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Research Article

From Cash to Code: A Bibliometric Study on Digital Payment Systems, Electronic Money, and Fintech

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Abstract: Digital payment systems have become one of the main innovations in financial transformation. Over the past few years, these systems have gained significant traction and are now at the forefront of reshaping financial landscapes globally. Currently, digital payment systems have changed global transactions by slowly replacing the transaction patterns of societies that were previously dominated by conventional transactions, offering more efficiency, security, and accessibility. This transformation is closely related to the development of fintech, which has given rise to instruments in the form of electronic money and blockchain technology. These advancements have not only changed the way payments are made but also enabled the inclusion of previously underserved populations in the financial ecosystem. This study uses a bibliometric approach to analyze scientific publications, with the main sources coming from Scopus using the keywords "digital payment systems," "electronic money," and "fintech." By utilizing Biblioshiny in the VOSviewer application, this study aims to examine publication trends, contributions from various countries, institutions involved, and thematic connections between topics. In conclusion, this study contributes to expanding the understanding of the development of digital payment systems, while also presenting a global research map that can be used as a reference for academics, researchers, and policymakers involved in financial innovation.

Keywords: Bibliometric; Digital Payment Systems; Electronic Money; Financial Transformation; Fintech.

1. Introduction

The rapid development of digital technology over the last two decades has had profound implications for global economic activities, particularly in the field of financial transactions. In earlier decades, most societies were heavily reliant on conventional cash based transactions, which were not only slower but also limited by physical presence and geographic constraints. Today, digital platforms have reshaped this structure, providing realtime connectivity that enables individuals and businesses to exchange value instantly across borders. This transformation reflects a broader shift toward the principles of the Fourth Industrial Revolution, in which efficiency, automation, and interconnected systems define economic competitiveness. Digital payment systems are therefore not merely substitutes for cash, but strategic tools that underpin the integration of markets, enhance consumer experiences, and drive sustainable growth. As such, they have evolved into one of the most visible indicators of how digital technology continues to transform everyday life (Ponsree & Naruetharadhol, 2025).

One of the key breakthroughs within this transformation is the emergence of financial technology, or fintech, which combines innovation in technology and finance to create new mechanisms for payments, lending, and investment. Among the wide range of fintech solutions, electronic money has proven to be particularly transformative because it facilitates fast, secure, and lowcost transactions that can be accessed by a broad spectrum of the population. Unlike traditional banking systems, which often exclude lowerincome or rural communities, electronic money reduces entry barriers, thereby strengthening financial

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inclusion and enabling greater participation in the formal economy. This innovation has not only altered consumer habits but has also supported small and mediumsized enterprises (smes) in reaching wider markets through digital platforms. By acting as both a financial tool and a driver of broader economic participation, electronic money now serves as the backbone of the digital payment ecosystem and plays an increasingly important role in enhancing the resilience and competitiveness of national economies in the global arena (Del Sarto & Ozili, 2025).

The expansion of electronic money adoption was further accelerated by the COVID19 pandemic, which profoundly altered how societies interacted and conducted transactions. During this period, restrictions on physical movement, social distancing policies, and concerns about health risks from handling cash created a compelling need for contactless and remote payment solutions. As a result, consumers who were previously reluctant to adopt digital methods were compelled to shift, and businesses had to adapt rapidly to survive in a digital first environment. This shift was not only temporary but has left a lasting imprint on transaction behaviors worldwide. Digital payments became not just convenient but necessary, highlighting their crucial role in sustaining commerce, employment, and supply chains during times of crisis. Moreover, the pandemic emphasized the importance of resilient digital infrastructures that could support such sudden spikes in demand, pushing policymakers and financial institutions to invest heavily in strengthening the regulatory and technological frameworks underpinning electronic money systems (Bugár & Somogyvári, 2025).

At the same time, governments and central banks have been prompted to reassess their roles in an increasingly digitalized financial ecosystem. The widespread adoption of electronic money has required them to craft regulatory frameworks that balance innovation with consumer protection and financial stability. Many countries have responded by introducing guidelines that regulate electronic money providers, establish standards for cybersecurity, and safeguard user data privacy. These initiatives reflect a recognition that electronic money has become a fundamental component of the financial system, and as such, requires robust oversight. However, while regulation provides assurance to users and prevents misuse, it must also remain flexible enough to accommodate ongoing innovation. The challenge for regulators is therefore to create environments that encourage the growth of electronic money while preventing systemic risks and ensuring equal access across diverse socioeconomic groups. This balance will continue to shape the trajectory of electronic money adoption in the coming decades.

