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Central Bank Digital Currencies: Bibliometric and Thematic Insights from the Literature

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Abstract.

This paper offers a bibliometric and thematic analysis of the literature on Central Bank Digital Currencies (CBDCs), treating the digital euro as a specific euro-area case within the broader CBDC debate. Drawing on 522 peer-reviewed journal articles from Scopus and Web of Science covering the period 2016-2026, this paper combines performance analysis, science mapping, Term Frequency-Inverse Document Frequency (TF-IDF) text representation, Non-negative Matrix Factorization (NMF) topic modelling, k-means clustering and interpretive content analysis, using Bibliometrix in R, Python, and VOSviewer. The results show a sharp acceleration in academic output from 2021 to 2025 and identify five thematic areas: technology infrastructure; monetary-financial stability; adoption and trust; digital euro governance and design; regulation and crypto-assets. The paper shows that the field has achieved thematic consolidation but remains only partially integrated across institutional, behavioural, technological, and market-oriented research strands.

Keywords: Central Bank Digital Currencies; Digital euro; Bibliometric analysis; Thematic analysis

JEL Classification: E42; E52; E58; G21; G28

1. Introduction

Technological innovation has significantly reshaped the monetary and financial landscape, fostering an ongoing redefinition of money and payment paradigms. Digital payments, platform-based financial services, crypto-assets and stablecoins have intensified the debate on the future of money, the role of central banks and the institutional architecture of payment systems (Brunnermeier and Niepelt, 2019; Auer et al., 2020; Bank for International Settlements, 2020). Within this transformation, Central Bank Digital Currencies (CBDCs) have emerged as one of the most significant monetary innovations of the last decade. Unlike privately issued digital assets, CBDCs are conceived as digital forms of central bank money, denominated in the official unit of account and potentially usable either by financial intermediaries or by the public (Bordo and Levin, 2017; Auer et al., 2021). For this reason, they are not merely technological innovations, but institutional instruments that may affect the relationship between public and private money, the functioning of payment systems, the transmission of monetary policy and the stability of financial intermediation (Fernández-Villaverde et al., 2021; Agur et al., 2022; Barrdear and Kumhof, 2022).

The academic and policy debate on CBDCs has expanded rapidly because these instruments bring together several analytical dimensions that are usually studied separately. From a monetary perspective, CBDCs raise questions about central bank liabilities, monetary sovereignty, bank deposits, credit creation and the transmission of policy rates (Meaning et al., 2018; Bindseil, 2020). From a financial-stability perspective, they require careful assessment of potential disintermediation effects, deposit substitution, liquidity risk and the design of safeguards such as holding limits or remuneration mechanisms (Kumhof and Noone, 2021). From a technological and infrastructural perspective, CBDCs are connected to issues of interoperability, cybersecurity, offline functionality, settlement architecture and integration with existing payment infrastructures. From a legal and regulatory perspective, they require a clear distinction between sovereign public money and privately issued digital instruments such as stablecoins or crypto-assets (Zetzsche et al., 2020; Regulation (EU) 2023/1114). Finally, from a socio-technical perspective, the success of a CBDC depends not only on institutional design, but also on trust, perceived usefulness, privacy expectations, accessibility and user adoption (Davis, 1989; Venkatesh et al., 2003; Taylor et al., 2016). Despite the rapid expansion of research on CBDCs and the digital euro, the literature remains only partially systematized. Existing studies have examined important aspects of the phenomenon, including monetary policy, financial stability, bank intermediation, legal design, payment infrastructure,

technological architecture, user adoption, privacy, trust and the interaction between CBDCs and crypto-financial markets (Dionysopoulos et al., 2024). However, these contributions often develop in parallel rather than as part of a fully integrated research field. This interdisciplinarity makes it difficult to understand how the different strands relate to each other, which themes dominate the field and where the most relevant research gaps remain.

Building on prior bibliometric and systematic reviews (Bhaskar et al., 2022; Hoang et al., 2023; Prodan et al., 2024), this study contributes to the existing literature through an analysis of both Scopus and Web of Science, from which a dataset of 522 peer-reviewed articles published between 2016 and 2026 emerges, explicitly integrating the digital euro as an institutionally embedded case, and combining bibliometric profiling, Term Frequency-Inverse Document Frequency (TF-IDF) representation, Non-negative Matrix Factorization (NMF) topic modelling, and k-means clustering. From this integrated approach allows the reconstruction of five interpretable thematic domains, clarifying how monetary, institutional, technological, behavioural, legal-regulatory and market-oriented strands interconnect within a multidisciplinary yet only partially integrated research field. Overall, these considerations underscore the need for an integrated bibliometric and thematic analysis of the CBDCs literature, capable of mapping both the field's scholarly evolution and its internal conceptual organization. Since CBDCs research spans monetary economics, banking, financial stability, payment systems, technological infrastructure, legal-regulatory analysis, user adoption, and digital-asset markets, a purely descriptive review would not be sufficient to clarify how the field is structured. An integrated approach is therefore needed to examine how the literature has evolved over time, which thematic areas organize it, how these areas are connected, and where the main research gaps remain.

This article therefore aims to examine three main research questions:

- RQ1. How has the literature on CBDCs evolved in terms of performance analysis and science mapping?
- RQ2. What are the main thematic domains that structure the literature, and how are these domains interconnected through topic modelling and clustering?
- RQ3. What research gaps emerge when bibliometric, thematic and interpretive evidence are considered together?

In order to answer these questions, the rest of the article is structured as follows: section 2 presents the methodology; section 3 reports the empirical findings; section 4 discusses the implications of the findings, focusing on the institutional

core, specialized research strands and unresolved conceptual gaps; section 5 concludes by summarizing the main contributions, limitations and directions for future research.

2. Methodology

Drawing on a combined performance analysis and science mapping approach, this study investigates the intellectual structure and thematic evolution of the CBDCs literature, while treating the digital euro as an institutionally embedded case within the broader CBDCs debate. Performance analysis is appropriate for measuring the productivity and visibility of journals, authors, institutions and countries; science mapping, by contrast, maps the relational structure of knowledge by identifying connections among publications, keywords and thematic clusters (Small, 1973; Moed, 2005; Zupic and Čater, 2015; Aria and Cuccurullo, 2017; Donthu et al., 2021; Sampagnaro, 2023). This approach is also consistent with broader developments in scientometrics and network-based analysis, where scientific fields are interpreted as evolving knowledge structures shaped by publication dynamics, citation patterns, conceptual proximity and thematic specialization (Newman, 2001; Leydesdorff, 2007; Waltman et al., 2010; van Eck and Waltman, 2014). The methodological design adopted in this article is justified by both the multidisciplinary nature of CBDCs research and the need to extend previous review and bibliometric studies on the topic. Bhaskar et al. (2022) provide an early bibliometric and content analysis of CBDCs research based on 174 Scopus publications, focusing on publication trends, influential studies, authors, countries, citation patterns and future research agendas. Hoang et al. (2023) adopt a systematic literature review supported by text-mining techniques, analysing 191 CBDC-related abstracts from Scopus through frequency analysis, topic modelling and network diagrams. Prodan et al. (2024) use a PRISMA-based systematic review and VOSviewer analysis on a larger Scopus and Web of Science corpus, with particular attention to keyword co-occurrence, research clusters and the relationship between CBDCs, finance, technology and sustainability.

