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Ready for a digital Euro? Insights from a research agenda

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ABSTRACT

Innovative tools—such as cryptocurrencies, electronic money, and digital payments—have enhanced the digitisation of financial system, but not without risk. To ensure financial stability and innovation, Central Banks have recently begun supporting the creation of so-called Central Bank Digital Currencies (CBDCs). The present study reviews the literature around the digital transformation of the financial environment, with a specific focus on the creation of a digital Euro. A bibliometric analysis, conducted on 290 documents from the Scopus database, provides insights into the topic and its future research avenues. The results show a growing interest for CBDCs and their related issues, especially those related to the implementation of monetary policy instruments, which can hinge on issues related to the digital transformation of finance and innovation-related problems such as crime prevention and cybersecurity.

1. Introduction

The disruptions of digitalization extend beyond everyday life into the economic system (Ponce, 2020). New schemes are fostered by new demographic trends, as new generations replace baby boomers, they are seeking new paradigms for managing everyday issues. The monetary system is no exception; thus, the last two decades have seen a revolution in payments methods as well as the birth of digital money and cryptocurrencies (Barontini and Holden, 2019; IMF, 2019). Although physical cash continues to be prominent in regular life, new groups of more technology-savvy consumers are challenging this primacy with a more frequent use of alternative, digital methods (Bank of Italy, 2021; ECB, 2022). The COVID-19 pandemic—and its requirements for social distancing and periodic lockdowns—accelerated this shift toward virtual transactions. Given the dramatic increase in digital payments and the related decline in physical cash withdrawals and cash holdings, financial institutions have enlarged their offer of non-cash payment methods and related services (ECB, 2020; BIS, 2021).

Besides the essential role of physical payments, digital ones gained a greater importance, as bank-based payment systems are challenged by other non-strictly financial corporations (e.g., PayPal, Amazon Pay, and others) in carrying on such business. Moreover, the invention of cryptocurrencies such as Bitcoin or Ethereum has disrupted the flow of the entire banking and monetary system, compelling governments and Central Banks to rethink their core assets and adapt their activity pillars (e.g., monetary policy, liquidity risk) (ECB, 2019). In fact, several Central Banks are currently exploring the possibility of launching their own Central Bank Digital Currencies (CBDCs). The long-term aim of this strategy is to fully replace physical money (which carries extensive liability) with a digital form of fiat money (Mancini-Griffoli et al., 2018; Auer et al., 2020a, 2020b).

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The shift to digital monetary systems has inspired considerable debate, in both the public and private spheres. On one hand, digital currencies could increase the efficiency of many economic processes (Barontini and Holden, 2019); on the other hand, there are serious risks related to digital security, data protection, and financial inclusion (de Almeida et al., 2018; Senyo and Osabutey, 2020; Keister and Sanches, 2021).

In short, there is a need to understand the social and economic schemes that might arise from this new monetary flow. What do users stand to both gain and lose in the process? To address this question, the present study reviewed state-of-the-art research regarding the process of digitising monetary systems and the advancements of digital currencies, with a particular interest in the digital Euro and the role of the European Central Bank. To this end, we collected relevant academic publications from the database Scopus and then performed a bibliometric analysis to assess this subject's evolution in the literature. In this way, we not only summarise advancements in academic knowledge about the impact of CBDCs on macroeconomic and monetary policies, but also illuminate gaps in the literature that might galvanise new research streams.

Moreover, we carried out a keywords co-occurrence analysis to identify the most relevant documents published by the most productive and impactful authors. Afterward, we performed a content analysis on several identified clusters of documents in order to clarify the most important trends and contributions. We conclude by discussing the theoretical and practical implications of our results for academics, policymakers, and financial institutions. Although this subject is highly niche, we believe that its importance and salience will only grow. We present this work as an attempt to mark the existing path as societies rapidly approach a challenging crossroads between research and innovation.

The remainder of this paper is organised as follows: The next section provides the theoretical background for the bibliometric analysis. Afterward, we articulate the methodology used and report the outcomes of the bibliometric analysis. The final section summarises the results and discusses their implications for future research.

2. Theoretical background

The revolutionizing of the monetary system has been an ongoing disruptive process. Although the debate on digital money has exploded in the last decade, scholars have been discussing the birth of digital business and e-commerce since the early 80 s when electronic payments were first introduced (Byron et al., 1981).

The early 2000s provided the first signals of a paradigm shift, with the introduction of cryptocurrency (Bitcoin) and unregulated peer-to-peer money transfer (PayPal). This new ecosystem depends on the technological underpinnings of the blockchain: a technological infrastructure that has largely been advanced by private entities. As these entities have enlarged their size and relevance in the financial environment, they have also put the stability of the entire banking system at risk. Indeed, private entities' creation of a parallel, non-regulated monetary ecosystem has raised serious concerns about security, data protection and financial inclusion (World Bank, 2016; Fletcher et al., 2021). Nonetheless, according to a Mediobanca report (2021), the PayTech industry continues to expand: It achieved a turnover of more than 140€Bn, with a projection of growth in 2021 on the previous year of 14.4 %. This phenomenon has significantly impacted the whole world but developing countries (especially in Latin America) have seen the most consistent growth indexes.

As a result, Central Banks have been compelled to develop new fiscal and monetary tools, which has inspired the process to create and refine CBDCs. This new digital form of fiat money is a response to the decentralization of financial power stemming from the spread of cryptocurrencies and private tokens, alongside a steep decrease in the use of physical cash. Rather than fight this trend, financial institutions are looking to infuse digital currencies with regulatory monitoring and financial stability.

