kmae002 > accessed 12 September 2025.

identified or associated with politically exposed persons.[827] Where an individual plans to open a bank account to hold CBDC with a commercial bank acting as an intermediary, the bank should conduct general CDD measures on all individuals, regardless of the value of future CBDC transactions, and carry out enhanced CDD for those who qualify as high-risk. Under the Payment Services and Payment Accounts (Contract Termination) (Amendment) Regulations 2025, which are due to come into force in April 2026, banks may close any accounts linked to a serious criminal activity with 90 days' prior notice.[828] However, this notice requirement does not apply if the banks are unable conduct CDD on the relevant transactions.[829]

9.73. Second, banks can also perform simplified CDD on a potential customer as a CBDC holder if a CBDC transaction poses a low degree of risk of money laundering and terrorist financing, such as in the case of customers in remote areas performing small amounts of CBDC transactions. Under current regulations, banks are allowed to take this measure for transactions exposing a low level of risk of money laundering and terrorist financing, targeting specific customers to promote financial inclusion.[830]

9.74. Third, banks can also not take any CDD measures if such CBDC transactions can be treated similarly to electronic money transactions, where the value transacted does not exceed specific amounts determined by the regulations. This approach might be applied, for example, to token-based CBDC transactions in digital wallets facilitated by the banks to purchase goods or services. The banks have already carried out this approach under the existing regulations, where no CDD measurement is required for electronic money transactions if the stored value is not more than the limit specified in regulations or the payment instrument is used solely to purchase goods or services.[831]

2. Responsibility in Protecting Data and Privacy

9.75. As mentioned above, depending on the design of privacy in CBDC, commercial banks as intermediaries could access data in small-value or retail CBDC transactions, as this data may be designed to be accessed only between the payer, payee and the ledger administrator. In this context, commercial banks can act as ledger administrators that settle CBDC transactions on the ledger between the payer and the payee.[832] This requires that commercial banks may access personal identity and transaction data, such as the payer's and payee's personal data, the amount transferred, the payment purpose and the transaction date.[833] Parties involved in transactions may also use pseudonymous

[827] See Money Laundering, Terrorist Financing and Transfer of Funds (Information on the Payer) Regulations 2017, s 33 – 34 and s 25.
[828] Payment Services and Payment Accounts (Contract Termination) (Amendment) Regulations 2025, s 51B(1).
[829] ibid s 51C.
[830] ibid s 37.
[831] See Money Laundering, Terrorist Financing and Transfer of Funds (Information on the Payer) Regulations 2017, s 38.
[832] See Bank of Canada and others, 'Central Bank Digital Currency: System Design and Interoperability' (n 21) 2-3.
[833] Murphy and others (n 814) 5 and 7.

identifiers, which allow CBDC holders to transact without revealing their identity. This data covers account numbers or token addresses, phone numbers or aliases.[834]

9.76. Regarding the accessibility of data by commercial banks as intermediaries, the banks should also be bound to protect such data under GDPR and other relevant regulations, as explained earlier.[835]

C. Designing Responsibilities of Individuals as CBDC Holders

9.77. Individuals who hold CBDCs must comply with the privacy requirements associated with the type of retail CBDC they opt to use as a means of payment. For conducting CBDC transactions, users of CBDC have the option to choose the type of retail CBDC available in the system (i.e., account-based CBDC or token-based CBDC), as well as to select the types of privacy preferences offered in the digital wallet services available to the public.[836] However, given that the level of privacy is designed by authorities and stated under the law as part of the CBDC system design, individuals as holders of CBDCs must comply with the privacy requirements regulated by the central bank or authorities.

9.78. Regarding the data protection elaborated from the perspectives of central banks and commercial banks in previous discussions, individuals must provide data that commercial banks require in relation to opening a CBDC account or digital wallet for CBDC transactions. In this context, consumer transparency is essential to ensure the accurate processing of data in CBDC transactions by financial service providers. Data provided by individuals must be true and up-to-date, as this data will be used to complete CBDC transactions.

