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MAPPING CENTRAL BANK DIGITAL CURRENCY LITERATURE: LESSONS FOR GOVERNMENTS AND RESEARCH

Ririn Riani[a] Nashr Akbar[b]
[a]Tazkia Institute, Bogor, [b]International Islamic University Malaysia, Malaysia and Tazkia Institute, Bogor
e-mail: ririnriani@tazkia.ac.id (corresponding author); n.akbar@tazkia.ac.id

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Abstract

CBDC has gained popularity in many countries as a result of technological development. Central banks in a number of nations have been experimenting, piloting, launching, and promoting CBDC. Therefore, this study maps CBDC-related literature using a bibliometric approach and content analysis of the Scopus database. The Biblioshiny R Package was used in this study to analyse 190 documents with the keywords "central bank digital currency". The analysis focuses on the main information about all documents, analysis of scientific production by areas (journals, authors, and countries), document and keyword analysis, and policy recommendations from the previous literature. The results show that CBDCs have had profound effects on monetary and payment systems, and their development could set the stage for a global central bank. The review also addresses the motivations and advantages of issuing a CBDC, including increasing financial inclusion, enhancing monetary policy, and promoting efficient digital payments. The analysis also reveals that numerous central banks are investigating the possibility of issuing CBDCs due to the numerous advantages of this form of money. There is a lot of potential for theoretical expansion, contextual coverage, and methodological contributions. Furthermore, some policy recommendations from previous literature and directions for future studies are provided in this study.

Keywords: *central bank digital currency, monetary policy, bibliometrics, content analysis, research agenda.*

I. INTRODUCTION

The nature of money is evolving alongside the rapid development of new payment technologies. Peer-to-peer digital transactions, which have the potential to radically disrupt payment and financial intermediation systems, have emerged as a result of the rise of internet-based retail and the development of digital networks and information technology. As a result of such technological transformation and the necessity to control money usage, the emergence of

digital currencies poses new challenges for economic agents, including central banks.[1]

These changes to the payment landscape are characterised by new players offering virtual currency, as well as by large-scale technology companies (big tech) and financial technology (fintech) companies offering financial services. While digital currencies provide alternatives to existing payment systems, providing the potential to reduce transaction costs, they also represent major risks and challenges. Cryptocurrencies, such as Bitcoin and Ethereum, are highly volatile and lack the conversion guarantee and security of conventional currencies.[2]

Stablecoins have been developed in recent years to address the problem of price stability. Asset settlement services, especially those involving central bank money and commercial bank money, are not available.[3] The credit risks associated with utilising Stablecoins are substantial, despite the fact that major digital and financial organisations are driving a more customer-centric experience through data analytics, customer omni-channels that overlay services, and lending provisions.[4] These businesses have flourished in China and are expanding into other developing countries like India and Indonesia, albeit initially just in the major cities of the latter country.[5]

A range of policies have been implemented by central banks to guarantee that individuals and businesses continue to have access to secure and efficient payment systems. By facilitating payment system infrastructure and enforcing rigorous regulations, China's central bank has boosted the transparency of financial data and ensured that money circulating outside of banks will eventually return.[6] On the other hand, their policies and regulations have proven to be costly. Several central banks selected the CBDC to considerably simplify payments and enhance monetary policy.[7] Due to the high expense and risk associated with the development of CBDCs by central banks, proper preparation is required.

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1 Sebastian Infante et al., "The Macroeconomic Implications of CBDC: A Review of the Literature," *Finance and Economics Discussion Series* 2854, no. 2022–076 (2022): 1–65.

2 John Kiff et al., "A Survey of Research on Retail Central Bank Digital Currency," *IMF Working Papers* 20, no. 104 (2020).

3 Kiff et al.

4 Vijak Sethaput and Supachate Innet, "Blockchain Application for Central Bank Digital Currencies (CBDC)," *Cluster Computing* 0123456789 (2023).

5 Bastian Muzbar Zams et al., "Designing Central Bank Digital Currency for Indonesia: The Delphi-Analytic Network Process," *Buletin Ekonomi Moneter Dan Perbankan* 23, no. 3 (2020): 411–38.

6 Ferry Syarifuddin and Toni Bakhtiar, "The Macroeconomic Effects of an Interest-Bearing CBDC: A DSGE Model," *Mathematics* 10, no. 10 (2022): 1–33.

7 Matthew Malloy et al., "Retail CBDC and U.S. Monetary Policy Implementation: A Stylized Balance Sheet Analysis," *Finance and Economics Discussion Series* 2022, no. 032 (2022): 1–17.

These concerns have prompted growth in the study of CBDC and have led to the development of CBDCs by various central banks. First, there were studies attempting to describe and characterise CBDC.[8] Second, there were studies that studied how CBDCs may be utilised.[9] Previous research on CBDC cantered on its effects, particularly on a financial system's stability, monetary policy, and payment system. Given the multifaceted nature of CBDC topics, classifying the extant body of knowledge is both advantageous and challenging. As a direct result, only a small number of reviews have been conducted using the bibliometric method. The disparity of between CBDC review papers in the academic literature, providing the significance of this review paper.

The emergence of CBDCs brings into considerable question the proper duties of central banks. This review aims to identify the major research themes in the CBDC literature so that researchers, policymakers, and practitioners can gain a deeper understanding of CBDC. Second, this article seeks to highlight the main themes of central bank digital currency literature included various paradigms. Bibliometric analysis provides a quantitative method for identifying research questions, influential aspects of the literature, and evolution trends using mathematical and statistical techniques. Bibliometric analysis improves narrative literature surveys that are prevalent in the body of finance literature by providing a more comprehensive understanding of the existing knowledge in the field. The recent adoption of quantitative-qualitative surveys, bibliometric, and content analysis methodologies in finance reflects a growing interest in employing various methodologies to conduct literature review studies. This new approach is particularly noteworthy because it has the potential to be the most effective instrument for informing academics, professionals, and policymakers about the current state of knowledge, consensuses, and ambiguities in this emerging discipline.

The following sections of this work are organised as follows: Section 2 includes a literature analysis on CBDC; Section 3 outlines our approach; Section 4 analyses the bibliometric outcomes and the finding; and Section 5 provides a conclusion and recommendation.

II. LITERATURE REVIEW

This study cites an historical body of work comparing and contrasting the characteristics of two-tiered monetary systems. Although money-multiplier

[8] Peterson K. Ozili, "Central Bank Digital Currency Research around the World: A Review of Literature," *Journal of Money Laundering Control*, 2022.

[9] Raúl Morales-Resendiz et al., "Implementing a Retail CBDC: Lessons Learned and Key Insights," *Latin American Journal of Central Banking* 2, no. 1 (2021): 100022.

analysis has existed since at least the 1940s, the concept of "inside" and "outside" money was not established until the work of Gurley and Shaw. Tobin[10] discusses the fractional reserve banking system and provides a predecessor to CBDC. In a more recent publication, Benes and Kumhof[11] developed a New Keynesian DSGE model and argued that the ex-nihilo creation of money by banks destabilises the economy. Andolfatto[12] explores the far-reaching consequences of banks' money creation on the economy as a whole using an OLG framework. Faure and Gersbach[13] examine welfare under 100% reserve banking vs. fractional reserve banking. According to Niepelt,[14] producers may be able to save money on financing due to "inside money" provided by other banks.

CBDC is a digital representation of cash or paper money. CBDC originated in the 1980s, when central banks let commercial banks use digital money, resulting in an increase in digital money.[15] At the time, digital money was depositors' account balances that could be accessed via bank applications, mobile wallets, or Internet banking programs, which are now known as mobile banking or Internet banking. Cryptocurrencies, also known as private digital currencies, arose two decades later, allowing users to hold significant quantities of private digital currencies without the need for an intermediary and without regulation. Cryptocurrencies include Bitcoin, Ethereum, Dogecoin, Tether, and others.

Central banks noticed that cryptocurrencies were gaining popularity and that a large number of people were adopting private digital currencies. This also raised concerns about consumers abandoning fiat paper money in favour of cryptocurrency. This prompted central banks to investigate the prospect of developing their own digital currencies and to assess whether there is a compelling rationale for developing a CBDC. Six countries have fully implemented digital currencies as of 2021.[16] The Bahamas, St. Kitts and Nevis, Antigua and Barbuda, Saint Lucia, Nigeria, Grenada, Dominica, and Montserrat are among them. Additionally, several countries have formally

[10] James Tobin, "Financial Intermediaries," *Cowles Foundation Discussion Papers*, no. January (1987): 1060.

[11] Jaromir Benes, Michael Kumhof, and Douglas Laxton, *IMF Working Papers* 14, no. 56 (2014): 1.