According to Soderberg et al. (2022), CBDCs serve multiple policy and economic goals. First, they aim to promote financial inclusion for people who are underserved by financial institutions (Dev, 2006; Kapoor, 2014; Ozili, 2020). The public's rapid adoption of digital technologies represents an opportunity to expand inclusion in new ways.

On the other hand, other relevant flows in CBDCs literature focus on the business model of private banks deriving from the introduction of a digital currency from a central bank. According to many scholars, the introduction of CBDCs may crowd out private banks and lead to a disintermediation of private credit institutions (Keister and Sanches, 2021), such as raising interest rates for bank loans (Mersch, 2017) or jeopardizing banks' stable funding (BIS, 2018). However, Meaning et al. (2018) argued that the benefits of CBDCs may be outweighed by their negative externalities.

Moreover, some studies focus on developing the architecture for issuing and managing digital currencies (Auer and Bohme, 2020). scholars have mainly discussed the design features of carrying interest rates, guaranteeing anonymity, offline disposal, and structuring a network for cross-border payments (IMF, 2022).

Several Central Banks have started to explore the opportunity to create a fully operative digital currency. So far, only nine countries have launched a digital currency (Central Bank of Bahamas, Eastern Caribbean (7 countries), and Nigeria). Another 15—including China, the Russian Federation and Sweden—have initiated a pilot version and achieved encouraging results (Atlantic Council, 2022). Bigger players like the European Central Bank (ECB) and the US Federal Reserve are still in a research phase. Notably, the ECB has moved beyond assessing citizens' interest in a digital euro to finalizing its design (ECB, 2022), and it is currently working on a regulatory draft (ECB, 2023). According to the ECB policy strategy, the main objectives in creating a central-backed digital currency are mitigating the risks of financial instability, increasing the power of the Euro as an international currency, and establishing strong regulatory frameworks for the digital monetary system (Bindseil, 2021).

Based on those theoretical pillars, our bibliometric analysis had two goals: first, to highlight existing gaps in this novel research domain in order to inspire future research, and second, to derive useful implications from the managerial, policymaking and governance points of view.

The following section will describe the applied methodologies.

3. Methodology

We conducted a bibliometric analysis of academic publications in order to uncover the state-of-the-art scholarship about CBDCs and the initial discussions about a digital Euro. We chose this approach for several reasons: First, it can be used to determine trends in journal and article performance, cooperative research efforts, and the state of discovery within a certain literature (Apriliyanti and Alon, 2017; Donthu et al., 2020; Khan et al., 2020; Verma and Gustafsson, 2020; Donthu et al., 2021; Goyal and Kumar, 2021; Jalal et al., 2021; Bretas et al., 2022). Moreover, evaluating the quality and quantity of research can provide different insights than testing hypotheses or advancing theory. This methodology is useful for building holistic views of phenomena, detecting niche areas in a research domain, formulating insightful proposals for further studies. Scholars recognize several advantages in conducting bibliometric analysis: it overcomes typical sample selection bias (Galletta et al., 2022), it makes a both qualitative and quantitative assessment of the documents via the implementation of statistical approaches, and it manages huge amounts of information and provides useful insights for future research through an objective evaluation of existing sources (Naciti et al., 2022).

The bibliometric methodology summarizes the literature in terms of quantitative methods, utilizing data such as the number of publications or citations (Broadus, 1987; Pattnaik et al., 2020; Kumar et al., 2020; Goyal and Kumar, 2021). However, it has only recently gained traction in the business fields of management, accounting, finance, econometrics, or other social sciences (Wallin, 2005). Thus, only a few recent scholars have used this methodology to explore the world of financial technology and digital payments (Merediz-Solà and Bariviera, 2019; Kyriazis et al., 2020). The number of scientific publications that use bibliometrics has grown recently. However, traditional non-digital review methods found the immense bibliographic datasets to be burdensome and unfeasible (Ramos-Rodríguez and Ruíz-Navarro, 2004). Fortunately, technological advancement in publication databases such as Scopus now allow for large volumes of bibliometric data to be processed easily. In this study the “unified approach” introduced by Waltman et al. (2010) was implemented. The unified approach is based on both the distance and strength of relationships between nodes, as captured in the Eq. (1):

$$V(x_1, \dots, x_n) = \sum_{i < j} s_{ij} d_{ij}^2 - \sum_{i < j} d_{ij} \quad (1)$$

where s_{ij} indicates the strength of link between keywords i and j , and d_{ij} represents:

$$d_{ij} = \begin{cases} 0 & \text{if } x_i = x_j \\ \frac{1}{\gamma} & \text{if } x_i \neq x_j \end{cases} \quad (2)$$

where γ is the resolution parameter, an arbitrary positive integer that determines the number of clusters to be obtained (Van Eck and Waltman, 2007; Van Eck et al., 2010; Naciti et al., 2021).

Moreover, to assess the shifting terrain of keywords in the literature across time, we used a chronological analysis of keywords with a weighted average of the years. Thus, the average year of occurrence for a keyword is calculated by:

$$y_i = \frac{\sum_t (n_{it} t)}{\sum_t n_{it}} \quad (3)$$

where n_{it} represents the number of times that a certain keyword i occurs in year t ($t = 2005, \dots, 2022$; Jalal et al., 2021; Galletta et al., 2022).

We applied a series of search queries to the Scopus database in order to extract relevant documents. Specifically, we gathered documents that contained the words “digital Euro” or “central bank digital currency” within the keywords, title, or summary. Through this method, we extracted a set of 290 documents published between 2005 and 2022. We decided to limit the search to 2022, since more recent data would have provided untrustworthy statistics from a time-series perspective.