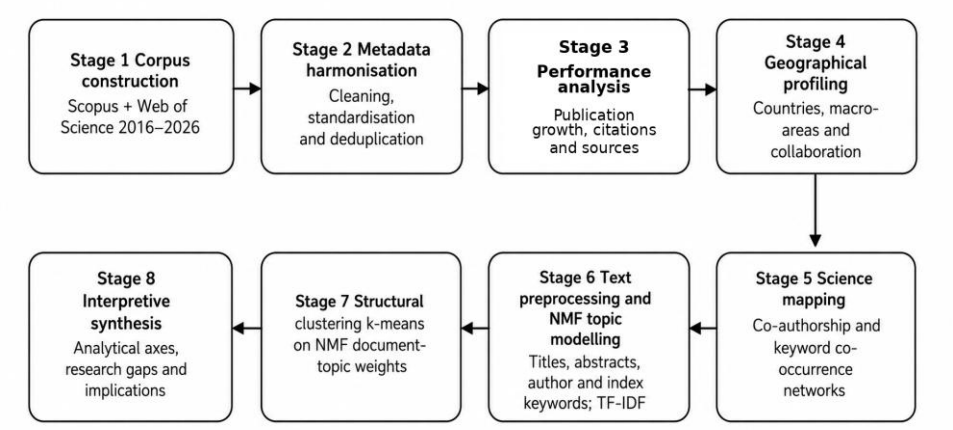
Building on these contributions, the present study differs in three main respects. First, it relies on a merged and curated dataset of 522 peer-reviewed journal articles retrieved from Scopus and Web of Science, covering the period 2016-2026 and allowing the analysis to capture the most recent phase of CBDC research. Second, it explicitly includes the digital euro as a relevant institutional case within the broader CBDC literature, thereby making it possible to distinguish general CBDC themes from euro-area-specific concerns related to monetary union governance, payment autonomy, legal tender design and the coexistence between cash and

digital public money. Third, it combines descriptive bibliometric profiling - performance analysis and science mapping - with TF-IDF text representation, NMF topic modelling, k-means clustering, keyword co-occurrence analysis and interpretive synthesis. This integrated strategy allows the study to move beyond publication trends, citation patterns or keyword maps alone, and to reconstruct five interpretable thematic domains while assessing how monetary, institutional, technological, behavioural, legal-regulatory and market-oriented strands are connected within a multidisciplinary but still only partially integrated research field. The methodological design is therefore appropriate for a literature that does not develop within a single disciplinary tradition, but across partially overlapping domains, including monetary economics, banking, financial stability, payment systems, financial regulation, technological infrastructures, crypto-assets, privacy, trust and user adoption (Agur et al., 2022; Auer et al., 2021; Barrdear and Kumhof, 2022).

The analytical strategy follows a cumulative logic articulated into a sequence of interconnected steps, as reported in Figure 1. The process begins with corpus construction and relevance screening, which are necessary to ensure transparency, replicability and conceptual consistency in data selection. It then proceeds with data harmonization, duplicate control and descriptive bibliometric profiling, aimed at reconstructing the temporal evolution of publications, source distribution, citation patterns and scholarly visibility. Geographical profiling is subsequently introduced to examine how scholarly attention to CBDCs and the digital euro is distributed across countries and macro-areas. Subsequently, standardized author keywords are used to construct a co-occurrence network, which provides insight into the main conceptual connections organizing the field and the relationships among its most recurrent terms, in line with established applications of network analysis to scientific knowledge structures (Callon et al., 1983; Borgatti et al., 2009; van Eck and Waltman, 2014). The following stages move from descriptive analysis to textual and conceptual reconstruction. Titles, abstracts and keywords are pre-processed and transformed into a TF-IDF matrix, following established principles in information retrieval and text mining (Salton and Buckley, 1988; Manning et al., 2008). This matrix is then used as input for NMF, which allows the identification of latent thematic domains within the corpus (Lee and Seung, 1999; Berry et al., 2007). NMF was estimated on the TF-IDF-weighted document-term matrix using NNDSVDa initialization, that is, a non-negative double singular value decomposition approach in which zero entries are filled with the average value. A fixed random seed of 42 and a maximum of 700 iterations were used to

ensure computational reproducibility. Finally, the document-topic weights generated by the NMF model are used for k-means clustering to examine the broader structural organization of the literature and distinguish between central research areas and more specialized subdomains (Jain, 2010). Details on the methodology associated with each analytical layer, the purpose of each step, and the software used are reported in Table A1 in the Appendix.

Figure 1. Analytical pipeline



Source: authors' own elaboration

Databases were selected because of their broad coverage of peer-reviewed scientific literature, structured metadata, citation information and compatibility with bibliometric and science mapping workflows (Mongeon and Paul-Hus, 2016; Echchakoui, 2020). The use of both sources provides broader coverage than a single-database strategy and reduces the risk of excluding relevant contributions indexed in only one source. At the same time, the combination of Scopus and Web of Science requires careful cleaning and harmonization, since differences in title formatting, author names, DOI availability, source titles, keyword indexing and citation metadata may affect the reliability of subsequent analyses.

The query was organized around two conceptual blocks. The first block identified the core object of analysis and included terms such as "central bank digital currency", "CBDC", "digital euro", "digital currency", "sovereign digital money" and "public digital money". The second block refined the search toward the analytical dimensions most relevant to the study, including monetary policy, financial stability, payment systems, interoperability, holding limits, blockchain, cryptocurrencies and stablecoins. The search was applied to title, abstract and

keyword fields to include both publications explicitly focused on CBDCs and contributions addressing the topic through conceptually related terminology.

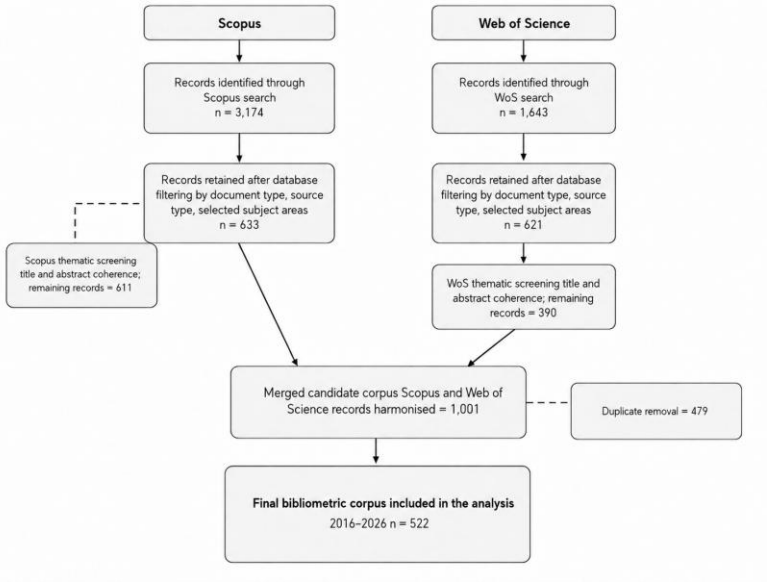
The initial search on Scopus, conducted over the broad time period of 2014-2026, returned 3,174 records. These records were filtered based on document type, source type, language, publication stage, and selected subject areas. Only journal articles written in English and classified as final publications were retained. The restriction to English-language publications was adopted to ensure consistency in bibliographic metadata, text preprocessing, and topic modelling, as the subsequent TF-IDF and NMF analyses require a linguistically homogeneous corpus. Although language restrictions may represent a potential source of bias in systematic and bibliometric research, this risk is mitigated in the present study by the predominance of English-language publications in the initial Scopus pool. Specifically, English-language records accounted for approximately 95% of the initial Scopus pool, with 3,015 out of 3,174 records written in English. This indicates that non-English publications represented only a marginal share of the initial retrieval and supports the construction of a linguistically comparable corpus for bibliometric and text mining purposes.

Additional relevance-based exclusions were applied to remove records primarily associated with research areas not aligned with the study's focus, provided they were not substantially related to CBDCs, the digital euro, or public digital currency. After this filtering phase, the Scopus dataset comprised 633 records. A subsequent cleaning phase removed 21 records lacking keywords and one duplicate within the same source, after which the remaining records underwent thematic screening based on title, abstract, author keywords, and index keywords.

For Web of Science, the initial query returned 1,643 records. Filters were applied based on time frame, subject area, publication type, language, and open-access availability. This phase retained 621 records. A subsequent title and abstract coherence screening retained 390 records that were substantively related to CBDCs, the digital euro, or the broader institutional and monetary transformation of payment systems. After database-specific filtering and relevance screening, the cleaned Scopus records and the retained Web of Science records were merged and harmonized. Duplicate records across the two databases were removed during this process. The final corpus used in the analysis consists of 522 journal articles published between 2016 and 2026. The final time frame reflects the actual temporal coverage of the selected corpus following filtering, cleaning, duplicate control, and relevance screening.

The corpus construction process follows a PRISMA-inspired logic, adapted to bibliometric research, as shown in Figure 2. The PRISMA framework was used as a transparency device for documenting the identification, filtering, screening and inclusion stages of the bibliometric corpus. This use is consistent with systematic review and bibliometric practices, where clear reporting of the selection process is necessary to improve replicability and to clarify the reasons why records are included or excluded (Donthu et al., 2021; Page et al., 2021; Sauer and Seuring, 2023).