[12] David Andolfatto, "Assessing the Impact of Central Bank Digital Currency on Private Banks," *Federal Reserve Bank of St. Louis, Working Papers* 2018, no. 025 (2018).

[13] Salomon Faure and Hans Gersbach, "Money Creation in Different Architectures," *CEPR Discussion Papers* 13156 (2018).

[14] Dirk Niepelt, "Monetary Policy with Reserves and CBDC: Optimality, Equivalence, and Politics," *SSRN Electronic Journal*, no. 20 (2021), https://doi.org/10.2139/ssrn.3740324.

[15] Hardik Gupta, "Cryptocurrency to CBDC : The Transition of Digital Currency" 23, no. 4 (2021): 53–63.

[16] Tao Zhang and Zhigang Huang, "Blockchain and Central Bank Digital Currency," *ICT Express* 8, no. 2 (2022): 264–70.

declared that they are conducting CBDC research or intend to implement CBDC in the near future, including Thailand, Ghana, the United States, India, and the United Kingdom.

Several characteristics define CBDC. First and foremost, a CBDC is a digital legal tender that is regulated by a central bank.[17] With this, the digital currency issued by the central bank has legal legitimacy. Only a central bank is authorised to issue CBDC, making them a central bank obligation. This means a central bank is solely responsible for any stolen or lost CBDC due to data breaches, privacy breaches, or other similar incidents. A CBDC is built to serve as a medium of exchange similar to paper currency and often has additional capabilities.[18] As a result, the CBDC can serve as a means of payment, a medium of exchange, a store of value, and a unit of account. CBDC can be used for both small and large transactions by consumers, businesses, and governments. Every transaction can be settled definitively with a CBDC. In other words, a CBDC money transfer is definitive, irreversible, and unconditional once it has been made.

A central bank can issue CBDC directly to citizens' digital wallets, similar to how the government makes stimulus payments directly to citizens' bank accounts.[19] The central bank can credit a recipient's account with a predetermined quantity of CBDC in exchange for the paper money equivalent held in the recipient's bank account in this case. CBDC may potentially be distributed by the central bank through financial institutions. In this case, a bank account holder will notify the bank that he or she desires to convert a particular amount of deposit balances into CBDC units. This sum is subsequently sent to the individual's CBDC account. The CBDC account deposit amounts can then be used to make electronic payments after conversion. The individual begins an electronic payment transaction and specifies the amount to be paid. Prior to completing payment, the individual authorises the electronic payment by scanning his or her transaction QR code against the selle's QR code (in the event of an account-based CBDC maintained in a digital wallet) or validating the seller's token (in the case of a token-based CBDC). After that, the value is electronically transferred.

[17] Dmitry Kochergin and Victor Dostov, *Central Banks Digital Currency: Issuing and Integration Scenarios in the Monetary and Payment System*, *Lecture Notes in Business Information Processing*, vol. 394 (Springer International Publishing, 2020).

[18] Kiff et al., "A Survey of Research on Retail Central Bank Digital Currency."

[19] Infante et al., "The Macroeconomic Implications of CBDC: A Review of the Literature."

II.A. Previous Studies

Since the early 2010s, researchers have examined the consequences of digital financial innovation on economic stability. Initial research in this discipline consisted of country-specific analyses of digital financial innovation, including by Zhou and others in their article entitled *Regulation of digital financial services in China: Last mover advantage*. These studies evaluated the potential of digital financial innovation and emphasised the need to regulate it in order to increase its impact on business performance. There are additional studies that focus on Fintech and its positive impact on financial services and the economy (see, Gulamhuseinwala, Dapp and others, and Narayan).

Within the review of the literature, we came across several previous studies that attempted to comprehend the viability of a cryptocurrency issued by a central authority, as well as the possibility of its implementation, the impact it would have on monetary policy, and the subsequent effects on financial stability and the economy. Previous research has examined the effects of digital financial innovations such as CBDC on banks and other economic system participants (see, for instance, Auer and Bohme, Kiff, and others). These studies investigated the technology underlying CBDC, the extent of CBDC adoption, how the design of CBDC is crucial to its success, how widespread use of CBDC can lead to a decline in the use of cash, and how CBDC affects monetary policy. However, these studies pay little attention to how CBDC influences financial inclusion, nor do they demonstrate the channels through which CBDC influences financial inclusion. In addition, the research has not investigated how CBDC influences a financial system's overall level of systemic risk or its stability.

Niepelt and Dirk examined the policies essential to implementation of CBDC in a two-tier monetary system. Non-competitive banks issue deposits, whereas the central bank is responsible for issuing reserves and a retail CBDC. Variable costs are associated with maintaining various forms of money and their respective liquidity. Florian Boser and Hans Gersbach examined how the introduction of an interest-bearing CBDC influences bank behaviour and monetary policy. Under such a scheme, at any time, households can transfer their deposits from banks to CBDC, which is a secure medium of exchange. Because digital runs on banks are possible, either because depositors prefer CBDC or because they fear the insolvency of their banks, monetary policy may initially increase bankers' oversight incentives in the presence of CBDC through collateral requirements and penalties for illiquidity. This is due to the possibility that banks may experience digital runs.

Manoj Kumar Singh examines the effect of digital currency decisions and a variety of other situations, including those based on the introduction of

CBDC, on the allocation of supervisory resources. Bargonovo, Caselli, Cilli, and Masciandro provide the theoretical bases for analysing the demand for a CBDC. They use a financial portfolio method to identify the origins of the political consensus in favour of or against a new currency, assuming individual preferences and policy are consistent. Given the different opportunity costs of the various currencies, CBDC issuances becomes more likely as more people prefer legal tender and are unconcerned with anonymity. Concurrently, the CBDC introduction becomes more likely if returns can be earned on it and its implementation can guarantee at least counterparty anonymity.

In addition, Alonso, Jorge-Vazquez, and Forradellas assess the present state of CBDC and their development in various economies. Multiple nations have adopted or are in the process of adopting CBDC. Furthermore, Laboure, Muller, and others suggest that the nature of CBDC is highly dynamic and requires a high level of technological sophistication and regulatory oversight by relevant actors. The article evaluates the socioeconomic effects of the adoption of government-backed digital assets or digital currencies, including CBDC. There are many CBDC implementation initiatives in the pipeline for many countries around the world.

The recent development of CBDC will have a substantial effect on how business is conducted. With the growing body of literature on CBDC, its significance cannot be overlooked. The increasingly digital global economy strengthens the case for a thorough investigation of the potential consequences of implementing a CBDC. Although, the academic inquiry into this area is in its infancy, therefore our grasp of its essential features and repercussions is incomplete. To present the knowledge base and research areas of this field, we employ a bibliometric approach to analyse publications derived from the Scopus primary database that investigate and visualise the knowledge base's emerging hot topics and research fronts in the field of CBDC. Bibliometric studies have demonstrated the method's utility in a variety of innovation research, including digital currency innovation. In terms of data, analysis, and scope, this study differs from related previous studies. The primary advantage of the bibliometric method is its capacity to assist in eradicating reviewer subjectivity and bias, which the literature is continually enhancing. This article presents the most recent bibliometric analysis of CBDC, encompassing the years 2018 to 2023. It is anticipated that policymakers and researchers will discover the findings useful for developing significant unexplored themes.

III. RESEARCH METHODOLOGY

The ultimate goal of this research is to map the existing body of knowledge concerning CBDC. This study used bibliometric analysis and content analysis to achieve this. Information about the development of a field can be gleaned through bibliometric techniques such as performance analysis and scientific mapping.[20] The Systematic Literature Review (SLR) technique was used to search for relevant articles to feed the study's bibliometric analysis. The quality of SLR is improved because it is conducted according to set standards, involving scanning many databases using a predefined search strategy.[21] Doing a systematic literature review not only improves the trustworthiness of the research but also reduces the likelihood that irrelevant studies will be included.[22] What follows is a detailed explanation of how we went about our literature review for this paper.

The outcomes of published studies constitute an existing body of knowledge. The citations indicate the fundamental characteristics that were recognised and examined, as well as the various relationships that were made.[23] Hence, a thorough literature search not only compiles existing information but also identifies research gaps prompting future studies. This paper's literature review focuses on CBDC research conducted between 2018 and 2023. Scopus is the database that is utilised to locate existing publications that are pertinent. Scopus is one of numerous databases used to locate literature on social scientific topics.[24] Many reasons exist for using the Scopus database to compile literature: (1) it is the greatest repository of abstract and citation data in the world; (2) Regularity of rapid updates; (3) flexibility in debugging and data processing; and (4) excellent coverage and indexing of pertinent journals.[25]

When choosing a keyword for the search parameters, the authors concentrated on the article's title because it describes the issues related to the research scope and objectives. The title of an article should include information that can be used to attract a reader's attention, as it is the first thing they would notice.[26] To conduct the bibliometric study, a total of 190 documents were gathered based on the query. As the search was conducted using only the

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[20] Hugo Baier-Fuentes et al., *International Entrepreneurship and Management Journal* 15, no. 2 (2019): 385–429.