Nevertheless, the growth of electronic money also brings to the surface a set of challenges that cannot be overlooked. Access disparities remain a pressing concern, as many communities, especially in rural or underdeveloped areas, lack the infrastructure needed to fully engage with digital payment systems. The digital divide, characterized by unequal access to the internet, smartphones, or digital literacy, risks excluding vulnerable groups from the benefits of financial technology. Additionally, concerns over cybersecurity, fraud, and misuse of data have raised questions about trust in electronic money platforms, particularly as financial activities move increasingly online. These risks illustrate that while electronic money holds the promise of inclusion and efficiency, it also introduces vulnerabilities that could undermine its longterm potential. As a result, addressing these barriers is essential to ensure that the digital payment revolution does not exacerbate inequalities but instead contributes to inclusive and sustainable development.

Alongside these realworld developments, academic interest in electronic money and digital payment systems has grown substantially. Scholars from various disciplines, including economics, finance, business studies, and information systems, have examined the multifaceted implications of this transformation. Research has covered diverse aspects, from consumer behavior and adoption models to regulatory frameworks and crosscountry comparisons of implementation success. However, despite this proliferation of studies, the literature often remains fragmented, lacking comprehensive integration across themes and regions. For instance, while some studies focus narrowly on technological efficiency, others examine broader socioeconomic impacts, yet few link these perspectives together. This fragmentation makes it difficult for policymakers and practitioners to obtain a holistic view of how electronic money is evolving globally and how it intersects with broader issues of economic growth, inclusion, and resilience (Bhatt et al., 2025).

Bibliometric analysis therefore emerges as a particularly valuable tool for addressing this gap. Unlike traditional reviews that often rely on selective narrative synthesis, bibliometric methods use quantitative approaches to systematically examine the structure of academic research. This includes analyzing publication patterns, mapping collaborations among authors and institutions, and identifying emerging thematic clusters through keyword cooccurrence. By applying these techniques, scholars can generate objective insights into how the field of electronic money research has evolved over time, which areas have received the most attention, and which remain underexplored. Such a datadriven overview not only enhances academic understanding but also serves as a foundation for guiding future research agendas, particularly in fields where rapid technological change continues to reshape priorities and challenges.

Accordingly, this study aims to undertake a bibliometric analysis of global research on digital payment systems, with a specific emphasis on electronic money. By collecting and analyzing data from Scopus covering the period 2006 to 2025, the study will map trends in publication output, identify the most influential journals and authors, and highlight the countries that have made key contributions to the field. Furthermore, keyword analysis will be used to trace the evolution of thematic focuses, thereby illustrating how academic discourse around electronic money has shifted in response to technological and societal developments. Through this comprehensive mapping, the study will uncover not only historical patterns but also provide a sense of the emerging frontiers in electronic money research, offering a valuable resource for both scholars and practitioners.

Ultimately, the expected contribution of this study is twofold. First, it seeks to provide academics with a detailed overview of the intellectual structure of electronic money research, clarifying how the field has developed and where it is heading. This will allow researchers to situate their own work within broader scholarly debates and identify opportunities for crossdisciplinary collaboration. Second, it offers practical implications for policymakers, regulators, and financial industry stakeholders by highlighting global trends and thematic priorities that can inform strategic decisionmaking. By bridging the gap between research and practice, the study underscores the critical role of electronic money not only as a technological innovation but also as a socioeconomic force that drives inclusion, competitiveness, and resilience in the digital era.

2. Preliminaries or Related Work or Literature Review

The development of digital payment in recent years has shown a very positive trend, both globally and nationally (Pradiatiningtyas et al., 2020). This growth is driven by society's demand for a transaction system that is faster, safer, and more efficient compared to conventional cash-based methods. Digital payment is considered capable of reducing barriers in transaction processes as it is no longer limited by distance or time. In addition, the advancement of internet technology and smartphones has become a major driving factor that makes digital payment increasingly accessible to various segments of society. This reinforces the notion that digital payment plays an important role in encouraging the transition toward a cashless society. It also proves that financial technology has made a tangible contribution to changes in consumer behavior in conducting transactions.

Furthermore, Diah argues that the advantages of digital payment lie in the speed and convenience it offers to its users. Unlike cash transactions that require physical meetings or traditional bank transactions that tend to be time consuming, digital payment can complete payments within seconds. This convenience directly impacts user satisfaction and transaction cost efficiency. In addition, many digital payment applications now provide features that allow users to record and monitor their expenses more transparently. Thus, people not only gain convenience in conducting transactions but are also assisted in managing their personal finances.

In addition to speed and convenience, security factors have also become a reason why digital payment has grown rapidly. The use of data encryption, two factor authentication, and protections from service providers have enhanced consumer confidence in digital transactions. Many studies show that security perception greatly influences an individual's intention to continue using digital payment services. The higher the trust in the system's security, the stronger the user loyalty toward the application. This explains why digital

payment providers continue to invest in improving security technology. Assured security eventually becomes one of the main attractions for consumers.