Figure 2. PRISMA-inspired flow diagram



Source: authors' own elaboration

The thematic layer of the analysis is based on the construction of a textual corpus combining titles, abstracts, author keywords and index keywords where available. These fields were selected because they provide a concise but informative representation of the conceptual content of each publication. Pre-processing included lowercasing, token filtering and the removal of standard English stop words. In addition, a small set of generic academic terms with no thematic value was excluded to reduce non-substantive noise in the topic modelling stage. After pre-processing, the cleaned textual corpus was transformed into a TF-IDF matrix. TF-IDF weighting is particularly appropriate in this context because it gives greater importance to terms that are frequent within specific documents but not uniformly frequent across the entire corpus, thereby helping to identify terms that

differentiate thematic areas within a multidisciplinary literature (Salton and Buckley, 1988; Manning et al., 2008). This representation was used as input for NMF topic modelling.

The NMF method was applied to identify the main latent thematic domains present in the literature. This method decomposes the document-term matrix into non-negative components that can be interpreted as topics or semantic dimensions (Lee and Seung, 1999; Berry et al., 2007). NMF was estimated on the TF-IDF-weighted document-term matrix using a non-negative double singular value decomposition (NNDSVDa) with zero initialization filled with the mean value, a fixed random seed of 42, and a maximum of 700 iterations to ensure computational reproducibility. Candidate thematic solutions were estimated for k values ranging from 4 to 10 and compared using reconstruction error, top-term uniqueness, and substantive interpretability. The retained topic solution is reported and discussed in Section 3.5.

To complement the thematic modelling, the document-topic weights generated by the selected NMF model were L1-normalized at the document level, so that each document was represented by comparable thematic shares whose sum equaled one. These normalized weights were then used as input for k-means clustering. While NMF identifies latent semantic components, k-means clusters documents according to the similarity of their thematic profiles. Candidate cluster solutions from k = 3 to k = 6 were evaluated using the silhouette, Calinski-Harabasz, and Davies-Bouldin criteria, with a fixed random seed of 42 and multiple initializations to reduce sensitivity to starting centroids. The retained cluster solution is reported and discussed in Section 3.6.

Keyword co-occurrence analysis was used to map the field's conceptual structure, with nodes representing standardized keywords and edges their co-occurrence in publications (Ding et al., 2001; Cobo et al., 2011; Klarin, 2024). After filtering by minimum frequency and edge weight, both the largest connected component and a selective backbone were examined (Serrano et al., 2009). Results were then compared with NMF and clustering outputs to assess thematic consistency across methods.

The final stage of the research design integrates the quantitative evidence with an interpretive reading of representative contributions. This step is necessary because bibliometric and text-mining techniques identify patterns, structures and associations, but do not by themselves explain their substantive meaning (Webster and Watson, 2002; Lim and Kumar, 2024). Interpretive synthesis therefore connects the empirical results to the theoretical and policy debates on CBDCs and

the digital euro. By combining these techniques, the study provides a multidimensional reconstruction of the CBDCs literature and offers a replicable framework for analyzing other emerging and interdisciplinary research domains.

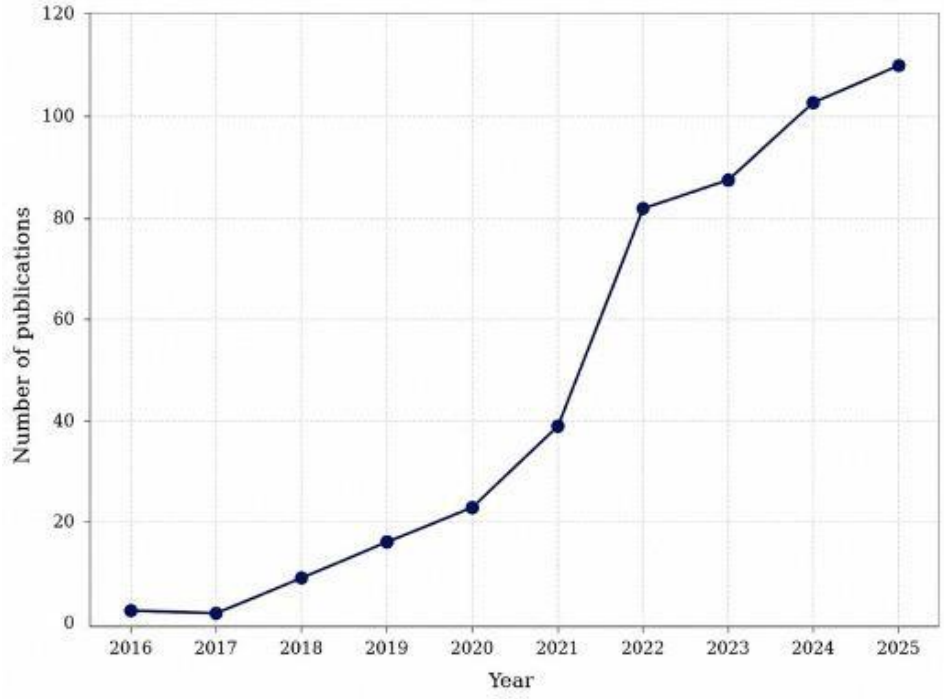
3. Results

This section presents the empirical findings of the bibliometric and thematic analysis. The results move from the general profile of the corpus to publication dynamics, citation patterns, geographical distribution, source concentration, co-authorship and keyword co-occurrence networks, thematic structure, and clustering results. The year 2026 is not included in the various analyses that will follow because it was still in progress at the time of data extraction. Documents already indexed in 2026 are retained in the overall corpus but are not used to interpret annual citation patterns.

3.1 Performance analysis

The first layer provides a performance analysis. This step is necessary to assess the size, temporal extension, source dispersion and citation profile of the literature before examining its thematic and conceptual structure. Figure 3 illustrates the number of articles published each year between 2016 and 2025. This graphical representation is useful for identifying the year-by-year evolution of the sector and for assessing whether research activity on CBDCs has followed a gradual or accelerated trend.

Figure 3. Annual number of publications

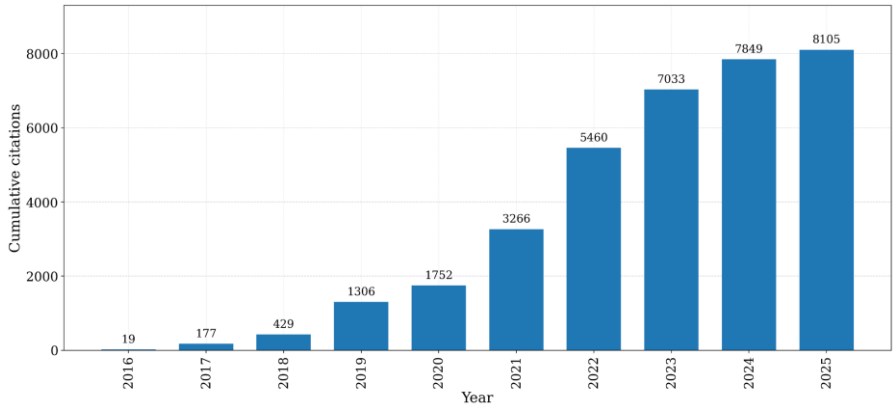


Source: authors' own elaboration

The annual trend shows that the literature remained relatively limited until 2020, before accelerating sharply from 2021 onward. The increase is particularly marked between 2021 and 2022 and continues through 2025. This pattern is consistent with the citation and regional-focus evidence discussed below, suggesting that the expansion of CBDC research was accompanied by growing scholarly visibility and by the emergence of a more articulated international research agenda. Overall, the trend indicates that CBDC research has moved beyond an initial exploratory phase and has become a more established area of inquiry within monetary, financial, and regulatory studies. The corpus also includes records from 2026 that had already been indexed at the time of data extraction.

Figure 4 shows the cumulative number of citations received by the articles in the corpus between 2016 and 2025. It also shows how the overall citation impact of the CBDC literature increases over time. The cumulative trend allows us to observe not only when citations begin to grow, but also the phase in which academic visibility accelerates most noticeably (Moed, 2005; Bornmann and Daniel, 2008; Wang, 2013).

Figure 4. Cumulative number of citations



Source: authors' own elaboration

There was a gradual increase in citations up through 2020, followed by a much more pronounced increase starting in 2021. The cumulative number of citations rose from 1,752 in 2020 to 3,266 in 2021, reached 5,460 in 2022, and continued to grow to 8,105 in 2025. This trend indicates that the rapid growth in publications has been accompanied by a parallel increase in academic visibility. In particular, the acceleration after 2021 suggests that CBDCs have become a more central and widely cited topic in monetary, financial, and regulatory research.