[21] Gareth H. Thomas et al., "A Systematic Bibliometric Review of the Strategic Entrepreneurship Domain," *Management Research Review* 45, no. 6 (2022): 841–63.

[22] H. W. Perry, *National Review of Black Politics* 2, no. 2 (2021): 95–106.

[23] Harshini Mallawaarachchi et al., *Journal of Cleaner Production* 258 (2020): 120618.

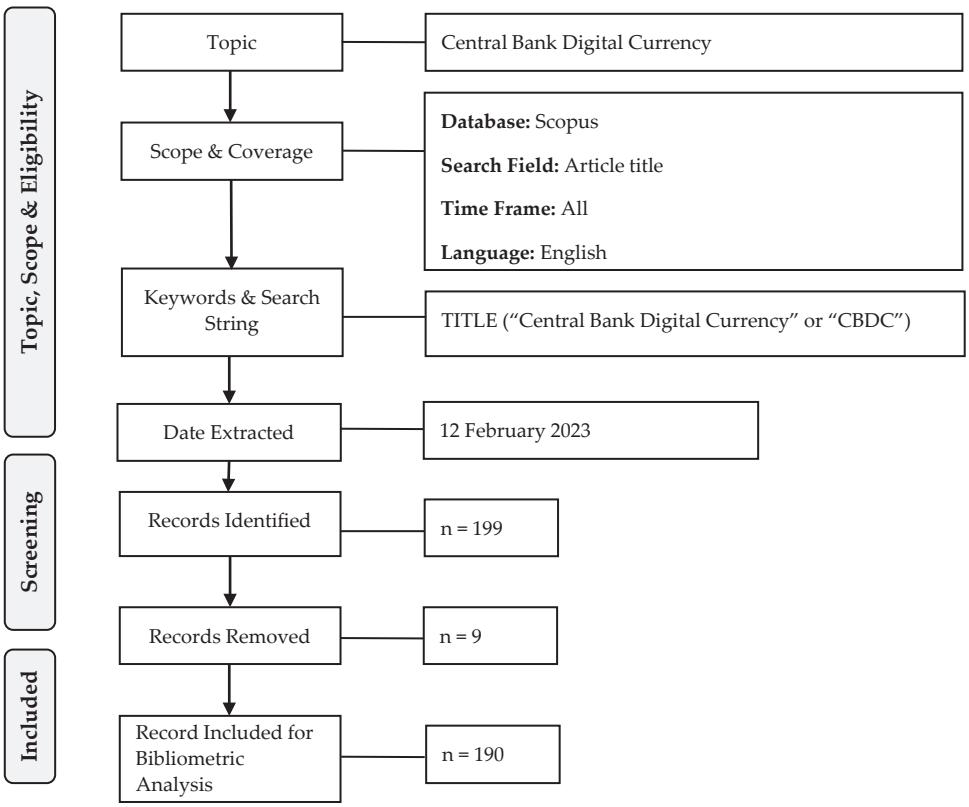
[24] José A. Aznar-Sánchez et al., "Worldwide Research Trends on Sustainable Land Use in Agriculture," *Land Use Policy* 87, no. May (2019): 104069.

[25] Aznar-Sánchez et al.

[26] Meifang Zhang et al., "Mapping Discourse Analysis in Translation Studies via Bibliometrics: A Survey of Journal Publications," *Perspectives: Studies in Translatology* 23, no. 2 (2015): 223–39.

article's title, it may be presumed that all retrieved documents pertain solely to Central Bank Digital Currency. Then, the selected papers were examined using Biblioshiny, an R-supported software that provides a suite of tools for quantitative investigations in scientometrics and bibliometrics.[27] Biblioshiny R is adopted over other software because of its flexibility in visualisation. However, the limitation is that we are only allowed to select one journal database. Figure 1 depicts the search strategy flow for this investigation:

Figure 1. Search Strategy Flow



Finally, an extensive content analysis was carried out in order to identify and characterise the main research areas.[28] Although the research questions

[27] Massimo Aria and Cuccurullo Corrado, "Package ' Bibliometrix ' R Topics," *Journal of Informetrics* 11, no. 4 (2020): 959–75.

[28] Vincent J. Duriau, Rhonda K. Reger, and Michael D. Pfarrer, "A Content Analysis of the Content Analysis Literature in Organization Studies: Research Themes, Data Sources, and Methodological Refinements," *Organizational Research Methods* 10, no. 1 (2007): 5–34.

were formulated at the beginning of the study, we considered possible categories of research areas that could have emerged at later stages. The authors read all of the articles and highlighted in the text any findings or insights that seemed relevant to the research question. To avoid personal bias, all authors contributed directly, working independently, carefully examining each document, comparing their results, and constructing research categories to increase the work's validity.

IV. RESULT & DISCUSSION

IV.A. Result

The current review study's findings can be divided into two categories. The initial section of the study presented the results of several bibliometric methods. We utilised a variety of bibliometric techniques to determine which studies, journals, and authors had the greatest influence on CBDC. In addition, the bibliometric analysis revealed a chronological publication pattern within the CBDC literature, thereby revealing its conceptual and intellectual framework. The second section provides an analysis of the content of multiple studies. This section helped organise the studies according to their respective themes.

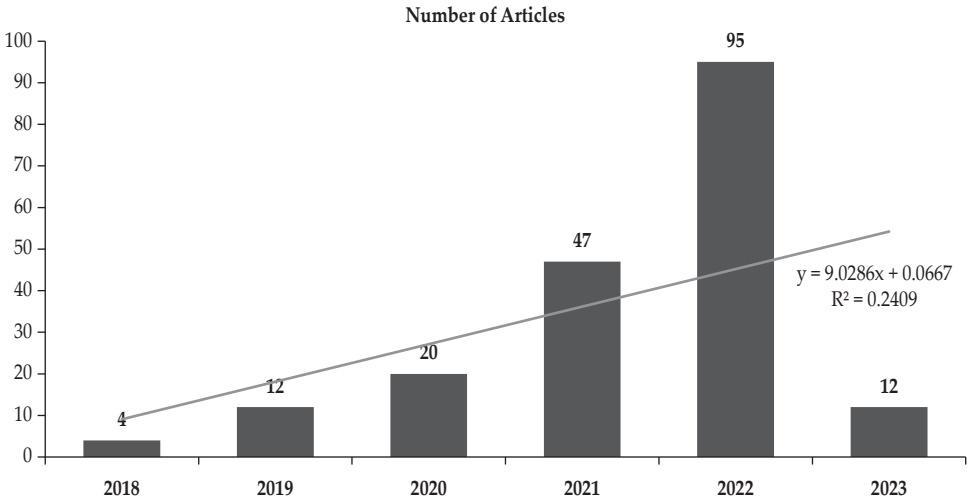
IV.A.1. Bibliometric Analysis

We use the Biblioshiny R package to compile annual trends, affiliation trends, contributing organisation patterns, journal quality analyses, profiles of influential authors, citation analyses, and keyword statistics.

IV.A.2. Chronological publications trend

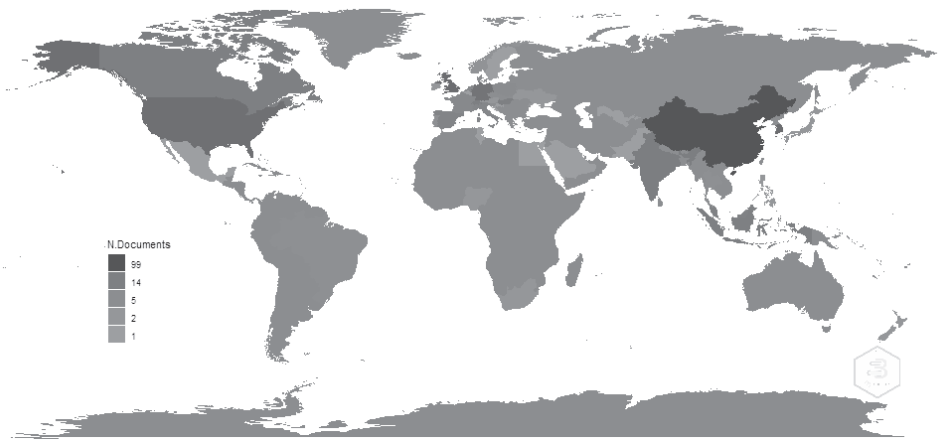
Figure 2 below depicts the rise in the number of CBDC publications. It includes a collection of research papers published in each year from 2018 to 2023. As indicated by the graph, the average number of research papers published each year has steadily increased over those years. The highest prevalence of papers were published in 2018 and later. This topic has sparked a growing amount of interest among those conducting research on it. The regression line was also fitted, and the coefficient of determination was R square=0.2409. Throughout the review period, these indicators show a statistically significant increase in the number of papers published. As a result, the topic continues to be favourable for research in its respective field.