After conducting an independent reading of the abstracts to filter out documents that deviated from our objectives, we limited the extraction to the timespan 2005–2022. This step of the analysis was also useful to examine documents which were not pertinent to the subject, keeping all those fields related to Computer Science, IT engineering, Economics and Finance, Mathematics, and Decision Sciences. Thus, if some document was included in other subject areas, we first checked the presence of duplications before excluding such areas. Additionally, we limited our search to journal articles and left out any documents related to conference papers, books, chapters and so on. Finally, we cleaned our remaining sample of any duplicate documents.¹

The analysis proceeded in two steps: The first involved the use of the software RStudio and, specifically the “Bibliometrix” package. First launched by Aria and Cuccurullo (2017), this software gives users the essential tools for performing bibliometric analysis a variety of tools for quantitative research in scientometrics and bibliometrics that includes all the main methods of bibliometric analysis (Moral-Muñoz et al., 2020). In this step, we examined scholars’ field-specific performance through various numeric measures, such as the total amount of scientific production, citation count and trends, publication count per unit of analysis (e.g., authors, countries,

¹ The query used for extracting papers from Scopus is available upon request.

affiliation), etc. This analysis exposed the most impactful documents in this field and their authors (Paltrinieri et al., 2019).

The second phase utilised the VOS Viewer software, first launched by Van Eck and Waltman (2007), to analyse the co-occurrence of keywords and link them via clusters. This technique employs authors' provided keywords to investigate the conceptual structure of the field, as well as surfaces more recent documents that might be overlooked on citation performance measures. Moreover, this tool provides outstanding visualization interfaces and can be adapted to numerous databases formats (Moral-Muñoz et al., 2020). We employed the full count method for this analysis² and specifically considered keywords that occurred at least six times.

4. Results

4.1. Data analysis

After using the aforementioned queries and removing the duplicate results, we retrieved 290 documents published between 2005 and 2022. (Table 1).

Our analysis of the descriptive statistics led to some interesting observations. For one, the average age of the sampled articles was 2.91 years, indicating that academia's interest in this topic is quite recent. Second, the average number of co-authors per document was 2.16, while nearly half of the articles (131 out of 290) had single authors, which indicates a very low degree of collaboration among scholars. Similarly, the degree of international collaboration among authors was quite low at 13.79 %, although this seems reasonable given that the topic is rooted in country-specific regulations. Fig. 1 displays the timing of the publications.

Following our objectives, we evaluated the publication trends in the indicated time span. Nonetheless, Fig. 1 shows that the publication growth trend has accelerated since 2013, performing a substantial, sharp increase since 2017, with an average yearly growth rate of 23.67 %. Clearly, interest in the subject is rising from several directions.

Fig. 2 offers another interesting insight regarding the average number of citations per year.

As can be seen, the distribution is irregular, so it may depend on social trends and causality induced by those variables related to the average timing in the publication process. The only pattern we can deduce is a general rise in the average yearly increment between 2014 and 2019. This suggests that interest in the topic increased in response to the issuance of the first regulatory frameworks on payment systems, such as the second Payment System Directive (PSD2) on electronic payments of the European Union (EC, 2015) and the Payment Services Act of Singapore (MAS, 2019), which opened interesting paths of research about digital currencies. The right limit of the graph shows a growing trend in the citations; although it is lower than 2019, that may be due to the relative recency of the information.

We also analysed the geographical distribution of the sampled documents. Table 2 highlights the most productive countries based on the authors' affiliations.

On a total frequency of 577 reported authors, the USA leads the chart with 11.7 % of the sample, followed by Germany (10.6 %) and China (7.9 %). The authors from the first 10 countries are collectively responsible for 61.5 % of the entire sample, indicating that universities in those countries have a major interest in this research field. The fact that 35.5 % of the total reported affiliations come from EU organisations seems appropriate, given EU authorities' significant steps toward creating and testing a digital currency. Countries with experience in using CBDCs – e.g., Barbados – are also featured.

Fig. 3 illustrates the frequent collaboration networks among the most productive countries. Collaboration networks are often able to bypass certain political/economic obstacles and can thus reveal the country-specific nature of the research in the field. In particular, European and North American organisations frequently collaborate, despite belonging to different currency areas, as do South Korea and the US. Interestingly, Chinese affiliations did not engage in any international collaborations, while EU countries established a few among their peers.

4.2. Authors analysis

In Fig. 4, we visualise another interesting observation about authors' productivity.

The authorship mapping results were very fragmented: Of the ten most productive authors, nine were authors (or co-authors) of three documents each, while one (Náñez Alonso et al., 2020; 2021) co-authored two documents. This may speak to the heterogeneity of the literature, with authors adopting a variety of approaches (theoretical and empirical) and working in different regulatory frameworks. That said, we cannot ignore the recency of the topic when assessing authors' impact: As Fig. 5 illustrates, the ten most productive authors published all their documents between 2018 and 2022 - a fairly concentrated time span considering the breadth of the research sample. This suggests that these authors belong to a new strand of literature.

Next, we assessed authors' overall relevance through the impact of their studies. The chart in Fig. 6 displays the *h-index* (i.e., the number of *h* publications with at least *h* citations) for each author.

When combining Figs. 5 and 6, we can clearly see an overlap that signals the recency of the topic. Moreover, this chart highlights the fragmentation of this research due to the vast number of authors. Therefore, we decided to conduct a content analysis in order to review and confirm the results of the bibliometric analysis (Potter and Levine-Donnerstein, 1999; Alon et al., 2018). Content analysis is a widely accepted methodology in social science for systematically reviewing and confirming the validity of knowledge in a specific

² For an overview, please see Waltman and Van Eck, 2015; Gauffriau, 2021.