3.2 Geographical focus and regional orientation of the literature

The second layer of the analysis examines the geographical dimension of the literature from two complementary perspectives. First, it considers the institutional distribution of scientific production, identifying the affiliations that contribute most actively to CBDCs research. Second, it analyses the geographical focus and regional orientation of the publications, in order to clarify whether the literature develops mainly around specific regional cases or within broader comparative and global frameworks. This twofold approach is consistent with established bibliometric practices, which distinguish between the geography of research production and the substantive orientation of the research itself (Zupic and Čater, 2015; Aria and Cuccurullo, 2017; Donthu et al., 2021; Sampagnaro, 2023).

Table 1. Top 15 most active institutions in CBDC research

No.	Affiliations	No. of articles	Country	Total citations	H-index	Average citations per item
1.	Ministry of Education & Science of Ukraine	8	Ukraine	36	4	4.50
2.	Durham University	7	United Kingdom	357	4	51.00
3.	University of London	6	United Kingdom	36	3	6.00
4.	Federal Reserve System - USA	5	United States	527	4	105.40
5.	Goethe University Frankfurt	5	Germany	51	3	10.20
6.	University of Bern	4	Switzerland	365	4	91.25
7.	International Monetary Fund	4	United States	326	3	81.50
8.	Trinity College Dublin	4	Ireland	234	4	58.50
9.	University of Economics Ho Chi Minh City	4	Vietnam	234	4	58.50
10.	Santa Teresa Jesus Catholic University of Avila	4	Spain	145	4	36.25
11.	University of Leeds	4	United Kingdom	144	3	36.00
12.	University of Cambridge	4	United Kingdom	132	4	33.00
13.	Korea University	4	South Korea	57	3	14.25
14.	Aalborg University	4	Denmark	20	2	5.00
15.	Russian Academy of Sciences	4	Russia	4	1	1.00

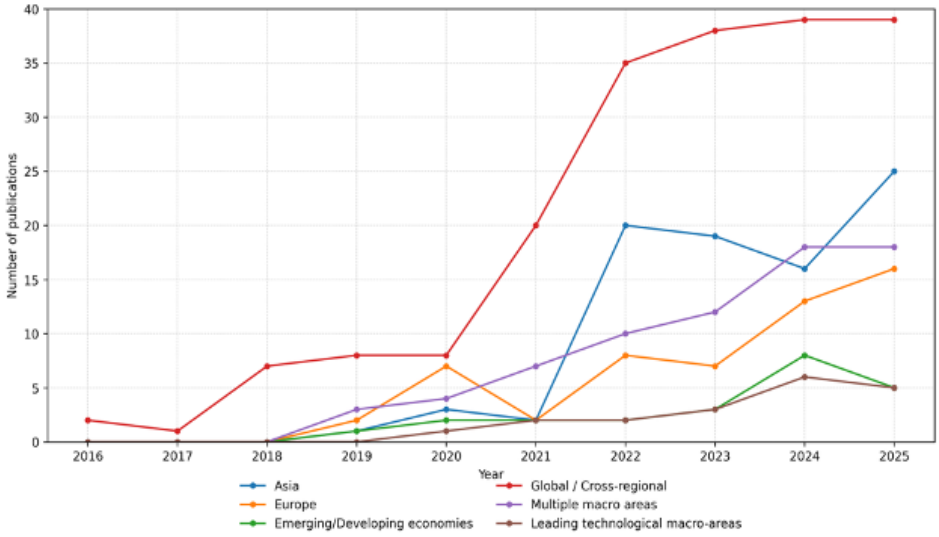
Source: authors' own elaboration

Table 1 reports the top 15 most active institutions in the corpus, measured by number of articles, and complemented by total citations, H-index and average citations per item. This table identifies the main institutional contributors to the field and provides an indication of their scientific visibility and impact. In this sense, it shows where a significant part of CBDCs research is produced and which institutions occupy a more prominent position in terms of output and influence. The inclusion of citation-based indicators is important because productivity alone does not capture the scientific visibility of the contributions produced by each institution (Moed, 2005; Bornmann and Daniel, 2008). Overall, Table 1 suggests that CBDCs research is institutionally dispersed across universities, policy-oriented institutions and research centers located in different countries, confirming the international and interdisciplinary nature of the field.

To complement this institutional perspective, the analysis then shifts from the geography of production to the geography of substantive focus. This is the more specific contribution of the section. The purpose is not to measure where research on CBDCs is produced, but to understand whether the literature discusses CBDCs and the digital euro through specific regional cases, comparative perspectives or broader global frameworks. Since the digital euro is institutionally rooted in the euro area but belongs to the wider global debate on CBDCs, this distinction is

particularly useful for clarifying whether the literature is mainly region-specific or embedded in a broader international and comparative research trajectory.

Figure 5. Annual publication trends across regional focus categories



Source: authors' own elaboration

Figure 5 reports publication trends according to the leading regional focus categories identified in the corpus over the period 2016-2025. Unlike Table 1, which concerns the institutional origin of the research, Figure 5 captures the geographical or regional perspective addressed by the publications themselves. This distinction represents a specific analytical feature of the study, because it allows the literature to be interpreted not only in terms of where it is produced, but also in terms of the territorial and comparative lenses through which CBDCs are examined.

The "Global/Cross-regional" category does not represent the sum of the other geographical areas. Rather, it identifies publications whose analytical focus is not limited to one specific region, but addresses CBDCs, the digital euro or public digital money from a global, comparative or cross-regional perspective. This category includes, for example, studies that discuss CBDCs as a worldwide monetary-policy issue, compare developments across different jurisdictions, or analyse digital public money in relation to global payment systems, international regulation, crypto-assets and financial stability. Its prominence therefore suggests that a large part of the literature frames CBDCs not only as national or regional projects, but as a transnational phenomenon involving monetary governance, technological infrastructures and regulatory coordination across jurisdictions. This

is particularly visible from 2021 onward, when the debate expands in parallel with the acceleration of CBDCs experimentation and the institutional development of digital currency projects.

Asia also emerges as an important area of scholarly attention, especially after 2021, reflecting the relevance of CBDCs initiatives and policy debates across Asian monetary systems. Europe demonstrates a more gradual but visible increase, consistent with the development of the digital euro as a specific euro-area project embedded within the broader global CBDCs debate. The curve for multiple macro-areas captures studies that explicitly compare two or more regional contexts, while the curves for emerging/developing economies and leading technological macro-areas identify more specialized strands of the literature. Overall, Figure 5 shows that the geographical structure of the field is not merely region-specific; instead, CBDCs research develops through a combination of global, comparative and regionally focused contributions.

3.3 Source distribution

The third layer of analysis focuses on the distribution of publications across journals. This step is important because source concentration provides information about the degree of consolidation of a research field. Table 2 reports the leading journals ranked by number of publications, together with total and average citation counts.

Table 2. Leading journals by number of publications (top 15)

No.	***Journal***	***AJG 2024***	***ISSN***	***No. Articles***	***Total Citations***	***Avg. Citations***
1	*Research in International Business and Finance*	*2*	*p-ISSN: 0275-5319 e-ISSN: 1878-3384*	*15*	*511*	*34.07*
2	*IEEE Access*	*NA*	*2169-3536*	*13*	*464*	*35.69*
3	*Journal of Central Banking Theory and Practice*	*NA*	*p-ISSN: 1800-9581 e-ISSN): 2336-9205*	*11*	*130*	*11.82*