Figure 2. Chronological publications trend



IV.A.3. Analysis of countries, regions, and affiliations

Figure 3. Scientific Countries



In the course of the research, an examination of the scientific production (i.e., the number of publications) and contributions made to the field of CBDC was carried out across various countries and regions. According to the findings, China has the highest publication count out of all the countries, followed by South Korea and the United Kingdom. The United States of America is making significant contributions to the field of CBDC being developed in the North American region. According to the findings of the study, a number

of countries—including Germany, India, Switzerland, Canada, Hungary, Indonesia, Malaysia, and Spain—have made significant contributions to the field of CBDC. The findings also indicate that a select number of nations, including Italy, France, the Netherlands, Poland, Australia, Turkey, Brazil, and Portugal, are making contributions of some kind to the field of central bank digital currency.

Table 1.
Geographical Region

Geographical Region	Freq	Percentage
Asia Region		**47,21%**
China	99	25,98%
South Korea	39	10,23%
India	16	4,19%
Indonesia	14	3,67%
Malaysia	12	3,14%
Europe Region		**37,48%**
UK	39	10,23%
Germany	26	6,82%
Switzerland	15	3,93%
Hungary	14	3,67%
Spain	11	2,88%
Italy	9	2,36%
France	7	1,83%
Netherlands	7	1,83%
Poland	6	1,57%
Turkey	5	1,31%
Brazil	4	1,05%
North America		**12,85%**
Canada	14	3,67%
USA	35	9,18%
Australia		**1,31%**
Australia	5	1,31%
South America		**1,05%**
Portugal	4	1,05%

Table 2 depicts a list of the ten institutions that have the highest total number of research papers that have been published. The most significant contribution to the currently available body of work currently on central bank digital currency was made by institutions in South Korea. The following are among the top ten institutes in each country:

Table 2.
Affiliation

Affiliations	Articles
Seoul National University	15
State Key Laboratory of Information Photonics and Optical Communications	10
Ningbo University	8
Schulte Roth And Zabel LLP	8
Beijing University of Posts and Telecommunications	7
International Islamic University Malaysia	7
Vnu University of Economics and Business	5
Beihang University	4
Deutsche Bank	4
Moscow State Institute of International Relations (University) of the Ministry of Foreign Affairs	4

IV.A.4. Journal quality analysis

During the years 2018-2023, a total of 123 different journals published 190 different articles. The list of the top ten journals that are currently active and have the highest number of publications in the field of CBDC is presented in Table 3. In addition to that, the table offers some material inputs such as the total citations and the H-Index. The most articles were published in the China Economic Journal, which had a total of 75 citations and a score of 5 on the H-Index scale. Next in line is the Asian Economic Policy Review, which has a total of two publications, five citations, and two H-Indexes to its name. The other excellent publications that can be found on this list are:

Table 3.
Journal quality analysis

Sources	h-index	Total Citations	Number of Articles
2019 1st-Africa Week Conference	1	4	1
Accounting, Economics and Law: A Convivium	1	10	1
Asian Economic Papers	1	4	1
Asian Economic Policy Review	2	5	2
Buletin Ekonomi Moneter dan Perbankan	1	3	1
China Economic Journal	5	75	5
Computer	1	5	2
Computer Law and Security Review	1	10	1
Credit and Capital Markets	1	2	1
Economic Inquiry	1	2	1

IV.A.5. Citation analysis

Citation analysis is one of the most frequently recognised methods for assessing the importance of the existing literature. Citation analysis evaluates the popularity of a specific publication in the existing literature based on the number of times a particular research study is cited by other research studies.[29] According to the number of local citations, Table 3 lists the ten most cited papers. Local citation analysis differs from global citation analysis in that the former focuses on the individual citations count from 190 papers in its own node network, whereas the latter focuses on the total Scopus citation count inclusive of all other concerned research disciplines. As shown in Table 4, there is a notable difference between the local citation score and the global citation score, indicating that central bank digital currency has attracted the attention of researchers from other fields.

The ranking of papers based on the amount of local and global citations was discovered to vary significantly. For example, Yao Q ranks 5th based on the number of local citations yet has the largest number of global citations. This finding is interesting given that the reference citation for Yao Q appears to be frequently utilised in the field of central bank digital currency. It has been observed that the number of citations rises with the passage of time. Therefore, articles with a large number of citations are at least five years old.

Table 4.
Citation analysis

Author(s)	Local Citations	Global Citations	LC/GC Ratio (%)
Andolfatto D (2021)	20	34	58,82
Fernández-Villaverde J (2021)	19	30	63,33
Agur I (2022)	12	23	52,17
Lee DKC (2021)	11	20	55,00
Yao Q (2018)	10	31	32,26
Qian Y (2019)	10	17	58,82
Alonso SLN (2021)	10	21	47,62
Han X (2019)	8	13	61,54
Chorzempa M (2021)	8	15	53,33
Tsai W-T (2018)	6	14	42,86

IV.A.6. Author influence

In the study, the Biblioshiny tool was utilised to analyse the occurrence of text in different areas of bibliographic data. From the input data file, the author field was derived, and the count of authors' names was analysed by

[29] Payal R. Phulwani, Divesh Kumar, and Praveen Goyal, *Journal of Global Marketing* 33, no. 5 (2020): 354–76.

documenting total and average citations. Table 5 presents the summary of the top ten contributing authors and the number of papers they published or co-authored together with total citations and average citations per article.

According to the findings from an analysis of the data, Lee J and Andolfatto are the most influential authors since their names dominate the list. Another interesting fact is that Huang Z received the highest number of overall citations, which was 24 citations from a total of two papers. Additionally, Huang Z received the highest number of total citations per year, which was 12.

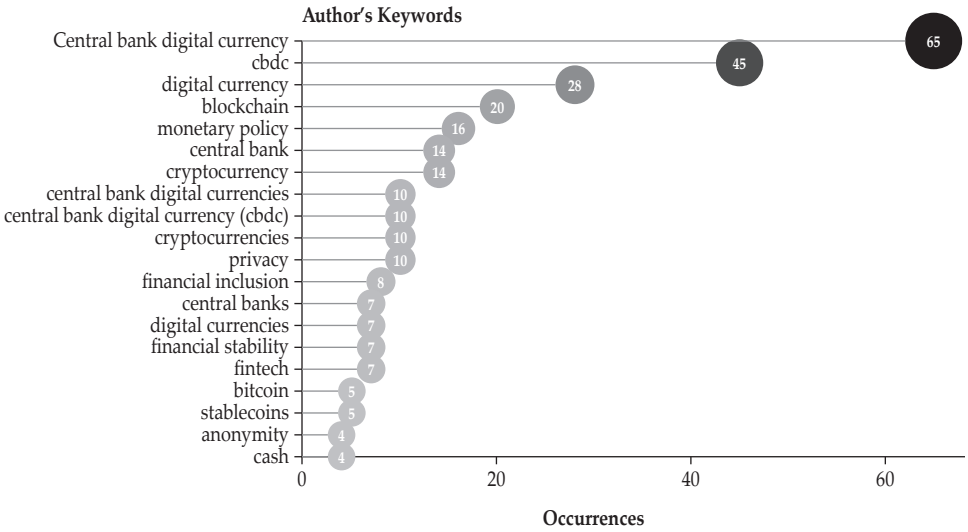
Table 5.
Author influence

Author	No. of Article	Total Citation	Total Citation Per Year
Lee J (2021)	3	11	3,667
Andolfatto (2021)	2	34	11,333
Huang Z (2022)	2	24	12
Belke A (2020)	2	12	3
Beretta E (2020)	2	12	3
Li Z (2022)	2	18	9
Ozili PK (2022)	2	9	4,5
Kochergin DA (2021)	2	7	2,333
Auer R (2022)	2	2	1
Groß J (2020)	2	1	0,25

IV.A.7. High-frequency keywords

A study was conducted to find frequently occurring keywords and phrases in the author's keywords of the papers. Figure 4 summarises the list of the top 20 keywords used in the author keyword section of the publications. Most pertinent word analysis was performed on each document's keywords, which contained a variety of terms with occurrence frequencies ranging from four to sixty-five. The keyword "Central Bank Digital Currency" was used to identify the 20 most pertinent terms from the study collection, which are displayed in Table 5 above. The term "CBDC" has been used 45 times in relation to Central Bank Digital Currency, making it the second most relevant term overall. In addition, "digital currency," "blockchain," and "monetary policy" are the third, fourth, and fifth most relevant terms in relation to the issue of Central Bank Digital Currency, appearing a total of 28, 20, and 16 times, respectively.