9.79. Individuals must also protect their privacy by keeping their data and any devices linked to the CBDC safe from third parties. The owner of a banknote has the practical responsibility to keep their note in their possession. Likewise with CBDC, the owner or holder of CBDC also has the responsibility to ensure their CBDC is kept under their control, including if CBDC is stored in a digital wallet or device linked to CBDC. Besides the value of CBDC, such digital wallets or devices might store data related to CBDC, such as the holder's personal data and transaction history of CBDC transactions. Given this concern, individuals who hold CBDC represented in any kind of device are responsible for safeguarding their CBDC, which also includes protecting the data and privacy contained in such devices. Another example is that when an individual uses a token-based CBDC through a digital wallet, they must use strong passwords to transact with the CBDC and protect their password from being accessed by any authorised party. Protecting this password is necessary, as it grants access to all data related to CBDC, including personal data and transactional data.

9.80. Another role for individuals related to privacy and data is providing consent related to data processing in CBDC transactions, as specifically regulated by the law or the central bank, if they want the commercial bank to process their data when transacting with

[834] ibid 5.
[835] See para 9.59.
[836] Bank of England, 'The Digital Pound: Technology Working Paper' (n 448) 20.

CBDC. This practice is similar to existing practices in the banking industry. This consent must be freely given, specific, informed and unambiguous for personal data to be processed.[837]

V. Principle 4 – Creating a Sustainable and Eco-friendly CBDC Ecosystem

9.81. The fourth foundational principle is that CBDC systems must be environmentally friendly so they can be continuously operated in the long term without harming the environment. It aims to protect the rights of individuals to access CBDC in the long term while safeguarding the environment. This principle is in line with the Group of 7 (G7) Public Policy Principles for Retail CBDC, which states that the energy usage of any CBDC infrastructure should be minimised to support the global commitment to transitioning towards a net-zero economy.[838]

9.82. The business continuity of the CBDC ecosystem is essential to its long-term adoption. Ensuring business continuity is one of the core principles applied to SIPS,[839] which the CBDC system would likely be classified as. CBDC operations should not be halted due to concerns about harmful environmental impacts. Negative impacts on the environment can result from the adoption of CBDC, primarily due to energy consumption and data storage for CBDC, as discussed in detail below.

A. Creating a Sustainable CBDC System

9.83. In general, sustainability in the creation of money is needed to provide a reliable supply of money that supports the central bank in achieving its goal of financial stability.[840] The continuity of CBDC as one form of central bank money to be used as a means of payment must also be guaranteed to achieve the purposes of the issuance of CBDC in general and to ensure that the rights of individuals related to CBDC can be exercised. However, if CBDC cannot be processed due to technical issues or failure, the holders of CBDC must be able to exchange their CBDC for other forms of central bank money.

9.84. To create sustainability in CBDC, the designs of CBDC, including systems and infrastructure processing CBDC, must consider its energy consumption and environmental impact. This is in line with the Group of 7 (G7) Public Policy Principles for

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[837] Article 6 (1) (a) The Regulation EU 2016/679 of the European Parliament and Of the Council on the Protection of Natural Persons with Regard to the Processing of Personal Data and on the Free Movement of Such Data (UK GDPR).

[838] Principle 8 of G7 Public Policy Principles for Retail Central Bank Digital Currencies (CBDCs), 2021, < https://assets.publishing.service.gov.uk/media/616754e1d3bf7f55fa9269d8/G7_Public_Policy_Principles_for_Retail_CBDC_FINAL.pdf > accessed 12 September 2025.

[839] Bank for International Settlement - Committee on Payment and Settlement Systems, 'Core Principles for Systemically Important Payment Systems' (n 521) 40.

[840] Stef Kuypers and others, 'Sustainable Money System: An Alternative Perspective on the Design of Monetary Systems' (2020) 18 < https://www.happonomy.org/wp-content/uploads/2021/09/Happonomy-Sustainable-Money-System-Details.pdf > accessed 12 September 2025.

Retail CBDC, where the energy usage of any CBDC infrastructure should be minimised to support the global commitment to transitioning towards a net-zero economy.[841]

9.85. The issuance, maintenance and processing of CBDC as money must continuously operate as this is one of the core principles for SIPS. A CBDC system most likely would fall into this categorisation, as explained in an earlier chapter.[842] The principle of business continuity needs to be implemented to ensure the continuity of the service in a variety of scenarios, including if one or more components of the system fail.