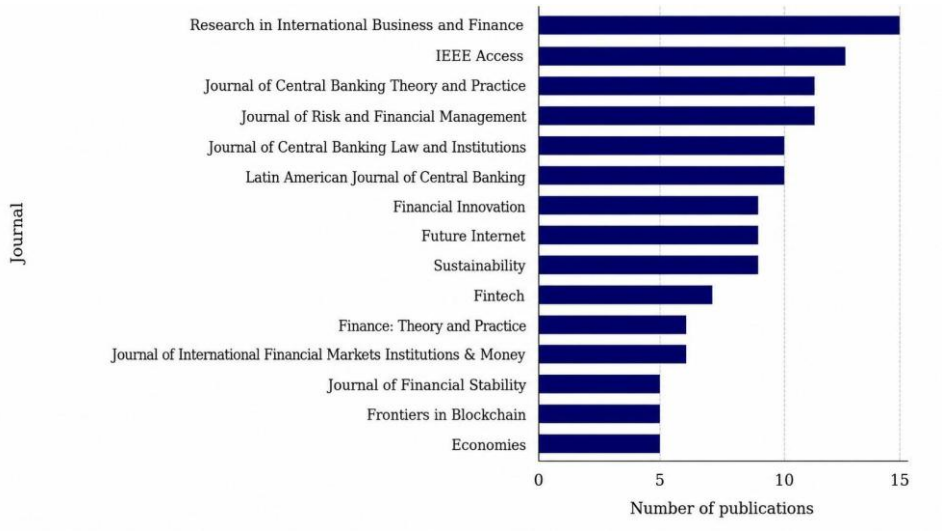
			2336-9205			
4	*Journal of Risk and Financial Management*	*NA*	*p-ISSN: 1911-8066 e-ISSN: 1911-8074*	*11*	*186*	*16.91*
5	*Journal of Central Banking Law and Institutions*	*NA*	*p-ISSN: 2827-7775 e-ISSN: 2809-9885*	*10*	*35*	*3.5*
6	*Latin American Journal of Central Banking*	*NA*	*2666-1438*	*10*	*106*	*10.6*
7	*Financial Innovation*	*2*	*2199-4730*	*9*	*192*	*21.33*
8	*Future Internet*	*NA*	*1999-5903*	*9*	*288*	*32*
9	*Sustainability*	*NA*	*2071-1050*	*9*	*384*	*42.67*
10	*Fintech*	*NA*	*2674-1032*	*7*	*57*	*8.14*
11	*Finance: Theory and Practice*	*NA*	*2587-7089 p-ISSN: 2587-5671 e-ISSN: 2587-7089*	*6*	*77*	*12.83*
12	*Journal of International Financial Markets Institutions & Money*	*3*	*p-ISSN: 1042-4431 e-ISSN: 1873-0612*	*6*	*337*	*56.17*
13	*Journal of Financial Stability*	*3*	*p-ISSN: 1572-3089 e-ISSN: 1878-0962*	*5*	*66*	*13.2*

14	*Frontiers in Blockchain*	*NA*	*2624-7852*	*5*	*69*	*13.8*
15	*Economies*	*1*	*2227-7099*	*5*	*71*	*14.2*

Source: authors' own elaboration

Research in International Business and Finance is the leading outlet by number of publications, followed by IEEE Access, Journal of Risk and Financial Management, Journal of Central Banking Theory and Practice, Latin American Journal of Central Banking, Journal of Central Banking Law and Institutions. The table highlights how, despite the limited number of contributions, this topic is also covered in journals with a high international ranking. The presence of both finance-oriented and technology-oriented journals confirms the interdisciplinary character of the field. At the same time, the citation indicators reveal that some journals with fewer publications display high average citation impact, suggesting that influence is not determined only by publication volume.

Figure 6. Top journals by number of publications, top 15



Source: authors' own elaboration.

Figure 6 confirms the presence of a small group of recurrent publication outlets surrounded by a broader long tail of journals with fewer contributions. This pattern

suggests that the field is beginning to develop a recognizable publication core but has not yet become concentrated within a narrow disciplinary niche.

3.4 Co-authorship and keyword co-occurrence networks

The network structure of the CBDC literature is examined here from two complementary science mapping perspectives. First, the co-authorship network maps the collaborative structure of the research community by identifying links among authors who have jointly contributed to publications in the corpus. Second, the analysis of keyword co-occurrences reconstructs the conceptual structure of the field by identifying relationships among the most frequently used author keywords. This twofold approach is consistent with established science-mapping techniques, where collaboration networks are used to examine the social organization of scientific production, while co-word and keyword networks are used to identify the intellectual and conceptual structure of a research field (Callon et al., 1983; Newman, 2001; van Eck and Waltman, 2010; Cobo et al., 2011; van Eck and Waltman, 2014; Zupic and Čater, 2015; Donthu et al., 2021).

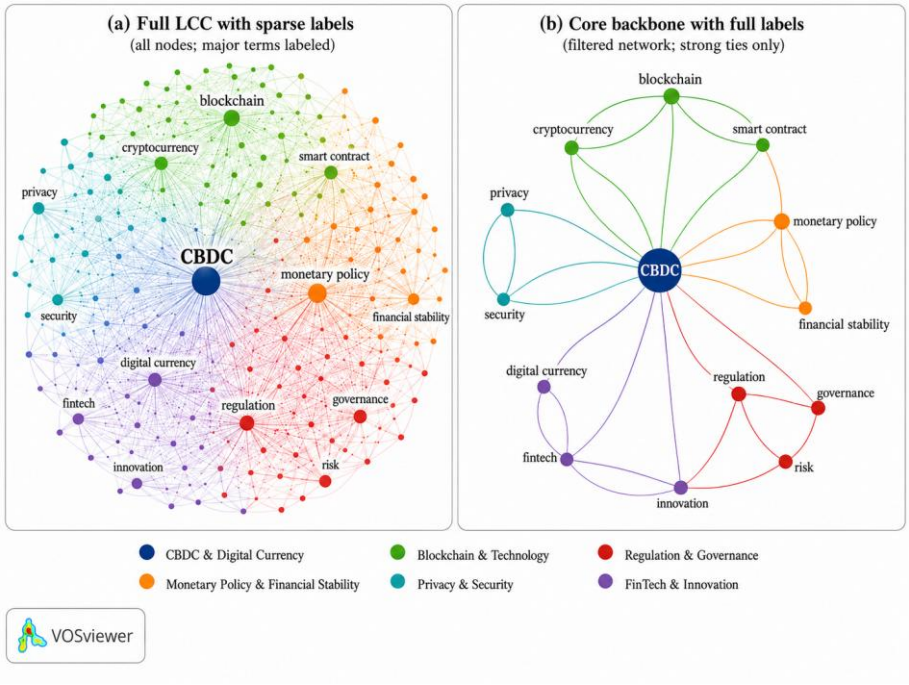
Figure 7. Co-authorship network in CBDC research

Source: authors' own elaboration.

Figure 7 reports the co-authorship network constructed from the full corpus of 522 articles. In this network, nodes represent authors and links represent co-authored publications. As a result, rather than systematically mapping the thematic content of the literature, this study maps the collaborative relationships among scholars who have contributed to CBDCs research. This distinction is important because science mapping is not limited to concepts or keywords: it can also be used to examine how research communities are socially organized through patterns of scientific collaboration (Newman, 2001; Glänzel and Schubert, 2004; Zupic and Čater, 2015). The co-authorship map shows that research on CBDCs is characterized by a decentralized collaborative structure, consisting of several small, interconnected components rather than a single, fully integrated network of authorship. This model indicates that collaboration in this field is organized primarily around localized research groups, with limited connecting ties between the various groups. Therefore, the most significant feature of the network is not the presence of a dominant authorial hub, but rather the fragmentation of the collaborative structure into multiple specialized communities. This supports the interpretation that CBDCs research has developed through several partially interconnected research groups, reflecting the multidisciplinary nature of the field and the coexistence of monetary, technological, legal-regulatory, behavioural, and market-oriented perspectives.

To complement this social map of scholarly production, the analysis then turns to the conceptual structure of the field. Whereas the co-authorship network shows who collaborates with whom, the keyword co-occurrence network shows how the main concepts of the literature are connected. Figure 8 reports a two-panel visualization: the first panel shows the full largest connected component with sparse labels, while the second panel presents a more selective core backbone with full labels.

Figure 8. Keyword co-occurrence network



Source: authors' own elaboration.

The keyword network confirms the centrality of CBDCs as the main conceptual hub of the field. Around this central node, several communities can be identified: CBDCs and digital currency, blockchain and technology, monetary policy and financial stability, regulation and governance, privacy and security, and fintech and innovation. The core backbone shows that CBDC is strongly connected to monetary policy, central banking, financial stability, blockchain, cryptocurrency, regulation, governance, risk, privacy, security, digital currency, fintech and innovation. This confirms that the field is organized around a broad CBDCs core, from which more specialized thematic branches emerge. At the same time, the keyword network highlights the partial separation among research strands. Terms related to monetary policy and financial stability are closely connected to central banking, while blockchain and cryptocurrencies form a more technological and market-oriented branch. Regulation and governance occupy an intermediate position, linking institutional and market-oriented debates. Privacy and security

appear as a distinct but relevant subdomain, connected to the broader discussion through the CBDCs node. Overall, the combined network evidence reinforces the results of the NMF and clustering analyses. The co-authorship network shows that the research community is organized around several collaborative groups, while the keyword co-occurrence network shows that the literature has a recognizable conceptual backbone but remains only partially integrated across its main strands. This supports the interpretation of CBDC research as a maturing and multidisciplinary field characterized by thematic consolidation, conceptual differentiation and incomplete analytical integration.