However, behind this positive development, digital payment still faces complex challenges. One of the biggest challenges is the accessibility gap, often referred to as the digital divide (Hellemans et al., 2023). Not all people own smartphones, have stable internet access, or possess sufficient digital literacy to use digital payment services. This condition causes the benefits of digital payment to be unevenly distributed, especially among people in remote areas or low-income groups. Therefore, the development of digital payment must be accompanied by efforts from both the government and service providers to expand access to technology.

Another challenge relates to consumer protection. Although digital payment offers many advantages, risks such as data theft, online fraud, and identity misuse still frequently occur (Mahardika, 2025). Regulations that have not fully adapted to technological developments also increase the potential losses for consumers. Several studies emphasize that consumer protection is a critical aspect that must be addressed to strengthen public trust in using digital payment. Service providers must be transparent about privacy policies and provide effective complaint mechanisms for their users. Without strong consumer protection, the sustainability of digital payment adoption could be hindered.

Beyond consumer protection, balanced regulation is also an important factor in the development of digital payment. Regulations must be able to accommodate technological innovation without compromising the stability of the financial system. Governments and monetary authorities are required to design policies that support innovation while preventing harmful practices against consumers. With appropriate regulations, service providers can innovate more easily, while society continues to feel secure in conducting transactions. This indicates that technological progress must move in line with adaptive and responsive public policies.

Ultimately, the development of digital payment reflects the dynamic interaction between technology, consumer behavior, and government policy. The rapid and positive growth demonstrates that society is increasingly accepting this modern payment system. However, the challenges that arise must not be ignored, as they have the potential to create inequalities in access and trust issues. Digital literacy, regulation, and consumer protection are key factors to ensure that the development of digital payment truly benefits all segments of society. By considering both sides, namely development and challenges, digital payment can continue to grow sustainably and support the broader transformation of the digital economy in the future.

3. Proposed Method

The methodological approach adopted in this study is structured into three main phases to ensure the reliability and comprehensiveness of the analysis. Phase 1, or the data collection phase, began with the definition of precise search criteria aimed at identifying relevant bibliographic records related to digital payment systems. The search was conducted using the Scopus database because of its wide coverage of highquality journals and articles. The time span selected for this study ranged from 2006 to 2025 to capture the evolution and longterm development of the field. Only specific document types such as journal articles, reviews, and conference papers were included to ensure academic rigor. Keywords such as "digital payment systems" were applied to titles, abstracts, and keyword sections to refine the search scope. To enhance accuracy, the dataset was further cleaned by removing duplicates and unrelated records. This structured approach provided a strong foundation for the subsequent phases of analysis.

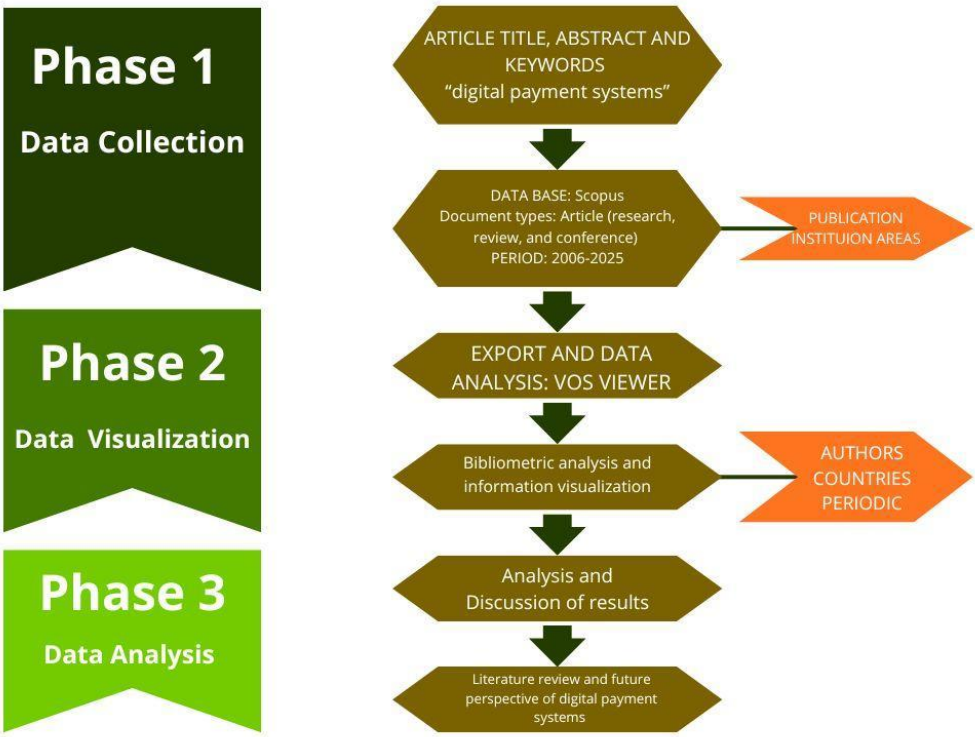

Figure 1. Methodology phases applied to the present work.