Table 1
Dataset general information.

Description	Results
Main Information About Data	
Timespan	2005:2022
Sources (Journals, Books, etc)	183
Documents	290
Annual Growth Rat %	23.67
Document Average Age	2.91
Average citations per doc	6.541
References	13,301
DOCUMENT CONTENTS	
Keywords Plus (ID)	201
Author's Keywords (DE)	814
AUTHORS	
Authors	577
Authors of single-authored docs	122
AUTHORS COLLABORATION	
Single-authored docs	131
Co-Authors per Doc	2.16
International co-authorships %	13.79
DOCUMENT TYPES	
Articles	290

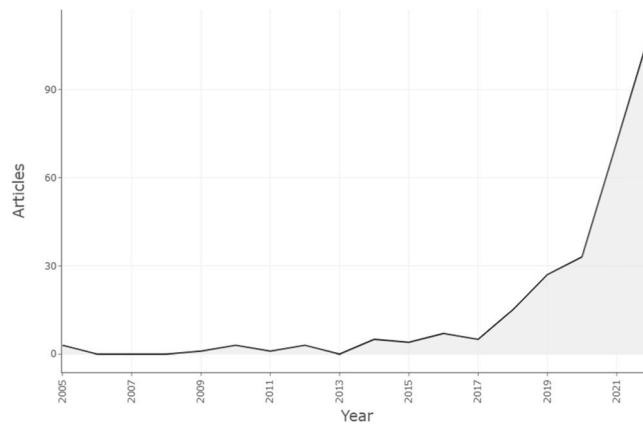


Fig. 1. Annual academic production.
(Source: own elaboration on Bibliometrix).

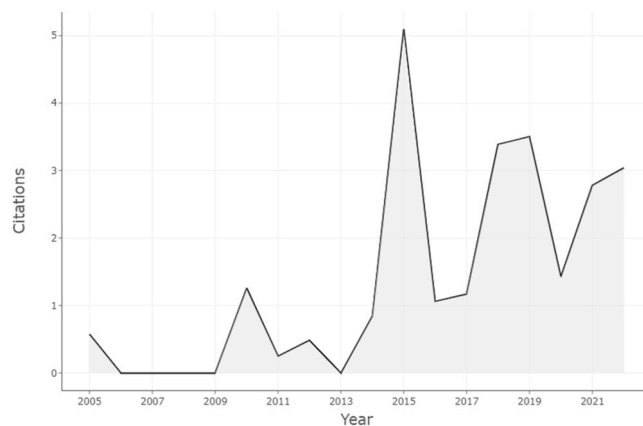


Fig. 2. Average number of citations per document per year.
(Source: own elaboration on Bibliometrix).

Table 2
most productive countries (source: own elaboration on Bibliometrix).

Region	Freq
USA	68
Germany	61
China	46
UK	46
France	29
Spain	29
South Korea	23
Italy	21
India	18
Canada	14

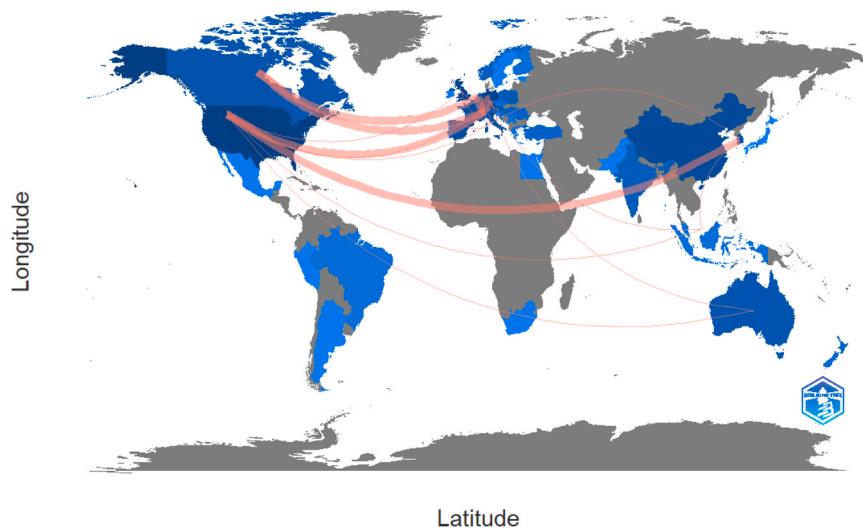


Fig. 3. Country collaboration.
(Source: own elaboration on Bibliometrix).

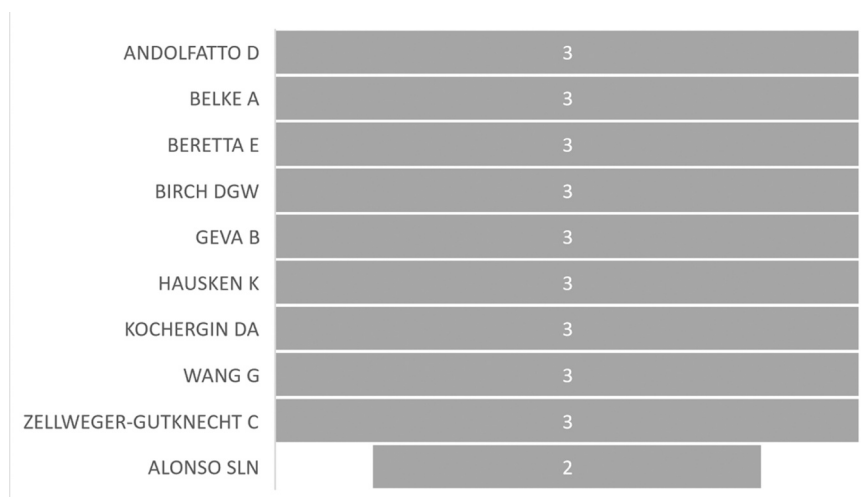


Fig. 4. Most productive authors.
(Source: own elaboration on Bibliometrix).