9.86. One example of business continuity arrangements, as explained in the core principles of SIPS, is an internally generated or uninterrupted power supply.[843] The power supply for the CBDC system should be continuously generated. Furthermore, this constant supply of energy should not cause any negative impact on the environment. Therefore, the adoption of the CBDC should thoroughly consider the environmental impact, as it may require significant energy consumption in the long term, especially in creating nodes, if blockchain technology is adopted, as is the case with private cryptocurrencies.

9.87. The process of creating, transferring and redeeming CBDC should be able to minimize negative impact on the environment since CBDC can be associated with the high usage of energy. This concern is valid given the heavy electricity demands made by the use of crypto assets. The rise of crypto assets can be associated with a surge in electricity demand for crypto mining activities.[844] These activities require significant amount of energy used for computers and cooling fans.[845] In 2022, the probability of having successful hash in crypto mining activities had fallen to less than 1 in 29 trillion, in contrast to 1 in 2 trillion in 2018.[846] The lower probability indicates that more energy is needed for crypto mining in the future. However, the increased use of energy contributes to a higher carbon emission that links to the global emission and global warming.[847]

B. Considering Energy Consumption in Issuing CBDC

9.88. The central bank needs to have strategies related to the use of energy consumption in issuing central bank money, including in digital form, as it may consume a significant amount of energy and produce a big carbon footprint. The BoE, for example, has issued policies related to strategies for climate change, aiming to reduce the carbon footprint in the production of cash or banknotes. According to the BoE, it continues to reduce its

[841] Principle 8 of G7 Public Policy Principles for Retail Central Bank Digital Currencies (CBDCs) (2021) < https://assets.publishing.service.gov.uk/media/616754e1d3bf7f55fa9269d8/G7_Public_Policy_Principles_for_Retail_CBDC_FINAL.pdf > accessed 12 September 2025.
[842] See para 5.81.
[843] Bank for International Settlement - Committee on Payment and Settlement Systems, 'Core Principles for Systemically Important Payments Systems' (n 527) 41.
[844] Shafik Hebous and Nate Vernon, 'Cryptocarbon: How Much is the Corrective Tax?' (2023) IMF Working Paper, 2 < https://www.imf.org/en/Publications/WP/Issues/2023/09/15/Cryptocarbon-How-Much-Is-the-Corrective-Tax-539214 > accessed 12 September 2025.
[845] ibid 2.
[846] ibid.
[847] ibid.

carbon footprint through the polymer procurement process for banknotes for each denomination.[848] The BoE has also secured carbon neutrality for the future supply of polymer substrate.[849] Just like issuing banknotes, when designing CBDC, including systems and infrastructure processing CBDC, the central bank must also consider energy consumption and its environmental impact.

9.89. As in cash printing, the issuance of CBDC would potentially produce a significant carbon footprint through electricity consumption. This electricity consumption in CBDC is derived from the use of data centres, servers, and transaction processing.[850] In blockchain technology, energy consumption can be influenced by several factors, such as the number of nodes that constitute the network, participant role assignment, node location and the ability to optimise power consumption through code and node updates.[851] In fact, the increase in energy consumption can be directly proportional to the increased number of nodes.[852] Knowing that CBDC, including its hardware configuration,[853] might risk a high amount of energy consumption, CBDC should be designed carefully to consider its environmental effect so it will not negatively impact the environment and produce a minimal carbon footprint. In other words, energy consumption and carbon footprint should be one of the criteria in selecting a platform, hardware and other elements in the CBDC ecosystem.[854]

9.90. Adopting CBDC would require massive data storage that requires a constant energy supply, and strategies for finding locations for cloud systems might be useful to reduce the negative impact on the environment. This energy supply for data storage in CBDC should not disproportionately exacerbate climate change or global warming.[855] The central bank must find a location for the main servers, including cloud systems that can use renewable energy or locations where energy is overproduced.[856] For CBDC using permissioned DLT, where the central bank is given full control of the DLT, the central bank has full authorisation in selecting such a location, including the number of nodes produced.[857]