Phase 2 of the methodology involved the visualization of bibliometric data using the software tool Vosviewer. The refined bibliographic data extracted from Scopus were first exported in CSV format to enable compatibility with Vosviewer. Vosviewer was chosen for its robust capacity in handling large bibliometric datasets and its ability to generate intuitive visual maps of research trends. The tool allowed the mapping of cooccurrence networks among keywords, the identification of coauthorship relations, and the clustering of research themes. The bibliometric analysis extended across multiple dimensions, including authors, publication years, affiliated institutions, countries of origin, journals, and research subject areas. These visualizations helped to illustrate the interconnections and growth dynamics in the field of digital payment systems. Moreover, the use of Vosviewer enabled the identification of thematic hotspots where research activities were concentrated. This process made it possible to recognize not only prominent topics but also emerging areas within the literature.

The data visualization phase also relied heavily on descriptive statistics to complement the bibliometric maps. Microsoft Excel was used to process the raw Scopus data and produce charts representing annual publication growth, the number of publications per author, and the distribution of journals contributing to the field. This quantitative perspective provided baseline insights into the publication trends and the level of academic interest in digital payment systems over time. Descriptive statistics also allowed for the comparison of publication volumes across different periods, highlighting years in which there was a significant increase in scholarly attention. When combined with Vosviewer visualizations, these descriptive measures contributed to a more comprehensive picture of the digital payment research landscape. The integration of these tools thus enhanced both the depth and breadth of analysis. Together, they provided a systematic framework for evaluating not only the growth of publications but also the intellectual structure of the research field.

Phase 3 of the methodological process was dedicated to data interpretation and analysis. At this stage, the bibliometric maps and descriptive outputs were carefully examined to identify major research themes, clusters, and trends within the literature. The thematic clusters revealed patterns of focus in digital payment research, such as consumer behavior, security, regulatory frameworks, and technological innovation. Trends were analyzed over time to understand how the field has evolved, including the emergence of new research priorities like blockchainbased payment solutions or financial inclusion. This phase also

involved the comparison of international contributions, highlighting countries that dominate research output and collaborations between institutions. By analyzing these findings, the study was able to reveal not only the direction of current research but also potential gaps that could inform future investigations. The interpretation thus acted as a bridge between raw data and meaningful scholarly insights.

In summary, the methodology of this study reflects a comprehensive bibliometric approach that integrates systematic data collection, visualization, and interpretation. Phase 1 established a robust dataset through welldefined search criteria and careful refinement of Scopus records. Phase 2 leveraged both Vosviewer and descriptive statistics to visualize research dynamics and trends in the digital payment domain. Phase 3 provided an analytical lens through which bibliometric patterns were interpreted to derive insights into the evolution and thematic priorities of the field. By combining quantitative and visual analyses, the methodology ensured both rigor and clarity in identifying the intellectual structure of digital payment research. The use of widely recognized tools such as Scopus, Vosviewer, and Excel increased the credibility and replicability of the study. Ultimately, this multiphased approach enabled the identification of research gaps, mapped scholarly contributions, and suggested future perspectives for digital payment systems. This methodological rigor serves as the backbone of the study's findings and discussion.

4. Results and Discussion

The figure below provides key information related to published research from 2006 to 2025. This data covers 1,315 sources with a total of 4,154 documents, with an average publication rate of 13.47% per year. This analysis involves 17,535 different authors, with only 3 single authors. A total of 18.54% of publications involved international authors, with an average of 9.45 authors per document.

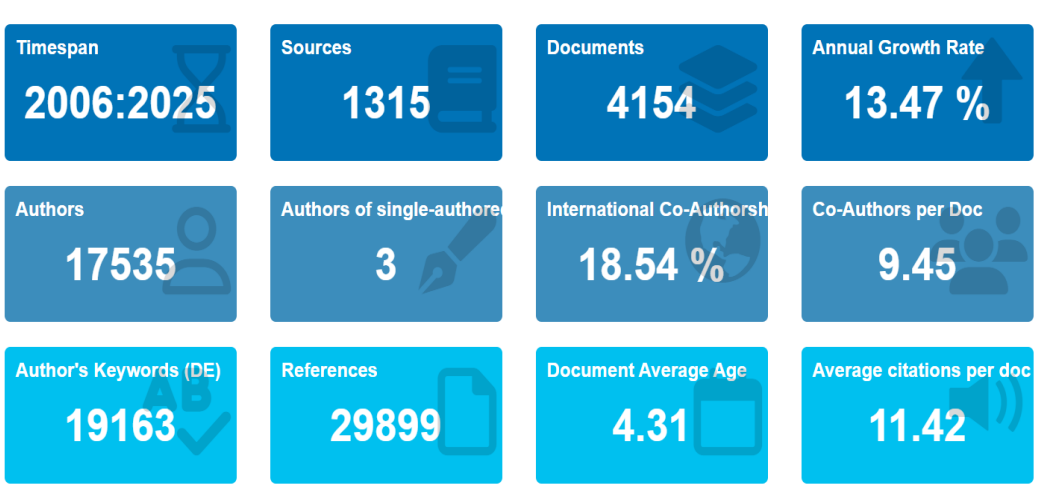

Figure 2. Main information overview (using R Studio).