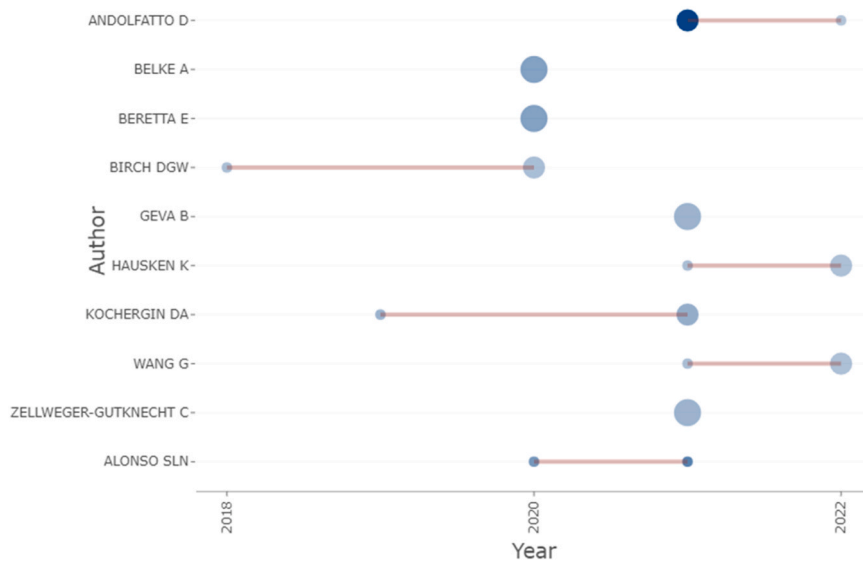


Fig. 5. Authors' production over time.
(Source: own elaboration on Bibliometrix).

ALONSO SLN	2
BELKE A	2
BERETTA E	2
BIRCH DGW	2
CHUA B-L	2
DAVOODALHOSSEINI SM	2
GEVA B	2
HAN H	2
HUANG Z	2
KIM JJ	2

Fig. 6. Authors' impact by h-index.
(Source: own elaboration on Bibliometrix).

field of study (Potter and Levine-Donnerstein, 1999; Bahoo et al., 2018; Gaur and Kumar, 2018). By combining content and citation analyses, we can uncover future research directions (Paltrinieri et al., 2019). Once the present content analysis is conducted, we will then supplement the content analysis with the results of a keyword co-occurrence analysis.

As reported in Table 3, the content analysis of the most impactful authors revealed some interesting insights. The first of which is the variety of methodologies applied: Most of the documents adopted a theoretical approach related to the strengths and weaknesses of implementing a CBDC. Only one of the documents discussed the adoption of a digital Euro (Grünewald et al., 2021) by examining the ECB's powers in light of the TFEU regulatory foundations. There were five empirical studies: three based on surveys (Belke and Beretta, 2020b; Kim et al., 2022; Radic et al., 2022) and two related to the use of digital currencies in a retail market (i.e., tourism sector). work by Belke & Beretta is notable insofar highlighted concerns about the trade-offs between money digitalization and financial stability. Finally, we identified two studies built with a strictly quantitative methodology: Davoodalhosseini (2022) quantitatively captured the monetary policy issues stemming from the Central Bank of Canada adopting a Digital Canadian Dollar; Li et al. (2022) quantitatively assessed the behaviour of Fintech firms in terms of adopting CBCDs. In the next section, we describe the keyword co-occurrence analysis in order to complete our overview of the most relevant literature strands.

Table 3
Content analysis on most locally cited authors (source: Scopus).

Author (s)	Most cited document	Year	Total Citations in Scopus	Source	Methodology
Alonso, S.L.N. et al.	Reasons fostering or discouraging the implementation of central bank-backed digital currency: A review	2020	21	Economies	Theoretical/comparative
Belke, A. & Beretta, E.	From cash to central bank digital currencies and cryptocurrencies: a balancing act between modernity and monetary stability	2020	11	Journal of Economic Studies	Empirical/Survey
Belke, A. & Beretta, E.	Not the time for central bank digital currency. Why cash is still irreplaceable	2020	2	Credit and Capital Markets	Theoretical/descriptive
Birch, D.W.G.	Who will make money? Tokens and the '5Cs' of future currency	2018	4	Journal of Payments Strategy and Systems	Theoretical
Grünenwald, S., Zellweger-Gutknecht, C., & Geva, B.	Digital Euro and ECB powers	2021	4	Common Market Law Review	Theoretical
Radic, A., Quan, W., Koo, B., Chua, B. L., Kim, J. J., & Han, H.	Central bank digital currency as a payment method for tourists: application of the theory of planned behavior to digital Yuan/Won/Dollar choice	2022	10	Journal of Travel and Tourism Marketing	Empirical/Survey
Davoodalhosseini, S.M.	Central bank digital currency and monetary policy	2022	28	Journal of Economic Dynamics and Control	Empirical/quantitative
Kim, J. J., Radic, A., Chua, B. L., Koo, B., & Han, H.	Digital currency and payment innovation in the hospitality and tourism industry	2022	3	International Journal of Hospitality Management	Empirical/Survey
Li, Z; Yang, C.; Huang Z.	How does the fintech sector react to signals from central bank digital currencies?	2022	30	Finance Research Letters	Empirical/quantitative

4.3. Keyword analysis

For this step, we used the VOS Viewer software to identify co-occurring keywords. In this way, we could map the most important themes in various macro-areas, as well as the themes' relationships to one another (Fig. 7).