3.5 Thematic structure of the field

Following the methodological procedure described in Section 2, Table 3 reports the diagnostic comparison of the candidate NMF topic solutions. Candidate solutions were evaluated using reconstruction error, a uniqueness ratio computed on the top 20 terms per topic, and substantive interpretability, in line with topic-model evaluation approaches that emphasize semantic coherence, stability and interpretability rather than reliance on a single numerical criterion (Mimno et al., 2011; Greene et al., 2014; Lau et al., 2014). The use of the top 20 terms should be understood as an operational threshold rather than as a fixed standard; it provides a sufficiently broad representation of each topic's semantic content while limiting the influence of lower-weight terms that may introduce noise.

Table 3. Comparison of candidate NMF topic solutions[1]

k	Reconstruction error	Uniqueness ratio top20
4	21.829	0.900
5	**21.745**	**0.890**
6	21.665	0.858
7	21.590	0.879
8	21.522	0.844
9	21.449	0.856
10	21.393	0.855

Source: authors' own elaboration

[1] Lower reconstruction error indicates better numerical fit, while higher uniqueness ratio indicates greater distinctiveness among the top terms of the topics. The retained solution is reported in bold.

The comparison shows that the reconstruction error decreases as the number of topics increases, as predicted by matrix factorization models. In this metric, lower values indicate better numerical fit. In contrast, the uniqueness ratio measures the distinctiveness of the principal terms across topics, where higher values indicate less overlap between the vocabularies of the topics. However, neither the reconstruction error nor the uniqueness ratio provides a universal threshold for selecting the optimal number of topics. The quantitative comparison reported in Table 3 was therefore based on these two diagnostic indicators, while the final solution adopted was selected by also taking into account the substantive interpretability of the resulting topics, in line with established approaches to topic model evaluation and semantic coherence assessment (Lee and Seung, 1999; Berry et al., 2007; Mimno et al., 2011; Lau et al., 2014).

As shown in Table 3, the five-topic solution offers the most appropriate trade-off between reconstruction error and the uniqueness of the main terms. Compared to k = 4, it improves the reconstruction error while maintaining a uniqueness ratio very close to the maximum observed value. Conversely, solutions with more than five topics further reduce the reconstruction error, but the gain is incremental and results in lower or less stable term distinctiveness and greater thematic fragmentation. Therefore, k = 5 was not selected because it maximizes a single metric, but because it provides the most appropriate compromise between reconstruction error and uniqueness ratio top20, while the resulting topics remain substantively interpretable.

The solution adopted allows the literature to be organized into five interpretable domains: technology infrastructure; monetary-financial stability; adoption and trust; digital euro governance and design; regulation and crypto-assets. The thematic labels and corresponding key terms are shown in Table 4.

Table 4. Final topic labels and top terms, NMF, k = 5

Topic	Label	Top terms
T1	Technology Infrastructure	blockchain, technology, distributed ledger, ledger technology, blockchain technology, security, design, literature, smart, digital currency, applications, technologies

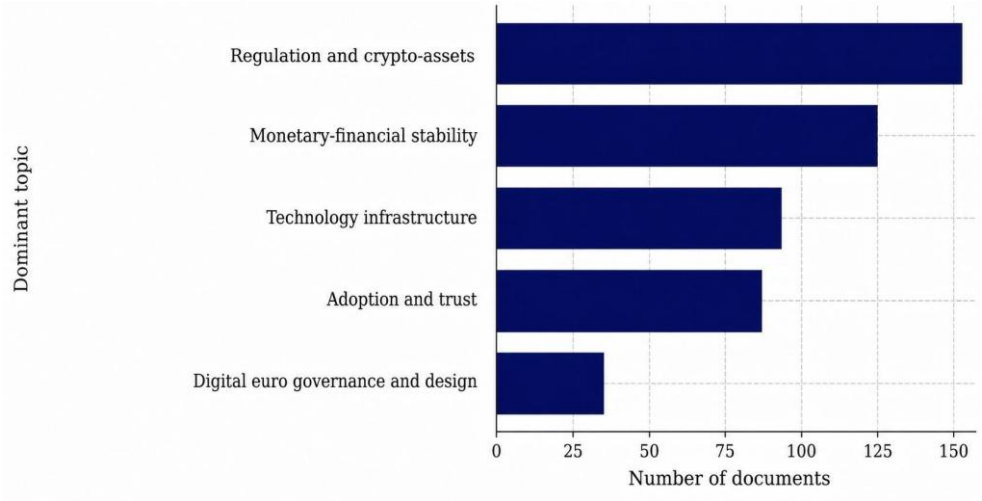
T2	Monetary-Financial Stability	monetary, CBDC, monetary policy, policy, stability, bank, financial stability, banks, central, central bank, banking, financial, bank digital, commercial, commercial banks, deposits, CBDCs, digital currency
T3	Adoption and Trust	adoption, trust, user, intention, user adoption, perceived, consumer, use, factors, empirical, users, acceptance, findings, consumer trust, model
T4	Digital Euro Governance and Design	euro, digital euro, european, ecb, euro area, european union, european central, union, area, payment, central, cash, CBDC, euro monetary, central bank, bank, privacy
T5	Regulation and Crypto-Assets	legal, regulatory, cryptocurrency, regulation, cryptocurrencies, currencies, international, stablecoins, digital currencies, money, legal regulatory, financial, global, regulatory analysis, payment, china, assets

Source: authors' own elaboration

The five-topic solution identifies a field organized around distinct but interconnected domains. The first topic captures technology infrastructure, including terms related to distributed ledger technology, blockchain, security and smart contracts. The second topic focuses on monetary policy, banking and financial stability, reflecting the macro-financial core of the CBDC debate. The third topic concerns adoption and trust, highlighting the socio-technical dimension of digital currency acceptance. The fourth topic is more specifically related to digital euro governance and design, with terms such as euro, European Central Bank (ECB), European Union, payment and cash. The fifth topic captures regulation and crypto-assets, connecting CBDCs to regulation, cryptocurrencies, stablecoins and digital currencies. This thematic structure confirms that the literature is multidimensional and spans institutional, technological, behavioural,

legal and market-oriented perspectives. Although some terms may represent cross-cutting themes across the CBDCs literature, the NMF results identify the topic in which each term attains its highest salience. For example, privacy, despite being discussed across multiple strands of research, emerges among the top terms only in T4 (Digital Euro Governance and Design). This suggests that, within the analysed corpus, privacy-related discussions are primarily associated with issues concerning the governance and design of the digital euro.

Figure 9. Distribution of documents across dominant topics, NMF, k = 5



Source: authors' own elaboration.

Figure 9 shows that regulation and crypto-assets represent the largest thematic domain, followed by monetary-financial stability. Technology infrastructure, as well as adoption and trust, also account for substantial portions of the corpus. By contrast, the topic specifically focused on digital euro governance and design is smaller. This does not imply that the digital euro is marginal in the literature, but rather that explicitly euro-area-specific contributions constitute a more specialized strand within the broader CBDCs debate.

3.6 K-means cluster analysis

The final layer of analysis examines whether the thematic domains identified through NMF correspond to broader document-level clusters. The document-topic weights generated by the NMF model were used as inputs for k-means clustering. Candidate solutions between three and six clusters were evaluated using silhouette, Calinski-Harabasz, and Davies-Bouldin criteria, as described in the Methodology

section. Unlike NMF, which estimates latent thematic components, k-means clusters documents according to normalized topic-weight profiles. Table 5 reports the comparison of the candidate cluster solutions.

Table 5. Comparison of candidate k-means cluster solutions[2]

k	Silhouette	Calinski-Harabasz	Davies-Bouldin
3	0.322	209.721	1.130
4	0.384	275.121	0.958
5	**0.435**	**342.965**	**0.775**
6	0.393	358.437	0.904

Source: authors' own elaboration

The five-cluster solution was chosen because it offers the best overall performance among the options tested. The three-validation metrics were interpreted according to their standard direction: the silhouette score improves as it approaches 1, the Calinski-Harabasz index improves with higher values, and the Davies-Bouldin index improves with lower values (Calinski and Harabasz, 1974; Davies and Bouldin, 1979; Rousseeuw, 1987; Jain, 2010). As shown in Table 5, k = 5 achieves the best value among the candidate solutions for both the silhouette score and the Davies-Bouldin index, indicating stronger cluster separation and greater internal compactness. Although the Calinski-Harabasz index is slightly higher for k = 6, this solution performs worse for both the silhouette and Davies-Bouldin values and would introduce an additional cluster without a corresponding improvement in the overall quality of the clusters or interpretability. Therefore, k = 5 was selected as the most robust solution within the considered range, as it offers the best balance between compactness, separation, parsimony, and substantial interpretability.