In addition, the dataset recorded 19,163 keywords and 29,899 references used. The publications analyzed are relatively recent, with an average age of 4.31 years, while their level of influence is reflected in an average of 11.42 citations per document. This data illustrates that research in this field is developing rapidly, is collaborative in nature, and has significant academic relevance.

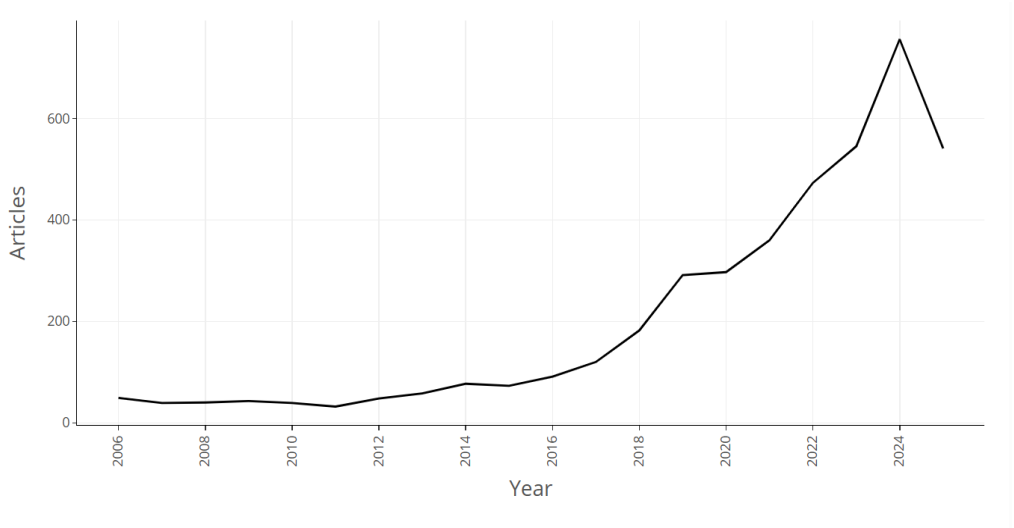

Figure 3. Annual Scientific Production (using R Studio).

The figure above shows a graph of the number of scientific articles published each year from 2006 to 2025. In the early period (20062012), the number of publications was relatively low, with an average of less than 100 publications per year. During this period, publications were still limited because digital payment technology had only just been introduced and academic literature had not yet developed widely. Entering 2013, there was an increase in the number of publications, which then experienced a sharp surge in 2018. This increase was in line with the growing popularity of emoney, mobile banking, and the emergence of fintech companies that encouraged research interest. This trend continued to grow, peaking in 2024 with more than 700 articles published. This significant surge was triggered by the massive adoption of applicationbased payment technology, supportive regulatory policies, and the acceleration of digitalization due to the COVID19 pandemic, which encouraged the shift from cash to digital transactions.

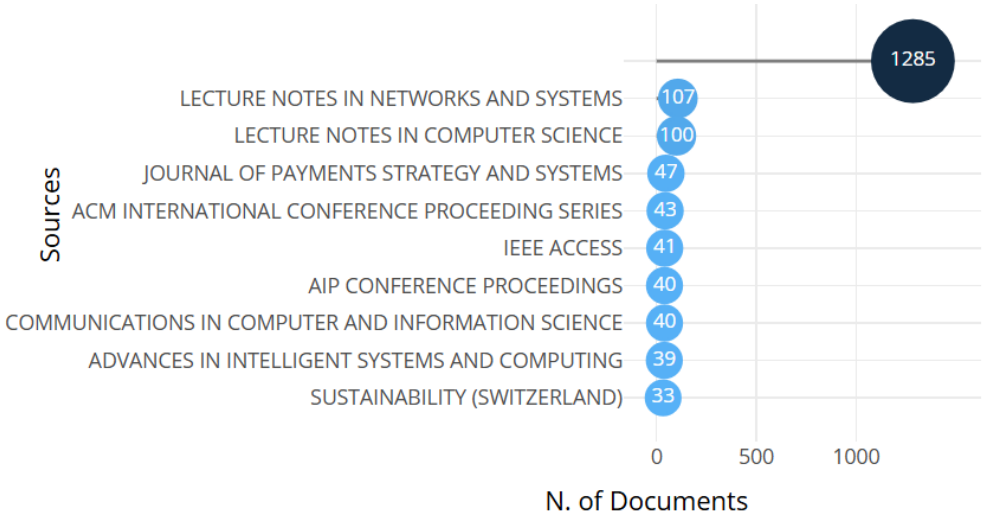

Figure 4. Most Relevant Sources (using R Studio).