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[848] Bank of England, 'The Bank of England's climate-related financial disclosure 2021' (2021) < https://www.bankofengland.co.uk/prudential-regulation/publication/2021/june/climate-related-financial-disclosure-2020-21 > accessed 12 September 2025.
[849] ibid.
[850] Niklas Arvidsson and others, 'Potential Climate Impact of Retail CBDC Models' (2024) Sveriges Riksbank Working Paper Series, 27, < https://www.riksbank.se/globalassets/media/rapporter/working-papers/2024/no.-437-potential-climate-impact-of-retail-cbdc-models.pdf > accessed 12 September 2025.
[851] ibid.
[852] ibid.
[853] ibid 17.
[854] Itai Agur and others, 'Digital Currencies and Energy Consumption' (2022) Fintech Notes, 14 < https://www.elibrary.imf.org/view/journals/063/2022/006/article-A001-en.xml > accessed 12 September 2025.
[855] Avgouleas and Blair (n 826) 111.
[856] Agur and others (n 854) 14.
[857] ibid.

VI. Conclusions

9.91. Public interest and the public's rights as CBDC holders would need to be prioritised in designing CBDC and its adoption into the financial system. Key aspects related to public interest and the exercise of the public's rights, such as its function as a monetary policy instrument, a tool for promoting financial inclusion, and a means of payment, are fundamental to ensuring that CBDC serves the broader public good. Ensuring the privacy and data protection of CBDC holders is also critical, as it directly influences public trust and the reliability of CBDCs and the financial system.

9.92. The four foundational principles elaborated in this chapter, which are intended to protect the public interest and the rights of CBDC holders, are the minimum standards that central banks as issuers of CBDC, as well as the private sector entities participating in the CBDC ecosystem, should observe. Nonetheless, individuals as CBDC holders also play a significant part in actively safeguarding their privacy and personal data related to CBDC transactions.

CHAPTER 10

CONCLUDING REMARKS

I. Summary of the Thesis

10.1. The state has the authority to determine any kind of money to be used by the general public as a means of payment. This authority is typically executed by a central bank as a monetary authority in a state. Central bank money that is available for the public to use has existed in the form of physical notes and coins. However, with the development of technology, it has become possible for central bank money to evolve into a digital version while still carrying the functions of traditional money.

10.2. This thesis concludes that CBDC can be classified as central bank money in digital form. Its issuance as a means of payment by the central bank demonstrates the sovereignty of the state in creating money regardless of its material. When specifically designed for retail payment, CBDC can perform the same functions as traditional money, such as banknotes and coins. It may also serve as legal tender and be used by the general public to discharge debts if such a status is conferred by legislation.

10.3. The thesis shows that many money principles and theories in the English law can still be applied to CBDC. The issuance and adoption of CBDC can be accommodated under these principles and theories. However, to ensure the legality of the issuance and transfer of CBDC as a means of payment, particularly for retail payment, it may require refinement of existing legislation due to the characteristics of CBDC as a new kind of money. This legislation should at least accommodate the issuance of CBDC by the central bank, its existence as central bank money and its function as money to discharge debts.

10.4. To ensure the protection to the general public as CBDC holders, including the need to create legal certainty in CBDC transactions, the system and technology used to issue and process CBDC must be governed and supervised by the central bank. The finality of settlement in CBDC transactions must also be guaranteed to occur.

10.5. This thesis argues that the concept of settlement finality in the existing payment system should also be applied to token-based and account-based CBDC. Settlement must be designed adequately to protect the rights of CBDC holders, both payers and payees. This finality of settlement is crucial to mark that the transaction is final and irrevocable. Furthermore, in CBDC transactions, settlement finality may occur simultaneously with finality of payment or at a later time in the case of offline transactions. For the payer, this settlement finality guarantees that his payment has discharged his debt to the payee. For the payee, it ensures the unconditional right to use the money received in his account from the payer.

10.6. Within the context of property law, the discussion explores CBDC as an object of property in account-based and token-based designs. In each design, proprietary rights cover the right to payment from the central banks as issuers of CBDC, arising from statutory rights, and the right to services from the relevant entities based on contractual relationships between the CBDC holders and entities that either manage the accounts or media for tokens.