The co-occurrence analysis revealed four main clusters. The first cluster (yellow) includes themes related to our core issue, i.e., the digitalization of money and payment systems. This cluster makes clear references to the present challenges posed by the actual phenomena (i.e., the spread of digital financial services). The second cluster (blue) focuses on the application of central bank digital currencies to economic and monetary policies. The third cluster (red) revolves around financial intermediation issues, the role of fintech, and the market for products and services related to blockchain technologies. The fourth cluster (green) emphasizes safety and security issues, including the effect of COVID-19 on cryptocurrencies and CBDCs, as well as themes related to privacy, cyber security, and crime prevention (e.g., money-laundering, terrorism financing, etc.). These latter themes are vitally important to protecting users in a digital monetary system.

After identifying the main clusters, we extended the analysis by examining how they have evolved over time. (Fig. 8).

The overlay visualization underscores several thematic shifts between 2020 and 2022, from private-backed cryptocurrencies to the adoption of a digital Euro, which are mainly linked to the theme of financial inclusion. Such node has relevant links with the topic of monetary policy, underlining the importance of using CBDCs as instruments of economic policy. We can also see an increasing interest in the management perspective on digital currencies, as reflected in the themes of financial intermediation and fintech.

At this point, we sought to disentangle the strands in order to uncover possible avenues for future research. Thus, we conducted a bibliographic coupling of the sampled documents, displayed in Fig. 9.

The technique of bibliographic coupling is useful to the identification of the literature strands, letting emerge those documents that share at least one citation. This coupling suggests that such documents are focused on similar topics. This analysis revealed four clusters: The red cluster (Masciandaro, 2018; Nández Alonso et al., 2020; Belke & Beretta, 2020a, 2020b; Andolfatto, 2021a, 2021b) encompasses elements related to monetary policy, specifically, the parallel use of private and public digital currencies based on blockchain. The green cluster (Kochergin, 2021a, 2021b; Kshetri, 2021, Kshetri and Loukoianova, 2022; Sakharov, 2021, 2022) is connected by the theme of privacy concerns and security risks related to issuing CBDCs. The yellow cluster (Zhang and Huang, 2022; Wang and Hausken, 2022) involves examinations of stakeholders' behaviour in the presence of transactions made with CBDCs. The blue cluster (Kim et al., 2022; Radic et al., 2022) features studies that examine the introduction of a CBDC specifically through the lens of tourism.

5. Discussion and conclusive remarks

Although Central Bank Digital Currencies are not yet ready for prime time, the curiosity around them merited a look at scholarship around the introduction and implementation of digitised monetary policies and everyday business. As our analysis showed, the subject has seen a surge of scholarly interest since 2013, with most documents flowing from the USA, followed by Germany, China, and the UK. Notably, we found that authors in this domain have thus far preferred to collaborate with other authors from their own country rather than their international peers.

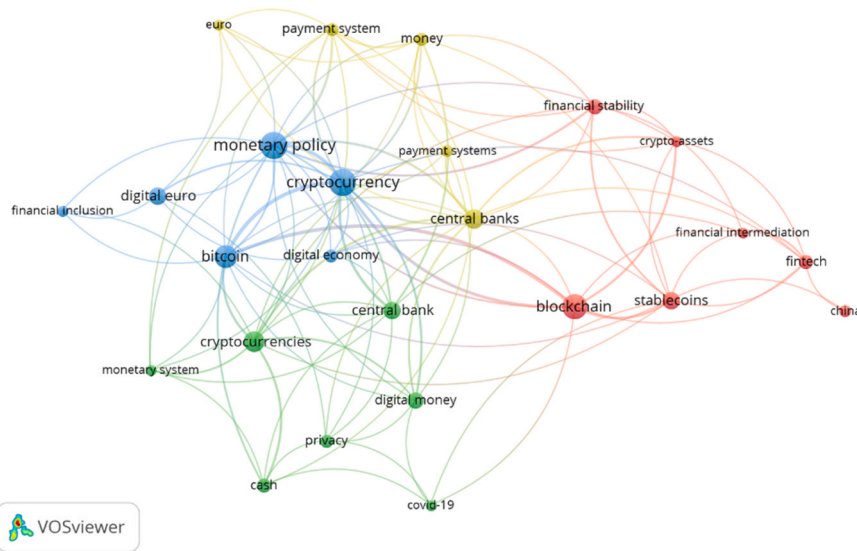


Fig. 7. Most frequent author keyword co-occurrences. (Source: own elaboration with VOS Viewer).