The image above is a bar chart showing the most relevant scientific publication sources, sorted by the number of documents contributed. The Yaxis shows the document source and the Xaxis shows the number of documents displayed. The top source is Lecture Notes in Networks and Systems with a total of 107 documents. Then there is Lecture Note in Computer Science in second place with 100 documents. Other sources such as Journal of Payments Strategy and System, ACM International IEEE access have less than 50 documents.

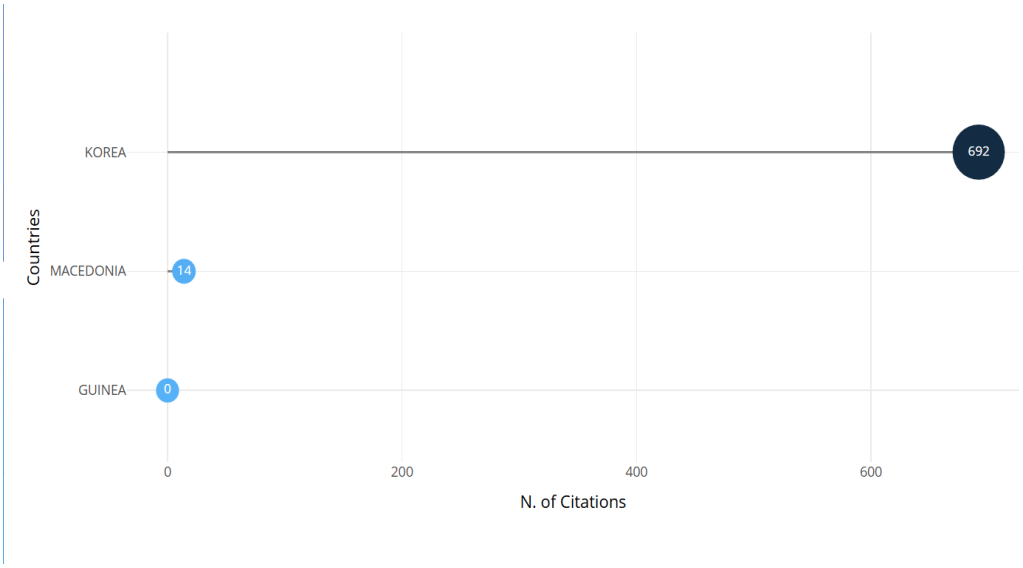

Figure 5. Most Cited Countries (using R Studio).

This image is a bar chart that shows how often different countries were mentioned or cited. Korea is the country that was cited the most, with 692 citations, followed by Macedonia as the country with the second most citations, with 14 citations. Each country is represented by a bubble, and the bigger the bubble, the more citations that country has received. The chart helps show which countries are cited the most in a simple, visual way.

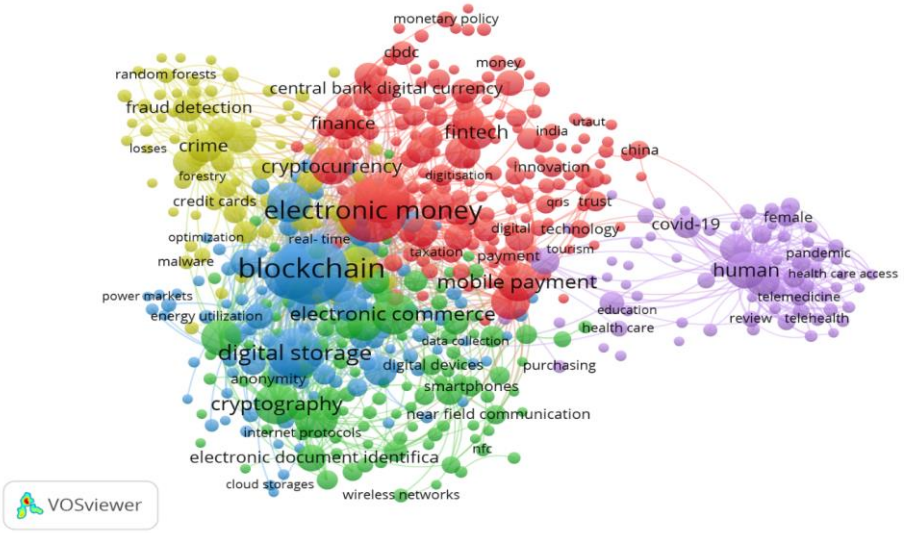

Figure 6. Network Visualization (using Vos Viewer).