10.7. An account-based CBDC would require a regular financial account. Therefore, there are rights to payment enforceable against the central banks through the banks that manage the accounts. The right to services related to accounts is also enforceable against those banks. Depending on the design, the right to payment on a token-based CBDC may be enforceable against the central bank either directly or through entities managing the media for tokens. CBDC holders are also entitled to rights to services from those entities. In more detail, a token-based CBDC is considered a digital object that is classified as an intangible, which is rivalrous and has an independent existence. It operates like a documentary intangible where the right to payment from the central bank is linked to the digital token. The transfer of such a token to a new holder carries with it the right to payment. Legislation under English law would be needed to ensure the creation and transfer of such a legal link.

10.8. The issuance of CBDC, particularly for retail use, has been subject to debate. One concern is that the issuance of CBDC could lead to the disintermediation of commercial banks in the financial system by shifting funds from commercial bank deposits to CBDC.[858] As explained throughout the thesis, CBDC can be designed as a two-tier architecture, involving commercial banks from the issuance through redemption process of CBDC.[859] When CBDC is intended to serve as a means of payment, the central bank should consider the best interest-rate policy for CBDC, such as adopting a non-interest-bearing one similar to physical banknotes.[860] As a non-interest bearing central bank money, the risk of potential funds migration from commercial banks to CBDC may be minimised. Another concern is that CBDC symbolises state's control over public money. As analysed in this thesis, CBDC is not programmable central bank money, as it cannot be programmed to follow the instructions from the state or central bank. Individuals' rights in CBDC are guaranteed in CBDC just like in traditional banknotes. In addition, the legal framework, including privacy rules, should be robustly designed to support the implementation of CBDC and boost public confidence in its use.

II. Recommendations for Regulation of CBDC in Indonesia

10.9. Given that Indonesia adopts a civil law system that relies on codified law, detailed legal rules need to be included in the regulation regarding CBDC issued by Bank Indonesia. Based on the discussion in this thesis, which mainly analyses CBDC from a private law

[858] Rhyss Bidder and others, 'CBDC and banks: Disintermediating fast and slow' (2024) 2 < https://www.bankingsupervision.europa.eu/press/conferences/shared/pdf/2024_research_conf/10_rottner.pdf > accessed 20 December 2025.
[859] See paras 7.51-69.
[860] See paras 9.13-16.

aspect, below are the minimum scope of rules that need to be included in Bank Indonesia regulation regarding CBDC:

a. The legal basis of CBDC should cover CBDC as a means of payment and its status as a legal tender. While these rules have been stated in the current law, further regulation is required to govern the central bank's planning, distribution and redemption of CBDC for both wholesale and retail payment;
b. Principles in the issuance of CBDC should be set in the regulation, which covers, among others, CBDC's convertibility with other kinds of money, CBDC as a non-interest-bearing, the sustainability and environmental friendliness of CBDC system, and protection of the rights of CBDC holders;
c. Regulation on CBDC should regulate essential roles and responsibilities of parties involved in the CBDC ecosystem, such as the central bank, commercial banks as intermediaries and CBDC holders;
d. Eligibility of CBDC holders for wholesale and retail payments;
e. Rights of CBDC holders that cover the right of payment and the right to services;
f. Thresholds for CBDC in wholesale and retail payments;
g. Protection of the privacy of the CBDC holders;
h. Technology and systems used in processing CBDC, including DLT; and
i. Finality of Settlement in CBDC transactions to ensure legal certainty for the CBDC holders.

Such recommendations and references to the discussion of this thesis are listed in Table 1 (Annex).

III. The Need for Dissemination of Information regarding CBDC to the Public and Private Sector

10.10. The thesis acknowledges several concerns regarding the issuance of CBDC that would interfere with individuals' rights. The introduction of CBDC to the financial system would neither restrict the use of cash nor impose control over how individuals spend or transact their money. CBDC will not replace cash as a traditional form of central bank money available to the public. Instead, it aims to be a digital form of cash that complements cash and other existing forms of central bank money. Moreover, the issuance of CBDC as digital central bank money should be understood as the state providing another payment option for the public, and thus, it should not be perceived as a monetary instrument issued by the state to compete with the existing money or payment instruments, including commercial bank money and cryptocurrency issued by the private sector.