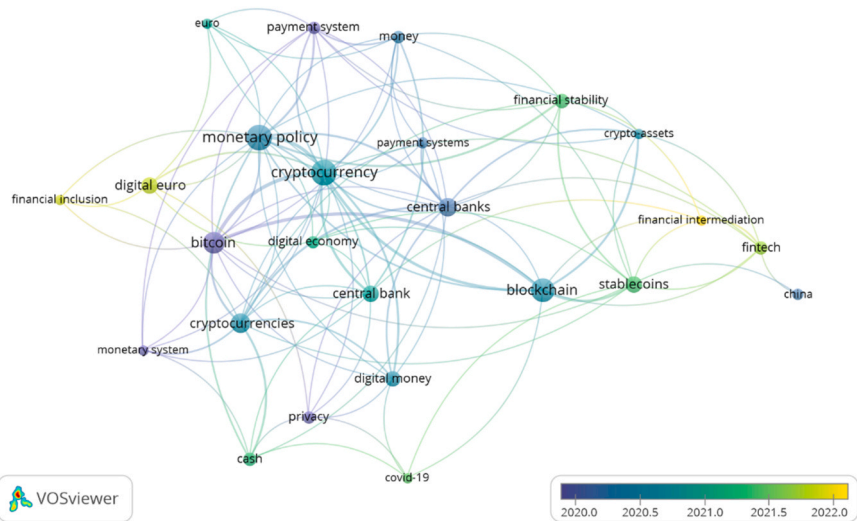


Fig. 8. Overlay visualization of the most frequent author keywords co-occurrences. Source: own elaboration with VOS Viewer.

Our study makes clear that the opportunity around digital currencies is fresh, but their future is uncertain. While Central Banks have several reasons for entering this space, their main motivation is competing with the so-called “stablecoins” by FinTech. Central Banks have expressed concerns about the possible consequences of these currencies achieving a significant role in the market, such as on the stability of bank deposits and the risk of bank loans (i.e., anti-money laundering). For instance, several authors in our sample analysed the opportunities and risks associated with the ECB issuing a digital Euro (Brunnermeier and Landau, 2022). First, the digital Euro could be used as a monetary policy tool if issued with interest rates. However, this would only be possible if the ECB could demonstrate that the interest rate of the new currency does not compete with commercial banks. Furthermore, a digital euro could support some of the Eurosystem’s objectives, such as maintaining the availability of optimal monetary items, improving cross-border payments, and allowing exchanges with other currency areas. A CBDC could also substantially reduce criminal risks, such as money laundering or frauds that are very common with the use of cryptocurrencies (Sapovadia, 2018). Finally, the risks associated with issuing a digital Euro were also considered. One of the main risks is the so-called bank disintermediation risk. This would occur in the event that the holders of commercial bank accounts find it more convenient to replace their deposits with the digital euro. One solution would be to introduce quantitative limits for different categories of customers and differentiated interest rates. Beyond the risk of banking disintermediation, the ECB would also be exposed to the possible risks of changes in the size and composition of the

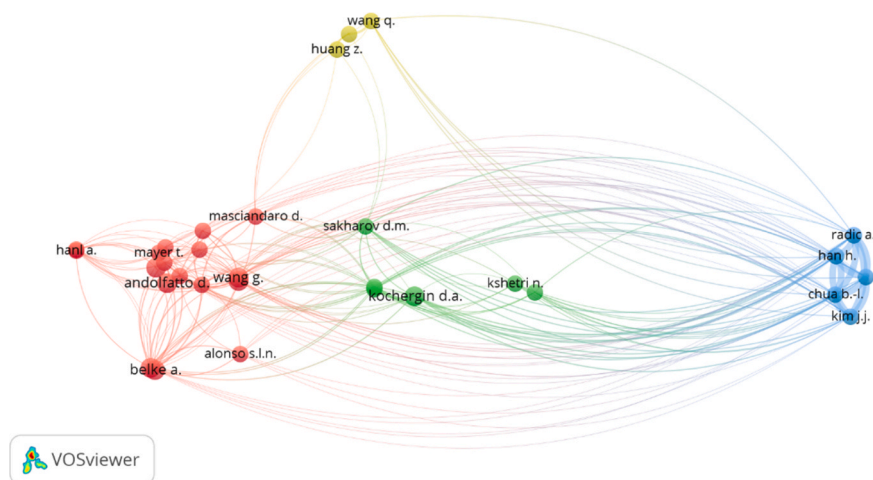


Fig. 9. Bibliographic coupling on authors.
(Source: own elaboration on VOS Viewer).

Eurosystem's balance sheet, as well as exposure to financial liabilities as an operator of a retail payment system. Furthermore, the digital Euro infrastructure could be vulnerable to cyber-attacks that carry financial and commercial repercussions.

Through our analysis of the literature, we identified four main strands:

1. **Digitisation and financial digital transformation:** This branch of literature focuses on the birth and adoption of innovative processes, as well as their effects on supply chain management and the business management of banks and financial institutions. One of the strand's most relevant studies is [Chen et al. \(2019\)](#), which argues that introducing technologies from non-financial sectors can have negative externalities, which can be mitigated by financial firms developing their own technologies. In this vein, it is important to understand how the financial sector can evolve according to its needs while adapting to the new economic environment. Moreover, it is relevant to include also the adaptation of such paradigms in everyday life, introducing customers to the use of CBDCs in retail transactions ([Radic et al., 2022](#)). This strand of literature also refers to the possibility of cybersecurity issues. Data leaks and digital frauds are among the most common criminal charges occurring in a technologically dense financial system ([Nathan and Smith, 2016](#)), jeopardizing the opportunity to build trust in such instruments ([Yousafzai et al., 2003](#)) and, by extension, the stability of the banks themselves ([Carbó-Valverde, 2017](#)).
2. **Digital currencies, bitcoin, and central banks:** This strand of studies primarily analyses the modalities of development ([Allen et al., 2020](#)), alongside the opportunities and threats in adopting and implementing these tools ([Barontini and Holden, 2019](#)). Specifically, these documents have examined the development and initial launches of CBDCs as Central Banks experiment with such systems, although a very little percentage of them has implemented a fully working system, and none of them is of a big economy. This element is in full accordance with [Minesso et al. \(2022\)](#) reporting of the effects of the domestic introduction of a CBDC in the open economy. Studies also discuss possible issues encountered in the implementation of instruments of monetary policy ([Ngo et al., 2023](#); [Rehman et al., 2023](#)). As highlighted by the reference, constructing such an instrument is difficult and delicate, as there are many regulatory issues that need to be ironed out regarding cryptocurrencies and their derivatives. Scholars are also focused on the effect of the issuance of CBDCs on blockchain and crypto assets market ([Mzoughi et al., 2022](#)), which unavoidably affects the configuration and the supervision of new payment systems ([Kuehnlenz et al., 2023](#)). In fact, this strand is also centrally concerned with the economic sustainability of "spending" digital money. After all, private fintech companies are openly competing on the digital currency market by creating virtual money that is reproduceable and not economically covered by a financial institution. This presents a risk similar to physical money counterfeiting, which necessitates the creation of institutions that can monitor issuance and spending rules ([Dwyer, 2015](#)).
3. **Finance and application of new technologies:** This third strand effectively bridges the first two. Indeed, these themes are profoundly connected with the implementation of not only products and services, but also organizational processes ([Vovk et al., 2021](#)). This strand also covers the collateral effects introducing such technologies, such as data protection and security issues ([Scarcella, 2021](#)), which are inevitably linked to technology acceptance and adoption ([Davis, 1989](#)). This strand emphasizes risk management aspects, with links to machine learning predictive models to prevent credit risks, volatility and a correct asset trade and management. The work in this strand illuminates the academic community's sensitivity to system stability ([Ciaian et al., 2016](#); [Baur et al., 2018](#)).
4. **Electronic money and blockchain:** This strand covers the technology underlying the implementation of electronic and digital payments ([Dyson et al., 2016](#); [Berentsen and Schär, 2018](#)). As mentioned before, blockchain is foundational to the creation and implementation of electronic money ([Chen et al., 2019](#)). Thus, many of the publications in this strand strictly focus on the blockchain and its acceptance in different industrial sectors; thus, they are more aware of technical and quantitative tools. Several authors also deal with themes related to privacy violation, corruption, bribery, and money laundering stemming from the use of blockchain technology ([Sat et al., 2016](#); [Jabbar et al., 2023](#)).

Our results illuminate some important considerations. First, although the topic of Digital Currencies has been in circulation for several years, it has only recently gained substantial traction thanks to digital tools and their revolutionary disruption of business and finance. Moreover, the COVID-19 pandemic notably contributed to the rise of electronic payments and money tools due to a dramatic reduction in physical interactions and transactions. This is absolutely in line with all leading institutions involved in the design process of such tools, as well as the mainly interested stakeholders in the field. Not surprisingly, most of the themes were developed in the last two years, more than what was done in the previous period, when the core themes related risks of digital evolution and IT systems were leading the chart. As the topics of digital evolution and IT systems have become more mainstream, research has branched out to hotter themes, some of which may be even more delicate and sector specific. Researchers are attempting to clarify the economic policies supported by CBDCs, but that is difficult to forecast. Further, there is a need to simulate the macroeconomic shocks in open economies that will result from having both physical and digital currencies (Bank of Italy, 2022).

Our work also highlights the strong territorial density of scholars and institutions. While digital currencies are already active in small countries, the world's biggest economies are proceeding more slowly. Thus, there are dozens of exploratory studies seeking to understand if digital currencies are a concrete opportunity or a far-off possibility. Case in point: The top ten most productive countries in our sample were G20 countries, indicating that the most powerful countries are aware of and concerned about the potential disruption of these technologies. Coupling that result with the higher concentration of single-country publications, it is clear that the world's biggest currency areas want to carefully assess the impact of this revolution in order to turn this innovation into a tangible opportunity.

This study provides some theoretical implications which may turn out to be useful either for policymakers or financial institutions. First, we comprehensively assessed the extant knowledge about the opportunities and threats implied by the creation and issuance of Central Bank Digital Currencies. We also verified the state of advancement for this disruptive innovation in different economies. Future research needs to assess experiences and best practices around the prospective introduction of a digital Euro, which would affect both domestic and international markets. It is pivotal that one of the world's largest and richest currency areas understand the consequences of this decision before a full rollout.

More broadly, researchers need to go deeper into some of these strands, such as performing quantitative analyses on the possible societal impact of CBDCs on markets and the resilience of the financial system. In this regard, larger countries should look at smaller economies to assess the impact of the introduction of CBDCs: although most of those states represents micro-economies in the world, some features may be assessed as good practices to be replicated. Moreover, there is room for academics to engage in more cross-border collaborations, which could expand knowledge about the possible obstacles and benefits of digital currencies. Furthermore, future research should address the new mixed monetary policies that derive from the extensive spread of CBDCs (Brunnermeier and Niepelt, 2019). The potential opportunity and risks are still poorly understood, especially in terms of financial markets and trade economy. Additionally, scholars need to assess how the introduction of digital currencies will affect everything, from consumption to asset management and volatility (Baur et al., 2018); there is also the issue of consumers' ongoing financial literacy related to cash and electronic payment methods. Finally, more work needs to be done on cybersecurity and fraud prevention in order to understand the pros and cons of digital fiat currencies (Dwyer, 2015; Tschorsch and Scheuermann, 2016; Jabbar et al., 2023).

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Data Availability

Data will be made available on request.

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