Figure 4. Keyword Trend



IV.A.8. Bibliographical coupling

Bibliographic coupling refers to the connection between two referencing documents that cite a common work or works. If the number of shared citations between two works is high, it indicates a greater connection. Bibliographic coupling is also indicative of subject similarity. In 1963, MM Kessler invented the word, denoting the concept's utility for retrieving relevant earlier research. Barbara and Debons criticised the notion, revealing that it merely signifies the association between two papers and cannot be used as a measure of resemblance. [30] This cleared the way for the development of concepts such as "co-citation analysis" by Henry Small in 1973 and "author co-citation analysis" by Howard White and Belver Griffith in 1981. The two authors are bibliographically linked if the reference list contains cited research from both of them. Although there are a number of techniques, such as co-citation analysis and citation analysis, for mapping the intellectual structure of a field, none of them can identify emerging themes.[31] This constraint is overcome by bibliometric coupling, which identifies contemporary themes in a certain field.

Figure 5 shows the bibliographic coupling of the 44 most-cited Central Bank Digital Currency articles. Publications are highlighted according to

[30] Barbara M. Hill and Anthony Debons, "Bibliographic Coupling," *Journal of the American Society for Information Science* 23, no. 4 (1972): 286–286.

[31] Johannes A.W.H. van Oorschot, Erwin Hofman, and Johannes I.M. Halman, "A Bibliometric Review of the Innovation Adoption Literature," *Technological Forecasting and Social Change* 134, March 2017 (2018): 1–21.

their frequency of citations. The various node colours indicate the results of applying the Louvain group identification method on the bibliographic matrix. The application of a community detection technique resulted in the development of four distinct clusters. The first cluster (in red) contains the Blockchain Technology-related work of Lee J, Lee Y, Jang H, and Son B. The second cluster (in green) contains Central bank and Financial System-related articles by Auer R, Belke A, Beretta E, etc. The third cluster (blue) contains CBDC Model-related works by Kshetri N, Lykov AA, Tronnier F, and others. The fourth cluster (coloured purple) contains publications about cryptocurrency. The collected literature for these research all helps to the development of Central Bank Digital Currency. Table 8 provides a detailed summary of bibliographic connected clusters.

Figure 5. Bibliographic coupling

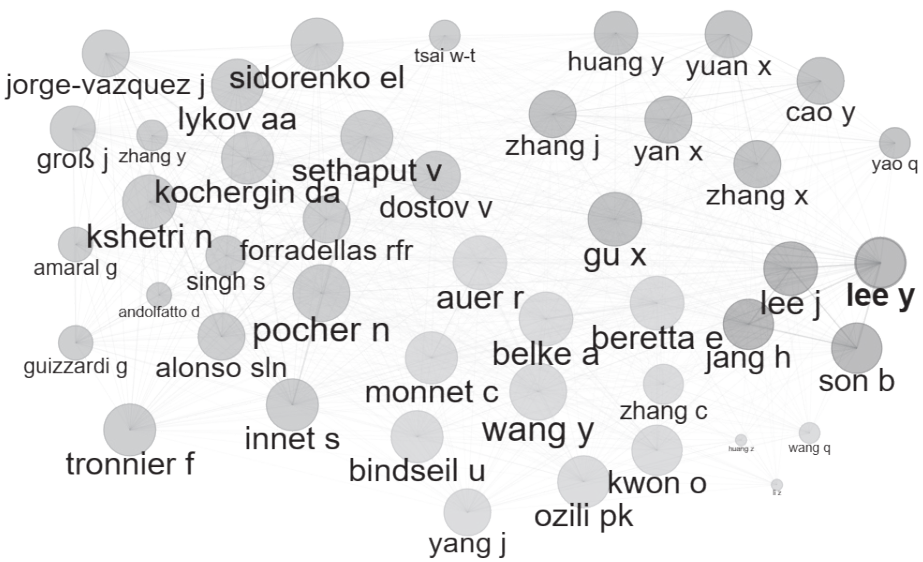


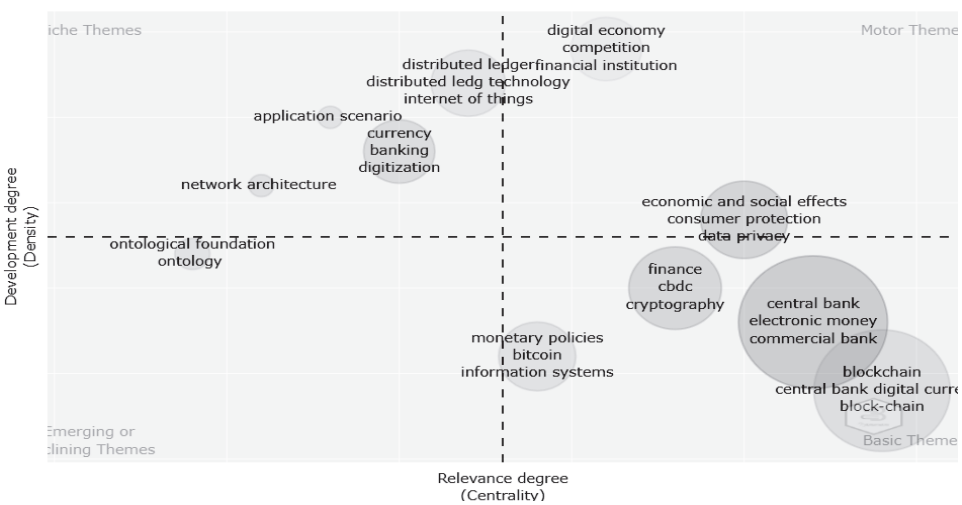
Table 6.
Summary of Bibliographic Analysis

Label	Cluster	No of Studies	Emerging Area
Blockchain technology	1	4	Facilitating money transfer, Blockchain public finance management, fraud detection, money laundering prevention.
Financial System	2	19	Bank market power, credit creation theory, government intervention, financial regulation, bank competition.
CBDC Model	3	13	Wholesale CBDC, Retail CBDC, Account-based CBDC, Token-based CBDC, Decentralised CBDC, Direct CBDC, indirect CBDC, interest-bearing CBDC, non-interest-bearing CBDC, multi-CBDC (m-CBDC).
Cryptocurrency	4	8	Curbing illicit practices, investor protection, corporate governance, digital bank currencies, Stablecoins, monetary instruments.

IV.A.9. Thematic Mapping

Techniques for scientific mapping consist of thematic maps that depict the conceptual framework of a certain research field. The thematic map is comprised of a network analysis of word occurrence to describe essential themes and trends on a scientific topic. Thematic mapping divides the literature on a domain into four distinct theme types. This study utilises the authors' keywords field to determine the topic's underlying conceptual structure. A thematic map defines four topic classifications depending on the quadrant in which each subject is located as displayed in figure 6.[32]

Figure 6. Thematic Mapping



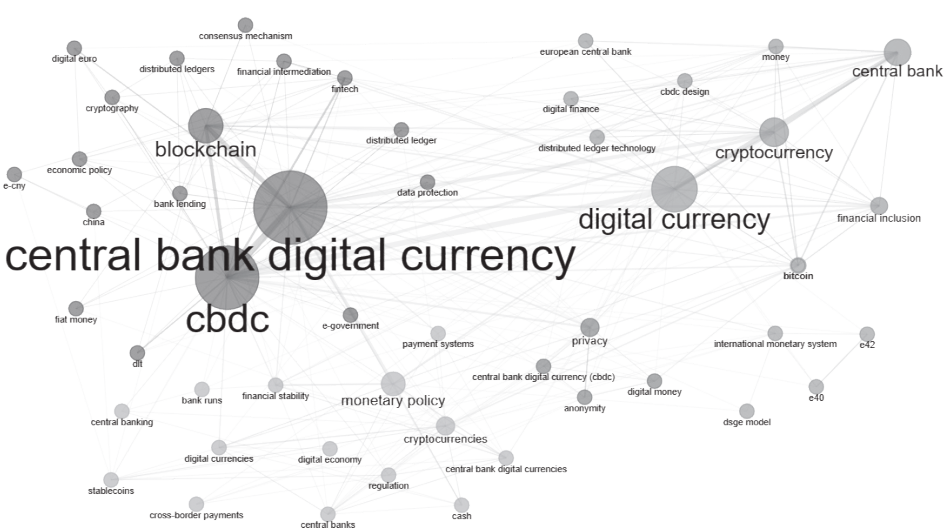
[32] Patrik Aspers and Ugo Corte, "What Is Qualitative in Qualitative Research," *Qualitative Sociology* 42, no. 2 (2019): 139–60.