The image is a network map of cooccurrence or word network that illustrates key terms connected by lines to show their relationships, with different colors representing distinct thematic clusters. The blue cluster highlights topics such as "blockchain," "electronic commerce," and "cryptocurrency," reflecting research on digital transactions. The green cluster focuses on "digital storage," "cryptography," and "electronic document identification," linked to security and data management. The red cluster includes "fintech," "finance," and "central bank digital currency," pointing to financial technology and monetary policy. Meanwhile, the yellow cluster features "fraud detection," "crime," and "credit cards," emphasizing security and fraud prevention, and the purple cluster connects terms like "human," "covid19," and "health care access," showing intersections with health studies. This visualization demonstrates how research on digital finance and technology is interconnected across multiple domains.

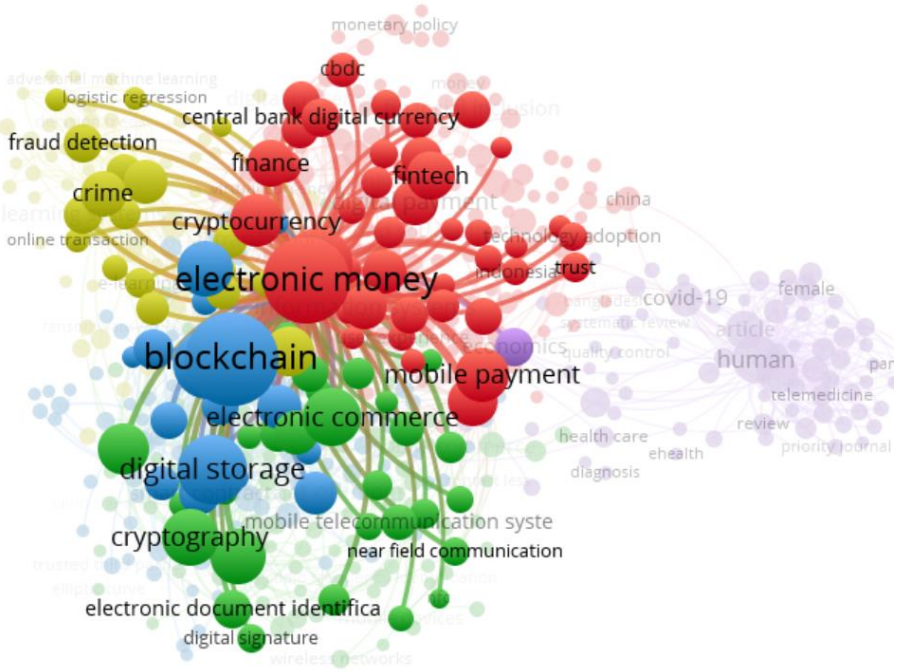

Figure 7. Network Visualization of Term Electronic Money (using Vos Viewer)

The image is a detailed cooccurrence network map used to visualize the relationships between different key terms or concepts in the field of digital finance and technology. The network consists of nodes representing terms and edges that indicate how often these terms appear together in research. The map is colorcoded into several clusters, showing distinct but interconnected themes. The central node is electronic money, represented by a large red node at the core of the map, highlighting its dominant role in this research area. Closely related terms include fintech, mobile payment, finance, and central bank digital currency, which frequently cooccur and suggest that much of the discussion revolves around innovations in payment systems and financial technology. Surrounding clusters connect to blockchain, cryptocurrency, and digital storage, emphasizing the strong links between electronic money, security, and technological infrastructure. This visualization demonstrates that electronic money serves as the focal point of research, bridging topics from digital payments and financial systems to data security and fraud detection.