10.11. To address such concerns, dissemination of information about CBDC to the public is essential to support the issuance of CBDC. As discussed in this thesis, public acceptance is crucial in making CBDC an effective means of payment. Accordingly, engaging the public in the consultation, research and planning of CBDC is important if the central bank intends to introduce CBDC into the financial system. The central bank needs to set both short-term and long-term objectives for the number of individuals and areas participating in the CBDC discussions. This effort would enhance the public understanding of the characteristics and functions of CBDC as a digital form of cash.

Since literacy levels can vary from one jurisdiction to another, the dissemination of information about money and CBDC can be held to also increase financial literacy in general, involving local government and experts to ensure effective communication.

10.12. Disintermediation of commercial banks is also a concern related to the issuance of CBDC, as it is feared that customers might shift their bank deposits to CBDC and thus, reduce deposits in commercial banks. However, given that the legal nature of CBDC is different from commercial bank money, especially if CBDC is designed to be non-interest-bearing and there is a threshold on the amount individuals can hold, it can be argued that CBDC will not result in such a disintermediation. Concerns about disintermediation can also be addressed through the adoption of two-tier designs of CBDC that involve commercial banks in the distribution and management of CBDC, as discussed throughout the thesis.

10.13. To address concerns about the disintermediation of commercial banks, the central bank can also mitigate it by actively engaging the private sector, including commercial banks and payment providers, in research and pilot projects on CBDC, which in the end will support the effectiveness of CBDC issuance. The legal arrangement with the private sector involved in the issuance of CBDC should be discussed early in the CBDC project to prepare for their involvement, including the infrastructure needed, when the CBDC is ready for implementation.

IV. The Need for Further Legal Research on CBDC

10.14. In general, a comprehensive regulatory framework for CBDC should be created to give legal certainty to its issuer, holders and all relevant stakeholders in CBDC transactions. This comprehensive regulatory framework is also needed to address all legal concerns related to the issuance of CBDC. This thesis has its limitations in addressing legal concerns related to CBDC. While the legal discussion in this thesis offers a legal analysis of CBDC as a kind of money, mainly from a private law perspective, further research from other legal branches is necessary to support the effectiveness of the issuance of CBDC.

10.15. Here are the examples of further legal research on CBDC that can be done. It could cover monetary law that explores mechanisms of CBDC as a monetary instrument that can be used by the central bank when performing its roles as a lender of last resort to provide a short-term facility to commercial banks. Regarding privacy and data protection, thorough research is needed to determine how the privacy of CBDC holders can be protected in both online and offline transactions. The use of CBDC as evidence in civil and criminal courts is also interesting to explore from civil and criminal laws. Tax law might also be impacted by the issuance of CBDC. It can create transparent tax reporting when conducting payments using CBDC. However, the privacy of CBDC holders should still be guaranteed when the technology is developed to integrate with the tax reporting system.

10.16. If CBDC is designed for cross-border payments and given the complexity of laws and regulations in multiple jurisdictions, extensive legal research is required. Since CBDC is

closely related to the monetary sovereignty of a state, harmonisation of laws and regulations governing CBDC across jurisdictions becomes crucial. In the field of private law aspect for example, the legal rights of the holders of CBDC must be recognised in the participating jurisdictions. At least, the scope of these rights is equivalent across jurisdictions, even if the mechanisms to enforce such rights differ from one jurisdiction to another. Legal research conducted for CBDC domestic payment can also be applied to cross-border payment from an international law perspective. A broader analytical framework is needed to address legal challenges in cross-border CBDC payment.

Final Remarks

A successful issuance of CBDC would require comprehensive research from various dimensions, including infrastructure, technology, public readiness and regulatory framework. If CBDC is intended for public use as a means of payment, the issuance of such CBDC would need thorough research and planning, as transactions using CBDC will impact individuals' rights. As discussed throughout the thesis, CBDC can be designed in various forms to tailor specific needs and purposes in issuing such CBDC. Nevertheless, each design needs a distinct legal analysis depending on the applicable laws of the respective jurisdiction. While this thesis offers a legal analysis of CBDC from the perspective of money, a more detailed legal analysis of CBDC is necessary to ensure that its issuance aligns with the national legal frameworks.