The "motor" theme, which includes "economic and social effects, consumer protection, data privacy" and "digital economy, competition, financial institution" is represented by the upper right quadrant, which is characterised by high density and centrality. This topic should be developed further in light of its importance to future study. The upper left quadrant indicates distinct and underrepresented subjects that are regions of rapid expansion, as shown by high density but low centrality, including "distributed ledger, distributed edge technology, internet of things", "currency, banking, digitisation", "application scenario", and "network architecture". The lower left quadrant covers subjects that have been addressed but are on the decline, as seen by low centrality and density; these areas include "ontological foundation, ontology". Finally, the lower right quadrant is comprised of the basic themes, which are represented by high centrality but low density. This topic is significant for research as a general topic, and includes "monetary policy, bitcoin, information system", "finance, CBDC, cryptography", "central bank, electronic money, commercial bank", and "blockchain, central bank digital currency, block-chain".

IV.A.10. Content Analysis

For content analysis, this research follows a narrative synthesis approach. In this approach, the actual content of the research study is used for literature classification. We use the network analysis as a reference to provide an in-depth explanation of research themes within the CBDC topic area as represented in figure 7.

Figure 7. Network Analysis



The co-occurrence network presents, in the form of coloured clusters, words that are associated with keywords that are associated with the topic of central bank. This is accomplished by taking into consideration the relationship that exists between each particular word. Several keywords that frequently appear in research on the topic of central bank digital currency have been grouped together into the following five categories.

1. Cluster 1 (red colour) consists of the keywords: Central bank digital currency, CBDC, blockchain, fintech, financial intermediation, distributed ledger, data protection, consensus mechanism, cryptography, economic policy, bank lending, China, fiat money, DLT, e-government, e-cny.
2. Cluster 2 (green colour) consists of the keywords: Monetary policy, payment system, digital economy, regulation, central bank, financial stability, central bank digital currencies, cross-border payment, Stablecoins, cash, and bank runs.
3. Cluster 3 (blue colour) consists of the keywords: Digital currency, cryptocurrency, central bank, digital finance, CBDC design, bitcoin, money, distributed ledger technology, and European central bank.
4. Cluster 4 (yellow colour) consists of the keywords: International monetary system, DSGE model, E40, E42.
5. Cluster 5 (purple colour) consist of keywords: Privacy, digital money, CBDC, anonymity.

Furthermore, the authors present five major research paths based on the findings of the co-occurrence network keyword cluster mapping. The authors conducted a search of the Scopus database, which was used for this investigation, for publications that contained the keywords identified on the cluster map. These publications were then screened to determine whether or not they are directly relevant to this investigation. It is important to keep in mind that each existing cluster does not simply represent a separate line of inquiry. This is due to the fact that a single cluster might not address a single topic, and keywords from one cluster might already be included in another. In addition, two different topics could be represented by two different keywords that are part of the same cluster. This evaluation is conducted by looking at the abstracts of each article to see if it contains any of the keywords from the map that came before it.

IV.A.11. Research Path 1 – Blockchain Technology and Central Bank Digital Currency

Blockchain is a distributed ledger technology that employs decentralisation, traceability, immutability, anonymity, transparency, and security via cryptographic techniques and consensus algorithms.[33] These features can aid

[33] Tao Zhang and Zhigang Huang, "Blockchain and Central Bank Digital Currency," *ICT Express* 8, no. 2 (2022): 264–7.

in cost reduction and efficiency improvement. Blockchain was developed by Satoshi Nakamoto, the creator of Bitcoin.[34] Only validated transactions will have their records included in the blockchain. Furthermore, once transactions have been validated by other nodes, they are immutable. Because each transaction on the blockchain is validated and recorded with a timestamp, all nodes in the blockchain network can confirm that these transactions occurred. Because the ledger is accessible to all blockchain network participants, its use can facilitate transparency.[35] Using cryptographic techniques, the blockchain is able to guarantee that the data recorded on the ledger cannot be altered.

One of the most essential aspects of blockchain technology is the smart contract functionality. When certain conditions are satisfied, a smart contract can be programmed to carry out its terms automatically.[36] This can help to improve the effectiveness of transactions, as well as lower their costs and make them easier to understand.

Global central banks are actively researching and investigating potential blockchain applications in CBDC. Since 2016, numerous central banks have initiated blockchain adoption projects in the CBDC. Several projects are complete and have produced proof-of-concept prototypes.[37] In this section, we conduct a literature review on blockchain based on central and decentralised CBDC projects and scheme.

IV.A.11.i. Bitcoin based CBDC

In 2015, the Dutch Central Bank created a prototype of a CBDC built on blockchain technology called DNBcoin/Dukaton. The original blockchain for DNBcoin was derived from Bitcoin, and its primary emphasis was on ensuring long-term viability within the financial system. After that, the Dutch Central Bank performed experiments on various consensus and validation techniques utilising the subsequent four blockchain prototypes. After these experiments concluded, the Dutch Central Bank ended up deciding that blockchain technology cannot be a viable choice for financial infrastructure due to the limitations it imposes on capacity, efficiency, and certainty of payment. Unfortunately, no published technological details regarding the Dukaton project are currently available.

Similarly, in 2016, the Bank of England and University College London suggested RSCoin as a blockchain-based CBDC prototype system. The

[34] Jinnan Zhang et al., "A Hybrid Model for Central Bank Digital Currency Based on Blockchain," *IEEE Access* 9 (2021): 53589–601.

[35] Hyunjun Jung and Dongwon Jeong, "Blockchain Implementation Method for Interoperability between CBDCs," *Future Internet* 13, no. 5 (2021).

[36] Jung and Jeong.

[37] Natalia Dashkevich, Steve Counsell, and Giuseppe Destefanis, *IEEE Access* 8 (2020): 139918–52.

UTXO (Unspent Transaction Output) paradigm is utilised in RSCoin, which is an implementation of Bitcoin. In RSCoin, there are two different kinds of ledgers, namely the high-level worldwide ledger and the low-level ledger. The issuance of currency and the maintenance of a worldwide ledger are both the responsibilities of the central bank. Payment interface companies are responsible for updating the low-level ledger, and it will eventually be sent to the central bank. The end users and payment interface companies are connected through a third party called a payment interface. Additionally, the central bank is accountable for resolving any potential transactional conflicts that may arise and ensuring that the global record is consistent around the world.

IV.A.11.ii. Permissioned blockchain-based CBDC

Central banks have made attempts to implement consortium blockchains in CBDC as permissioned consortium blockchain has reached a more developed stage. Ethereum, Corda, Hyperledger Fabric, and Quorum are the four collaboration blockchains that have seen the most widespread use in CBDC. The primary application scenarios for these initiatives include settlements, payments between banks, payments made across national borders, and payments made within banks.

The use of blockchain technology may confer distinctive benefits on CBDC as well as on financial networks. Because of features such as auditability and immutability, blockchain technology is ideally suited to fulfil the specifications of CBDC. In addition, a CBDC model that is built on blockchain technology has the advantage of regulation, and it also has the potential to help reduce costs and improve payment efficiency. Even though several central banks have already confirmed that they are working on blockchain-based CBDC, the question of whether or not to embrace blockchain technology is still a contentious one.

IV.A.12. Research Path 2 – Monetary Policy and Payment Systems related to CBDCs

CBDCs are interesting not only because they offer new ways to improve the effectiveness of existing monetary and payment systems, but also because of the concerns of central banks and international financial institutions such as the International Monetary Fund and the Bank for International Settlements regarding the stability of national monetary systems and the future of central bank money. CBDCs offer new ways to improve the effectiveness of existing monetary and payment systems.

When compared to bank deposits or virtual currencies, digital currencies issued by central banks have a great deal more in common with currency and

reserve balances issued by central banks. The most important characteristics are: 1) the status of the issuer as a centralised regulator and last-line lender; 2) the capability of an issuer to regulate the procedures and conditions of issuing digital currency; and 3) the role of an issuer in controlling the volume of digital currency. Because digital currency can be as universally accepted as cash while at the same time being stored in electronic form as money balances on reserve and settlement accounts in central banks, it should be identified as a new form of central bank money, which offers a middle position between other forms of central bank money.

Scholars have realised that the digitisation of currency plays a crucial role in enhancing the efficiency of implementing monetary policy. Stiglitz[38] investigated macroeconomic administration within a digital currency system. To address the current limitations of monetary policy, he proposes a credit auction mechanism that would enable central banks to directly impact on the lending behaviour of commercial banks, such as restricting loan size or the use of money, to bind the actions of commercial banks and encourage the flow of money into the real economy. In addition, the credit auction mechanism would include a design for state-contingent loans based on macroeconomic stability and income, which has the potential to reduce the pro-cyclicality of commercial banks' risk preferences in order to reduce the uncertainty during the transmission of base money to bank loans.