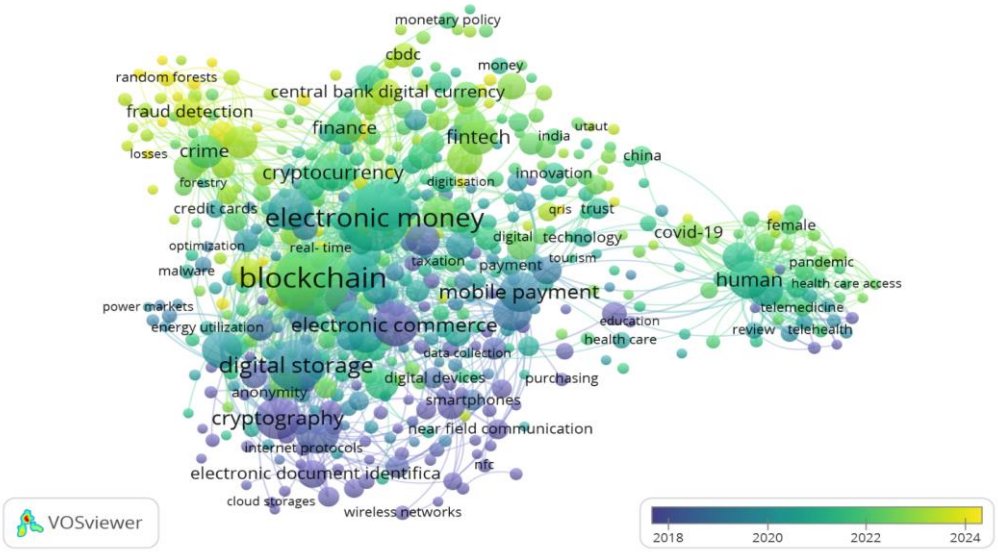

Figure 8. Overlay Visualization of Term Electronic Money (using Vos Viewer)

Overlay visualization used in bibliometric, typically generated using VOSviewer. The network of electronic money in the image maps out a set of terms or concepts commonly found in academic research related to digital finance, payment systems, and financial technology. Each node (circle) represents a keyword, term, or concept, with larger nodes representing those that appear more frequently in the dataset. The edges (lines) connecting the nodes represent relationships or cooccurrences between the terms. The thicker and more numerous the edges, the stronger or more frequent the connection between the terms. The color of the nodes indicates the recency of the research or publication in which the terms were most prominent. The color bar at the bottom right provides a timeline, ranging from 2018 (purple) to 2024 (yellow). Darker shades (blue/purple) represent older topics, while lighter shades (green/yellow) represent more recent developments.

Terms like "blockchain," "cryptocurrency," and "digital storage" appear in darker colors, showing that these themes have been present in earlier stages of research. In contrast, lightercolored nodes such as "fintech," "central bank digital currency," and "mobile payment" indicate emerging areas of focus in more recent years. The clusters formed by the nodes represent distinct thematic areas of research. The central cluster includes terms like "electronic money," "finance," "cryptocurrency," and "mobile payment," showing that research has revolved around innovations in digital transactions and financial systems. Another significant cluster, formed around "fraud detection" and "crime," reflects the growing attention to risks and security challenges. Smaller clusters connect to technological infrastructure, including "cryptography," "digital storage," and "electronic document identification," indicating the supporting role of security and data management in the development of electronic money.

The connections between nodes show how various research topics are interlinked. For example, "electronic money" is highly connected to terms such as "blockchain," "fintech," and "mobile payment," suggesting a strong body of work that examines the evolution of digital financial ecosystems. Similarly, "fraud detection" is linked with "credit cards" and "crime," reflecting the ongoing concern with security in digital payment systems. In summary, this overlay visualization provides a comprehensive view of the evolution of research on electronic money, showing both the temporal trends of emerging topics and the interconnected nature of themes spanning finance, technology, and security.

5. Conclusions

This study demonstrates that research on digital payment systems, electronic money, and fintech has expanded rapidly over the past two decades, driven by continuous technological innovation, evolving regulatory frameworks, and significant shifts in consumer behavior and expectations. The bibliometric analysis conducted provides a comprehensive overview of the growth patterns in scholarly publications, highlighting not only the increasing volume of research but also the collaborative and interdisciplinary nature of contributions from multiple countries, institutions, and authors. Key findings reveal that digital payment research is increasingly concentrated around emerging topics such as blockchain technologies, central bank digital currencies, mobile payment systems, and fraud detection mechanisms, reflecting the dynamic and evolving priorities in the digital finance ecosystem. At the same time, persistent concerns regarding financial inclusion, cybersecurity, data privacy, and regulatory compliance underscore the ongoing challenges that accompany the rapid adoption of electronic money worldwide. By mapping global contributions, identifying influential journals, authors, and thematic clusters, this study offers valuable insights into both the intellectual structure and the temporal evolution of the field. These insights not only inform academics about existing research gaps and opportunities for crossdisciplinary collaboration but also provide policymakers and industry stakeholders with a clearer understanding of global trends, emerging innovations, and potential areas for strategic intervention. Overall, this study serves as a critical reference point, illustrating how electronic money and digital payment systems are reshaping financial landscapes, promoting inclusion, and driving sustainable growth, while simultaneously highlighting the need for adaptive regulation, secure technological infrastructures, and targeted research to support the ongoing transformation of the global digital payment ecosystem.

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(Placeholder for e-money specific coverage) — One could consider: "A Bibliometric Analysis of Digital Payment in Indonesian MSMEs" (year unspecified) which analyses 747 articles in Google Scholar from 2014–… Retrieved from https://scispace.com/pdf/bibliometric-analysis-of-digital-payment-in-indonesian-msmes-35hgbrokjc.pdf?utm_source=chatgpt.com