The resulting five-cluster structure is also consistent with the five-topic NMF solution, allowing the analysis to compare latent thematic domains with structural groupings at the document level. To facilitate interpretation, the k-means clusters shown in Table 6 and Figure 10 are ordered according to their dominant NMF topic.

[2] The retained cluster solution is reported in bold.

Table 6. Cluster summary and topic shares, means of L1-normalized topic weights[3]

Cluster	Documents	T1	T2	T3	T4	T5
1	102	**0.646**	0.102	0.106	0.034	0.110
2	111	0.041	**0.720**	0.068	0.041	0.130
3	94	0.074	0.129	**0.634**	0.038	0.125
4	40	0.045	0.112	0.080	**0.660**	0.103
5	175	0.097	0.149	0.122	0.046	**0.586**

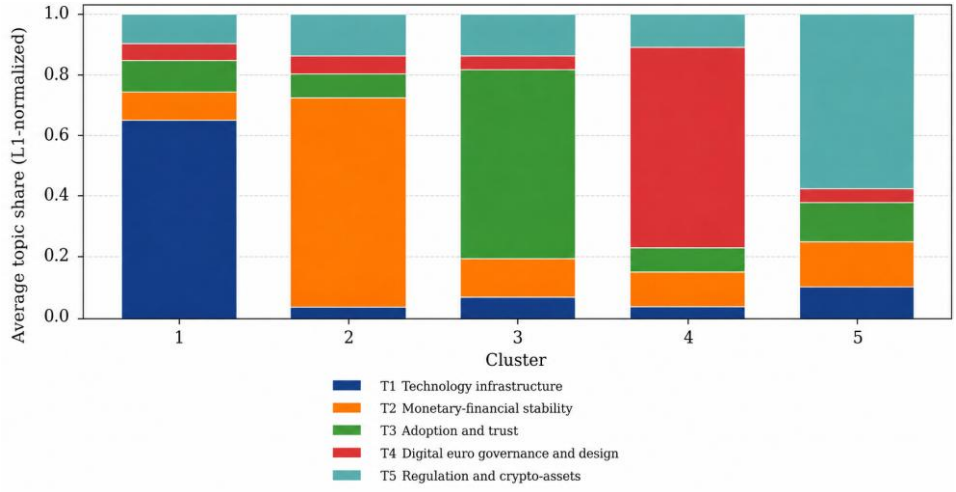
Source: authors' own elaboration

The composition of the clusters confirms that each is primarily associated with a dominant thematic focus. As highlighted by the bolded values in Table 6, Cluster 1 is primarily related to technological infrastructure, Cluster 2 is dominated by monetary and financial stability, Cluster 3 focuses on adoption and trust, Cluster 4 centers on governance and the design of the digital euro, while Cluster 5 is mainly associated with regulation and crypto-assets. This alignment between NMF topics and k-means clusters indicates that the five-cluster solution is not only statistically defensible but also substantively meaningful.

At the same time, the non-dominant thematic shares demonstrate that the clusters are not completely isolated. Figure 10 shows that each cluster contains secondary thematic components, suggesting that the literature is organized around recognizable domains while maintaining cross-cutting connections between various topics. This is particularly important for interpreting the field as thematically consolidated but only partially integrated. For example, the "Regulation and Crypto-Assets" cluster also includes monetary, technological, and behavioural components, while the "Monetary and Financial Stability" cluster maintains regulatory and institutional links. The cluster structure thus supports the broader interpretation that CBDC research has developed into distinct subfields, yet these subfields remain connected through shared institutional, technological, and regulatory concerns.

[3] Bold values indicate the dominant topic share within each cluster.

Figure 10. Topic composition of k-means clusters, k = 5



Source: authors' own elaboration

The bar chart visually confirms the thematic composition shown in Table 6, highlighting the dominant thematic orientation of each cluster and the presence of secondary thematic components.

4. Findings and Discussion

Taken together, the findings indicate that research on CBDCs has evolved from an emerging topic into a structured, multidisciplinary field of inquiry. The data presented in the previous section should not be interpreted as a series of isolated findings, but rather as a sequence of complementary analytical levels. The performance analysis shows how the field has expanded and gained academic visibility over time; the institutional, geographical, and source analyses clarify how this literature is produced, disseminated, and framed at the regional level; science mapping, through co-authorship networks and keyword co-occurrence, reveals the collaborative and conceptual organization of the field; NMF topic modelling identifies the main latent thematic domains; and k-means clustering verifies whether these domains correspond to recognizable groupings at the document level. The added value of the study therefore lies in the combined interpretation of these levels. Taken together, they show that the literature on CBDCs is no longer an unstructured or purely exploratory area of research. Rather, it has developed identifiable thematic domains, publication channels, collaborative communities, and conceptual connections. However, the field remains only partially integrated across its main analytical strands.

The first finding concerns the field's evolution and visibility. Performance analysis shows a clear acceleration in CBDCs research after 2021, along with a progressive accumulation of citations over time. This indicates that CBDCs have become a more stable and visible research topic within monetary, financial, and regulatory studies. The field is therefore not only expanding in terms of publication volume but is also consolidating as an area of academic debate. At the same time, the distribution of sources shows that this consolidation has not occurred within a single disciplinary niche. The contributions are spread across journals covering finance, central banking, technology, fintech, law, and related interdisciplinary fields. This confirms that CBDCs are not treated solely as a matter of monetary policy or merely as a technological innovation, but as institutional, financial, technological, regulatory, and socio-technical instruments.

Institutional and geographical evidence reinforces this interpretation. Among the most active institutions are universities, policy-oriented institutions, and organizations linked to monetary and financial research. This suggests that research on CBDCs is shaped by the interaction between academia and policy-oriented expertise. Geographical analysis adds a further distinction: the field is defined not only by where the research is produced, but also by the regional and comparative perspectives through which CBDCs are examined. The importance of global and transregional perspectives indicates that CBDCs are increasingly studied as part of a transnational transformation of money and payments. At the same time, the prominence of regional cases, including Europe and Asia, demonstrates that institutional contexts remain important. The digital euro should therefore be interpreted as a specific case within the euro area in the broader debate on CBDCs, rather than as a separate research object detached from it.

The results of the science mapping clarify both the social and conceptual structure of the field. The co-authorship network shows that CBDCs research is organized around multiple collaborative groups rather than a single, fully integrated research community. This pattern is consistent with the multidisciplinary nature of the topic, as scholars approach CBDCs from the perspectives of monetary economics, banking, law, technology, user behaviour, and digital finance. The keyword co-occurrence network provides the conceptual counterpart to this social structure. It shows that CBDC is the central organizing concept around which various thematic communities form, including monetary and financial stability, technological infrastructure, regulation, privacy, security, fintech, and digital currencies. The key point is not simply that these terms appear in the literature, but that they form a recognizable conceptual structure. At the same

time, their connections remain uneven, suggesting that the field has a common conceptual core but does not yet possess a fully integrated analytical framework.

The thematic and clustering results provide the clearest evidence of this dual pattern of consolidation and partial integration. NMF identifies five main thematic domains: technological infrastructure; monetary and financial stability; adoption and trust; governance and design of the digital euro; and regulation and crypto-assets. These domains demonstrate that the literature is organized around coherent areas of inquiry. K-means clustering confirms that these thematic domains are not merely semantic labels generated by the topic model but also correspond to recognizable groupings at the document level. This reinforces the robustness of the interpretation, as the same structure emerges from two different analytical procedures: one based on latent textual components and the other based on document-level similarity.