However, for such an arrangement to be successful, it is necessary for the central bank to have broad, updated information on the state of the economy, the actions of the banks, and the circulation of the money.[39] In order to guarantee this, the system of computerised currency must become an essential piece of infrastructure. In the words of economist Joseph Stiglitz, "While credit auctions and trade chits could have been introduced even without e-money, the enhanced ability to monitor flows and to organise markets that e-money and digitalisation provide increases the potential gains that might arise from these institutional innovations". Unfortunately, Stiglitz does not elucidate the concept of digitising money from the standpoint of making monetary policy more efficient.

IV.A.13. Research Path 3 – Cryptocurrency to CBDCs

The word "digital currency" is an umbrella term that is used to refer to the many different sub-categories of alternative currencies that have surfaced over

[38] Joseph E Stiglitz and Joanne J Myers, "Making Globalization Work," *Choice Reviews Online* 44, no. 06 (2007): 44-3398-44–3398.

[39] Lambis Dionysopoulos, Miriam Marra, and Andrew Urquhart, "Central Bank Digital Currencies : A Critical Review," n.d.

the course of the previous decade.[40] Because of the sudden attention that cryptocurrency has received during this period, the term is frequently used to refer to alternative currencies that are supported by blockchain technology. It is important to delve deeper into the terminology of what is covered under the umbrella of each term in order to gain a clear understanding of the current academic discourse on digital currencies and their various sub-parts. This will allow one to gain a clear comprehension of the overall topic. The Financial Action Task Force (FATF) was an organisation that made one of the earliest endeavours to provide specific and clear definitions of "Digital Currency". This independent intergovernmental body works to develop and promote policies that will safeguard the global financial system from activities such as money laundering, the financing of terrorist organisations, and the financing of the proliferation of weapons of mass destruction.

The publication of a white paper by Satoshi Nakamoto on October 31, 2008, titled "Bitcoin: A Peer-to-Peer Electronic Currency System", is considered to be the moment that marked the beginning of the cryptocurrency industry.[41] The paper discussed the role that "trust" plays in financial organisations within the traditional system, in addition to addressing other inefficiencies that are present within the system. The paper suggested an alternative method of electronic cash that does not require this element of "trust", relying solely on proof as the foundation for the transaction. Bitcoin, the proposed form of electronic currency, would operate on a peer-to-peer basis, making it possible to make direct transfers without the involvement of a financial institution. It was proposed to use a system of digital signatures as the premise for the proof, which would then use cryptography as the foundation. In addition, distributed ledger technology was utilised to incorporate a decentralised system into the suggested peer-to-peer network in order to mitigate the possibility of fraudulent transactions. Bitcoin, the first cryptocurrency, was introduced into the world approximately two months later, on January 3, 2009.

On the other hand, numerous policymakers from around the world have come to the consensus that virtual currencies include cryptocurrencies as one of their subcategories.[42] In addition to FATF and the BIS, organisations with similar goals include the ECB, the IMF, the EBA, the ESMA, and the World Bank. A study conducted by the Policy Department for Economic, Scientific, and Quality of Life Policies of the European Parliament gave a summarised

[40] E Kabaklarlı, "Future of Money: Cryptocurrencies, Blockchain Technology and Central Bank Digital Currency," *Dpublication.Com*, n.d., 18–27.

[41] Satoshi Nakamoto, "Bitcoin: A Peer-to-Peer Electronic Cash System," *Bitcoin.–URL: Https://Bitcoin. Org/Bitcoin. Pdf* 4, no. 2 (2008): 1–15, https://doi.org/10.1108/TG-06-2020-0114.

[42] Eswar Prasad, "The Future of Money and Its Implications for Society, Central Banks, and the International Monetary System," *Review* 105, no. 1 (2023): 1–8.

definition of cryptocurrency as "[(i)] a digital representation of value that is intended to constitute a peer-to-peer (P2P) alternative to government-issued legal tender, (ii) is used as a general-purpose medium of exchange (independent of any central bank), and (iii) is secured by a mecha". Maintaining the position of various organisations like these in this effort provided a concise definition of the word, which was derived from the characteristics of the currency.

IV.A.14. Research Path 4 – International Monetary System and CBDC Design

Central banks and governments have reacted in a variety of ways to the rapid rise of new financial technologies and digital payment systems, including cryptocurrencies.[43] These responses range from trying to adapt to the changes to their advantage to resisting certain developments due to concerns about monetary and financial instability. Cryptocurrencies are one example of the rapid rise of new financial technologies and digital payment systems.[44] One solution to this problem has been for central banks to experiment with new techniques for creating money independently. In particular, a number of countries central banks are investigating the prospect of creating digital forms of their respective fiat currencies.[45]

CBDC is essentially a digital representation of money issued by central banks. The retail and wholesale payment methods are both included in the ambit of CBDCs' adoption. Since the balances held by commercial banks at the central bank (reserves) are already in electronic form, wholesale CBDCs involve some efficiency improvements but do not fundamentally change the interbank payment system administered by central banks. The introduction of retail CBDC, which could act as a digital supplement to traditional currency or as a replacement for it entirely, would be a more revolutionary change. The CBDC sold in retail stores can either be based on tokens or on the worth of the product. These have very distinct repercussions for monetary policy as well as other types of policies.

Switching from physical to digital versions of money issued by the central bank has the potential to bring about a number of beneficial outcomes, including the relaxation of some constraints placed on traditional monetary policy and the establishment of an official electronic payment system to which all participants in an economy, and not just financial institutions, have access. The transition from physical currency to CBDCs will not have any impact on

[43] Dmitry Kochergin and Victor Dostov, *Central Banks Digital Currency: Issuing and Integration Scenarios in the Monetary and Payment System*, *Lecture Notes in Business Information Processing*, vol. 394 (Springer International Publishing, 2020).

[44] Yao Qian, "Central Bank Digital Currency: Optimization of the Currency System and Its Issuance Design," *China Economic Journal* 12, no. 1 (2019): 1–15.

[45] Gupta, "Cryptocurrency to CBDC : The Transition of Digital Currency."

the fundamental mechanisms that underpin the administration of monetary policy. On the other hand, other technological shifts that are likely to have an impact on financial markets and institutions could potentially have a substantial impact on the implementation and transmission of monetary policy.

The structure of the international monetary system could be altered, as could international capital flows, exchange rates, and the types of money that are used within and between countries.[46] New forms of money and new channels for moving funds could have these effects. It will become increasingly challenging for national authorities to exercise control over cross-border capital flows as a result of the proliferation of channels through which these flows can occur. Emerging market economies will have a particularly difficult time coping with the volatility of capital flows and exchange rates, and they may be more susceptible to the impacts of monetary policy spillovers and contagion as a result of this.[47]

IV.A.15. Research Path 5 – Data Privacy and Security Implications of CBDC

The protection of individuals' personal information is at the top of a government's list of priorities for the CBDC system. The design decisions that were made bring up substantial "consumer protection, legal, and privacy considerations. The Fed made public the essential pillars of design, one of the points that were brought up was that any future CBDC needs to have the following characteristics: (1) privacy protection; (2) intermediated; (3) widely transferable; (4) identity verification; and (5) resilience to operational and cybersecurity risks." Notably, the protection of one's privacy comes first on the list.

This is not surprising given the widespread global focus on the privacy risks connected with newly developed CBDC systems. The September 2022 Interagency Technical Evaluation produced a number of privacy-related implications of the CBDC design, including the potential to (1) disrupt current balances between individual data privacy and the special needs of law enforcement to surveille financial transactions for illicit purposes, (2) create privacy risks associated with the collection, storage, and transmission of payment information and associated business identifiable and personally identifiable information, and (3) trigger state and international data incident notification and response compliance requirements.

Threats to CBDCs' cybersecurity that are constantly evolving and sophisticated pose a risk to the industry's various components and levels,

[46] Qian, "Central Bank Digital Currency: Optimization of the Currency System and Its Issuance Design."

[47] Debesh Bhowmik, "Monetary Policy Implications of Central Bank Digital Currency with Special Reference to India," *Asia-Pacific Journal of Management and Technology* 2, no. 3 (2022): 1–8.

offering profitable opportunities to unauthorised attackers.[48] Any payment infrastructure is susceptible to a persistent and substantial threat posed by cyberspace. This highlights how important it is for central banks to create, construct, and manage a secure and resilient CBDC ecosystem throughout its entirety, including all components and integrations of the underlying systems.