ANNEX

TABLE 1

Summary of Proposed Regulation on CBDC in Indonesia

No.	Topic	Proposed Regulation
1	CBDC as a Means of Payment and Legal Tender	• The law has regulated CBDC or Digital Rupiah as a means of payment and given status as legal tender, including stated that the central bank's authority as an issuer (see para 1.5). • However, the central bank's planning, distribution and redemption on CBDC for wholesale and retail payment (see para 2.16) should be further regulated. The regulation should elaborate at least the detailed mechanism and the parties involved for planning, issuance, distribution and redemption of CBDC including agreement between Bank Indonesia and the Ministry of Finance (see paras 3.16-3.17).
2.	Principles in the Issuance of CBDC	Principles in the issuance of CBDC should be regulated and at least cover as follows: • CBDC must be able to exchange at par with other kind of central bank money, or with commercial bank money if it is an account-based CBDC (see paras 2.23, 2.66, and 7,25). • If intended as digital version of banknotes, CBDC must not bear any interest (see para 9.14). • CBDC system must be governed by the central bank to protect public interests and CBDC holders rights including privacy (see para 5.4). • CBDC system must be sustainable and environmentally friendly (see paras 9.81-9.92) • Central bank guarantees the protection of the rights of CBDC holders and data privacy in accordance with existing regulations (see paras 5.7,5.25, 6.53, 9.6, 9.52, 9.53, 9.59)
3.	Parties involved in CBDC Transactions	• Roles and Responsibilities of the central bank, intermediaries and the holders of CBDC should be covered in the regulation. For example, central bank is authorised to issue CBDC including to determine DLT as the system used in CBDC transaction which is integrated in the existing

No.	Topic	Proposed Regulation
		system (BI-RTGS) (see paras 5.41-5.43 and 9.48-9.80).
4.	Eligibility and Rights of the CBDC Holders	• Eligibility of CBDC Holders for wholesale CBDC e.g financial institutions, government institutions, etc. (see paras 4.95, 7.8, 7.33). • Eligibility of CBDC Holders for retail CBDC e.g. individuals, financial institutions, and other entities (see paras 4.95, 7.8, 7.33). • The scope of rights of the holders of CBDC should cover at least the right to payment and right to services from responsible parties (see paras 7.3, 7.23). • The mechanism of the holders for acquiring, transferring and redeeming CBDC should be explained to give legal certainty for the holders (see paras 7.51-7.73).
5.	Thresholds of CBDC Transactions and privacy concerns	• Threshold for CBDC transaction should be regulated to differentiate wholesale CBDC and retail CBDC (see paras 4.95, 9.67) • If a certain limit of threshold for retail payment is set, then the level of privacy in CBDC transaction might need to have classification (see paras 9.67-9.69). • Furthermore, these provisions should be harmonised among others with anti-money laundering, privacy law and data protections regulations (see paras 2.78, and 5.25).
6.	DLT as Technology and System used in CBDC	• The central bank must have the authority to control DLT, just like in the existing payment system (RTGS) (see paras 5.41-5.43). • Business procedures in DLT, the parties involved in the ecosystem, and terms and conditions in DLT must be stated clearly (see paras 5.3, 5.6, 5.23) • Legal arrangement between parties involved in the ecosystem must be documented or stated in agreement or regulations (see paras 5.57, 5.65, 5.67-75, 7.38, 7.39)
7.	Finality of Settlement in CBDC Transactions	• Finality of settlement must be determined for both online and offline CBDC to give legal certainty to CBDC holders (see paras 6.28-6.30).

No.	Topic	Proposed Regulation
		• A transfer order for CBDC should not be able to be recalled or cancelled by a participant within the system unless certain circumstances occur (see para 6.38) • For online transaction, the finality of settlement in may want to resemble the existing fund transfers (see para 6.46) • In an offline transaction, the finality of settlement may occur at the different time. Momentum of this finality should be set according to the designs of CBDC (ie fully offline, intermittent offline or staged offline) (see paras 6.50-6.54). • For certain designs of offline CBDC, there should be a maximum settlement time that can range from a few hours to days, depending on the amount of funds transferred. However, if the system fails to reconnect within this timeframe, then the offline payment should be cancelled (see para 6.72).

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