The central implication of these findings is that research on CBDCs has become internally differentiated. Monetary and financial stability represents the institutional and macro-financial core of the debate, reflecting the nature of CBDCs as public monetary instruments linked to the central bank, financial stability, banking intermediation, and the design of payment systems. Technological infrastructure, adoption and trust, governance and design of the digital euro, as well as regulation and crypto-assets represent more specialized but nonetheless relevant strands. These strands are not isolated, as the clustering results show secondary thematic components within each cluster and the keyword network highlights conceptual links between the main terms. However, they are not fully integrated either. The field is therefore best understood as thematically consolidated but analytically incomplete: it has developed well-defined research areas, but the connections between these areas remain only partial.

If considered separately, each method would provide only a partial view of the literature. The originality of the study lies precisely in the combination of these levels. Together, they show not only that the literature on CBDCs is expanding, but also how it is organized, where it is integrated, and where its internal connections remain weak.

The results point to three main research gaps. The first concerns the relationship between institutional design and user acceptance. Studies on monetary architecture, banking effects, payment system design, and legal feasibility do not always adequately address adoption, trust, privacy, and user behaviour. This is a significant gap because the long-term sustainability of CBDCs depends not only on systemic soundness or legal feasibility, but also on whether users perceive them

as useful, reliable, accessible, and compatible with their expectations regarding privacy and convenience (Davis, 1989; Venkatesh et al., 2003; Taylor et al., 2016). The second gap concerns the relationship between macro-financial analysis and market research on digital assets. CBDCs are public monetary instruments, but they will operate in a financial landscape increasingly characterized by stablecoins, crypto-assets, tokenized assets, and private digital currency ecosystems. The findings suggest that these areas are interconnected but not yet systematically integrated. Future research should therefore examine more directly how CBDC design, banking disintermediation, financial stability, stablecoins, crypto-assets, and private digital finance interact within the same analytical framework (Zetzsche et al., 2020; Auer et al., 2021). The third gap concerns the integration of legal and regulatory design, technological infrastructure, and real-world usage conditions. Legal and regulatory studies clarify governance, compliance, and institutional jurisdiction. Technological studies focus on infrastructure, interoperability, cybersecurity, and settlement architecture. Behavioural studies examine trust, privacy, and adoption. However, these dimensions are often analysed separately. Future research would benefit from conceptual frameworks capable of linking legal design, technological implementation, payment interoperability, user behaviour, and systemic resilience.

Overall, the findings show that CBDC research has reached a stage of thematic consolidation and conceptual differentiation, but not of full analytical integration. The field has expanded rapidly, developed recognizable thematic areas, gained academic visibility, and generated both collaborative and conceptual networks. Nevertheless, its main strands remain only partially connected. The literature on CBDCs should therefore be understood as a multidisciplinary field in the process of maturing: no longer exploratory or embryonic, but still in need of more integrated frameworks capable of linking monetary design, financial stability, regulation, technological infrastructure, user adoption, and the dynamics of the digital asset market.

5. Conclusion

This paper shows that CBDCs research has expanded rapidly since 2021 and has developed into a multidisciplinary research domain located at the intersection of monetary economics, banking, financial stability, payment systems, technological infrastructure, legal-regulatory design, user adoption and digital-asset markets. The findings indicate that the CBDCs literature has reached a stage of thematic consolidation, but not full analytical integration. Performance analysis evidence shows a clear acceleration of publication output and a concentration of citation

visibility around the early consolidation phase of the field. Institutional and source-level evidence shows that CBDCs research is produced across a heterogeneous set of universities, policy-oriented institutions and research organizations, and is disseminated across finance, central banking, technology, fintech, legal and interdisciplinary outlets. Geographical evidence further shows that the field combines global and cross-regional perspectives with more specific regional orientations, confirming that CBDCs are studied both as national or regional projects and as part of a broader transnational transformation of monetary and payment systems. The thematic and clustering evidence identifies five main domains: Technology infrastructure; Monetary-financial stability; Adoption and trust; Digital euro governance and design; and Regulation and crypto-assets. The institutional and macro-financial core remains central, especially in relation to monetary policy, banking intermediation, financial stability and payment-system design. At the same time, technological infrastructure, user adoption, trust, privacy, legal-regulatory frameworks and crypto-asset linkages constitute important, specialized strands. The digital euro appears within this structure as a specific euro-area case rather than as the exclusive focus of the paper.

A central contribution of the study lies in its integrated methodological design. The analysis combines descriptive performance analysis, science mapping, computational text-mining, topic modelling, document-level clustering and interpretive synthesis. Performance indicators, citation patterns, institutional profiling, source analysis and geographical classification reconstruct the publication profile of the field. The co-authorship network maps the collaborative structure of the research community, and the keyword co-occurrence network reconstructs the conceptual relationships among the main terms of the literature. Finally, TF-IDF representation and NMF topic modelling identify latent thematic domains, while k-means clustering verifies whether those domains correspond to document-level groupings. The originality of the article therefore lies in the combination of complementary analytical layers rather than in any single technique considered in isolation. The combined evidence also clarifies why the field should be interpreted as multidisciplinary but only partially integrated. The literature has developed identifiable thematic domains and a recognizable conceptual backbone, but the links among institutional design, user adoption, technological implementation, legal frameworks, and digital-asset markets remain uneven.

Three priorities emerge for future research. First, institutional and design-oriented analyses should be more closely integrated with studies on adoption and

reputation, as well as trust, privacy, and user behavior. Second, macro-financial research on CBDCs should be connected more systematically with work on stablecoins, crypto-assets, tokenized assets, and broader digital-money ecosystems. Third, greater attention should be devoted to integrating legal-regulatory, technological, and behavioural perspectives into comprehensive analytical frameworks capable of explaining how governance, interoperability, adoption, and systemic resilience interact in practice.

This study has several limitations. First, the analysis is limited to journal articles indexed in Scopus and Web of Science and therefore reflects the coverage, indexing rules and metadata characteristics of these databases. In addition, the restriction to English-language publications may exclude some contributions published in other languages, although English-language records represented the large majority of the initial retrieval. Finally, the bibliometric and text-mining analyses depend on the consistency and quality of titles, abstracts, author keywords and index keywords, which may vary across journals and databases. Future studies could extend the analysis by incorporating working papers, policy documents, central bank reports and more detailed citation and collaboration networks.

Taken together, the results suggest that CBDCs research has evolved from an exploratory topic into a consolidated but not yet fully integrated field. The literature is structured around a common monetary and institutional core, while technological, regulatory, behavioural, and market-oriented perspectives have emerged as distinct yet interconnected domains. This configuration reflects the inherently multidisciplinary nature of CBDCs as both a monetary innovation and a socio-technical system. The main challenge for future research is therefore no longer the identification of new themes, but the development of integrative frameworks capable of linking monetary design, financial stability, regulation, technology, and user adoption within a coherent analytical perspective.

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Appendix

The general structure of the query was as follows:

```
TITLE-ABS-KEY (
(
"CBDC" OR
"central bank digital currency" OR
"central bank digital currencies" OR
"digital euro" OR
"digital currency" OR
"digital currencies" OR
"central bank money" OR
"electronic central bank money" OR
"sovereign digital currency" OR
"sovereign digital currencies"
)
AND
(
"monetary policy" OR
"monetary policies" OR
"financial stability" OR
"payment" OR
"payments" OR
"payment systems" OR
"payment system" OR
"interoperability" OR
"holding limits" OR
"holding limit" OR
"blockchain" OR
"cryptocurrency" OR
"cryptocurrencies" OR
"stablecoin" OR
"stablecoins"
)
)
```

Table A1. Analytical layer, methodologies, purpose and software

Analytical layer	Methodologies	Purpose	Software/tool
Performance Analysis	Publication counts, citation analysis, source profiling and geographical distribution	To describe the size, growth, visibility and publication structure of the field	Bibliometrix in R
Science Mapping	Co-authorship and keyword co-occurrence network	To visualize the co-authorship and co-occurrence network	Python and VOSviewer
Text representation	TF-IDF matrix	To transform textual information into a weighted document-term representation suitable for thematic extraction	Python
Topic modelling	Non-negative Matrix Factorization (NMF)	To identify latent thematic domains in the corpus	Python
Document-level clustering	K-means clustering	To group publications according to similarity in their thematic profiles	Python
Cluster validation	Silhouette score, Calinski-Harabasz index and Davies-Bouldin index	To assess the statistical consistency of candidate cluster solutions	Python
Keyword network analysis	Keyword co-occurrence network	To identify conceptual relationships among standardized author keywords	Python and VOSviewer
Interpretive synthesis	Content-based reading of representative contributions	To connect quantitative patterns to substantive theoretical and policy debates	Authors' qualitative interpretation

Source: authors' own elaboration

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