IV.B. DISCUSSION

The implementation of CBDC may have an impact on the transmission of monetary policy. CBDC, for example, would alter the demand for basic money and its composition in unpredictable ways, as well as the sensitivity of demand for money to changes in interest rates.[49] However, Mancini-Griffoli[50] contends that under plausible CBDC designs, this impact is unlikely to be significant. Indeed, monetary policy transmission could improve if CBDC expands financial inclusion, exposing more households and businesses to interest-sensitive instruments. The introduction of CBDC may alter the exchange rate transmission channel because it would allow for more active currency management, which could result in stronger/faster exchange rate movements for given market rate changes.[51] If central banks provide stable funding by recycling deposits back into the banking system, the bank lending transmission channel, through which monetary policy impacts bank creditworthiness and cost of funding, could also be maintained.

CBDC may have an impact on financial stability and banking intermediation depending on how it is designed.[52] CBDC capacity to compete with commercial bank deposits will depend in part on whether or not CBDC is offered interest rates. A non-interest-bearing CBDC would be the most similar to currency. Banks with a larger share of retail deposits will experience competition from CBDC, especially interest-bearing CBDC, and may be forced to raise deposit rates to compete. Higher deposit rates would lower interest margins, and banks could try to raise lending rates at the expense of loan demand. Banks' capacity to respond and maintain profitability will be determined by their

[48] Charles M Kahn and Francisco Rivadeneyra, "Security and Convenience of a Central Bank Digital Currency," 2020, 1–7.

[49] Laila Ohk, Cam-Duc Au, and Alexander Zureck, "Analysis on the Role of Digital Currencies in Economies," *SSRN Electronic Journal*, no. January (2022).

[50] Tommaso Mancini-Griffoli et al., "Casting Light on Central Bank Digital Currency," *Cryptoassets*, 2019, 307–40.

[51] Carl Andreas et al., "The E-Krona and the Macroeconomy The e-Krona and the Macroeconomy," 2018.

[52] Jonas Gross and Jonathan Schiller, "A Model for Central Bank Digital Currencies: Do CBDCs Disrupt the Financial Sector?," *SSRN Electronic Journal*, no. October 2020 (2020).

lending market power.[53] Deposit insurance enables banks to fund themselves at a cheaper cost than other instruments. CBDC issuance may weaken market discipline if banks lose more uninsured savings than insured deposits, leading to banks taking on more risk.

Additionally, banks could increase their reliance on wholesale funding, which would have implications for funding cost and stability, as well as market discipline. However, regulatory liquidity requirements may force them to reduce lending or corporate bond holdings. Additionally, it would not be viable in countries with underdeveloped capital markets. However, even when and where switching from deposits to wholesale funding is practicable, it may result in lower bank profits or higher lending rates in order to maintain margins. Furthermore, bank funding could become more volatile. In such a case, banks might be required to hold more liquid assets to comply with regulatory requirements or reduce lending, potentially at the expense of financial inclusion or growth-promoting policy measures.[54]

Depending on the CBDC conversion mechanism, the issuance of CBDC could have substantial effects on central bank balance sheets. If disintermediation occurs, the central bank could lend the funds diverted from commercial bank deposits back to those banks, allowing them to continue lending[55]. However, this represents a radical departure from the typical mandates of central banks, and they would have to determine how to allocate funds across banks, thereby allowing political interference. CBDC is least disruptive when issued only against extant physical cash, as it results in a simple switch on the liability side of the central bank's balance sheet from cash to CBDC. However, the effect is less clear when CBDC is issued against central bank reserves, as will be the case when consumers convert from commercial bank deposits. In particular, to the extent that CBDCs are paid for with reserves, the size of the central bank's balance sheet will remain unchanged, as reserves and currency are both liabilities, while commercial bank balance sheets would decline.

Several strategies have been suggested to control the potential disintermediation of the banking sector that could result from this balance sheet devaluation. Panetta[56] suggests imposing holding limits, but this could restrict the number or size of payments because the CBDC holdings of the

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[53] Syarifuddin and Bakhtiar, "The Macroeconomic Effects of an Interest-Bearing CBDC: A DSGE Model."

[54] Pichler, P., Summer, M., and Weber, B., "Does Digitalisation Require Central Bank Digital Currencies for the General Public? In: Monetary Policy and the Economy," *4/2019*, no. January (2020): 1–18.

[55] Markus K Brunnermeier and Dirk Niepelt, "On the Equivalence of Private and Public Money On the Equivalence of Private and Public Money," *Journal of Monetary Economics* 106 (2019): 27–41.

[56] Fabio Panetta, "21st Century Cash: Central Banking, Technological Innovation and Digital Currencies," *Do We Need Central Bank Digital Currency? Economics, Technology and Institutions*, no. 40 (2018): 23–32.

user would need to be known in order to finalise the payment. Bindseil[57] suggests that CBDC users could circumvent the payment finality issue by designating a "waterfall" account to which payments that exceed the cap would be automatically transferred. This is the strategy utilised in the Central Bank of the Bahamas CBDC pilot. Kumhof and Noone[58] propose a more radical approach that would restrict the ability of commercial banks to convert deposits into CBDC on demand. Bindseil[59] argues that it is unnecessary to implement such far-reaching, albeit conditional, changes to the fundamental convertibility principles of banking and central banking. Instead, he proposes a tiered remuneration system with a relatively attractive rate applied up to some holding ceiling, while a lower interest rate would be applied to quantities in excess of the ceiling.

A CBDC that is not well-thought-out risks hastening bank runs by providing a convenient, risk-free, and liquid substitute for savings. Nonetheless, Mancini-Griffoli and others[60] suggest that the increase in run-risk will depend on whether or not bank deposits are covered by credible deposit insurance and the type of crisis. There should be no more bank runs in many countries as long as deposit protection is considered reliable. Government bond funds and state banks that provide safe and relatively liquid assets already exist in many nations. Because running from one bank to another is technically feasible with the click of a button in most jurisdictions, CBDC is not likely to impact the likelihood of runs in cases of individual bank insolvency. However, CBDC may raise the risk of widespread bank runs, depending on how it is implemented and its surrounding ecosystem, such as possible convertibility limits. However, CBDC could enable the central bank to give liquidity to distressed commercial banks more quickly, avoiding the first-come, first-serve dynamics that fuel runs. In addition, during a currency or sovereign crisis, depositors usually flee from all local assets, so CBDC is not likely to raise generalised run risk.

V. CONCLUDING REMARKS

The large number of periodicals that actively publish articles on CBDC suggests that various viewpoints are being presented to a variety of audiences. The China Economic Journal Computer is potentially the most productive journal

[57] Ulrich Bindseil, "Central Bank Digital Currency: Financial System Implications and Control," *International Journal of Political Economy* 48, no. 4 (2019): 303–35, https://doi.org/10.1080/08911916.2019.1693160.

[58] Michael Kumhof and Clare Noone, "Central Bank Digital Currencies - Design Principles and Balance Sheet Implications," *SSRN Electronic Journal*, no. 725 (2018).

[59] Bindseil, "Central Bank Digital Currency: Financial System Implications and Control."

[60] Mancini-Griffoli et al., "Casting Light on Central Bank Digital Currency."

that focuses on CBDC, but Financial System is the publication that has had the most significant effect on the field that is being researched (Government intervention and financial regulation). Additionally, China, South Korea, the United Kingdom, the United States of America, and India are the countries that have made the most significant contributions to the body of knowledge.

Four universities have affiliates who have authored eight or more of the articles analysed here: Seoul National University, South Korea; State Key Laboratory of Information Photonics and Optical Communications, China; Ningbo University, China; Schulte Roth and Zabel LLP, New York City. The most influential authors are Lee J (2021), Andolfatto (2021), Huang Z (2022), and Li Z (2022). This analysis demonstrates that keywords such as "central bank digital currency", "CBDC", "digital currency", "blockchain", and "monetary policy" have acquired prominence over the past few years, highlighting the growth of CBDC literature.

This research provides a basic reference to see how the visualisation of graphics development of research trends with the theme of CBDC in published scientific research so that it can be further developed by experts. Recommendations for further research can refer to the most popular keywords that can be discussed further, such as the economic and social effects of CBDC implementation, as well as competition and their relation to the Financial Institution.

The implications of these findings are that central bankers must pay more attention to the CBDC design. First, central bankers must determine the objectives they wish to accomplish with CBDC, and then they must design CBDC with the desired characteristics. There should be opportunities to redesign and reinvent the CBDC in order to accommodate shifting central bank objectives. Moreover, central banks must always place a high priority on CBDC security and privacy. Central banks believe that no cost is more considerable to issue a national CBDC, despite the fact that establishing one will be expensive. Lastly, it is too early to determine what the actual benefits and repercussions of CBDC will be, whether they will produce the anticipated results suggested in the literature and whether CBDC can live up to their promise.

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