

CHARTING THE AI REVOLUTION IN BANKING: A BIBLIOMETRIC STUDY OF EMERGING THEMES AND FUTURE DIRECTIONS (2018–2025)

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Abstract

This paper brings together a changing research landscape of artificial intelligence (AI), Internet of things (IoT) and big data within banking industry from the year 2018 to 2025 through a bibliometric analysis. The study utilized Biblioshiny for the research output from Scopus, analysing the body's document type, metrics, author names, contributions to themes, cites and suggests future research gaps (particularly fraud detection, risk modelling and customer engagements). AI is still a strong theme, but networks of sectors will begin growing and ethics is still a sub-theme. The geographic analysis shows that India leads in research work but still there is limited impact of citations. The study offers conceptual research possibilities for futures research around cross-border AI research, ethical applications of AI applications in banking, integration with IoT, associated regulation and developing innovative platforms to build sustainable practices around AI-impacted financial services.

Keywords: *Artificial Intelligence, Internet of Things (IoT), Blockchain, Big Data Analytics, Sustainable Finance*

1. INTRODUCTION

The global financial ecosystem is in an unprecedented state of change now more than ever, supported by faster acceleration and fusion of emerging technologies such as Artificial Intelligence (AI), the Internet of Things (IoT), Blockchain and Big Data Analytics. Recent FinTech scholarship increasingly frames this transformation as a convergence-driven phenomenon, where Artificial Intelligence, Big Data Analytics, and digital platform architectures jointly redefine banking value creation, competition, and regulatory oversight (Gomber et al., 2022; Vives & Ye, 2025). The emerging technologies play an indispensable role as accelerators of decisions, operational efficiencies, cost reductions, enhanced customer value, innovation and even sustainability in banking and financials in general (Zhang & Tao, 2020; Vives & Ye, 2025). This convergence of technological

capabilities is changing the practical operational parameters of traditional banking which is ultimately changing the broader trajectory of financial services in the global economy (Jain, 2023). In this way, it is necessary to comprehend the theories and practices of these technologies to understand their relevance and impact on banking sector in the modern age.

Artificial Intelligence (AI), defined as machines' ability to perform intelligent behaviour of humans — primarily learning, reasoning and self-correcting from data — can be a game-changer in financial services (Jain, 2023). Artificial Intelligence-based algorithms can improve decision-making at greater speed and with higher accuracy by using historical and real-time data feeds, thus, enhancing service and operational resilience (Luger, 2002; Galazova & Magomaeva, 2019). Empirical evidence from recent banking studies shows that AI-enabled decision systems embedded within FinTech infrastructures are no longer experimental but are becoming core components of credit evaluation, compliance automation, and customer analytics (Begenau et al., 2023). At the same time, the Internet of Things (IoT)—the constellation of devices communicating with one another (and with us)—has made its way into practical applications in banking. While IoT has been primarily implicated in industrial and consumer use cases, IoT in banking enables enhanced layers of security and customization, partly made possible by the geolocation data and transactional behaviour identified by IoT devices (Vives & Ye, 2025).

Big Data Analytics is a Digital Banking Transformation based on the ability to process and analyze extremely large data sets which traditional systems struggle way not anyway. Banks are using Big Data technologies now more than ever to understand customer behaviors, risk profiles, and emerging trends in the marketplace (Gillis, 2019). Using predictive analytics, banks can also develop targeted marketing agendas, customize financial products, and create proactive risk management strategies, thereby enhancing their competitive advantage (Vijai, 2019).

1.1 NEED & SIGNIFICANCE OF THE STUDY

The convergence of Artificial Intelligence (AI), Internet of Things (IoT), and Big Data Analytics is transforming the global banking industry. As stated in a McKinsey report, AI technologies were expected to create up to \$1 trillion of annual incremental value to global banking by improving risk management, customer engagement, and automating repetitive tasks (Bughin et al., 2018). The International Data Corporation (IDC) anticipates that global spending on AI in banking will grow to \$97.9 billion by 2027, reflecting a compound annual growth rate of 29.8% (IDC, 2023). Consequently, there is substantial need to know how research in this area is evolving, given the scale of the economic and strategic significance for banks.

While this area is growing rapidly, the literature covers this broad area heterogeneously. Most studies concentrate on much more narrow applications such as fraud detection and chatbots (Jakšič & Marinč,

2019; Banerjee et al., 2022), and most studies do not systematically examine the overall thematic development and trends of AI, IoT, and Big Data in banking. Borrowing from bibliometric analysis and mapping, researchers can gain an evidence-based assessment of the intellectual landscape by continuously mapping research productivity, co-citation patterns, and the thematic structures of publications (Donthu et al., 2021; Zupic & Čater).

By providing a holistic and longitudinal perspective on research activity across the years 2018 to 2025, this study is important. For example, India has been a major contributor in the total number of publications in AI-finance research, albeit lower average citation impact than other countries like Spain and Slovenia (Gupta, Chugh, & Mahajan, 2025). Such results are vital for academics and practitioners as they illustrate where research attention has concentrated, where gaps are now obvious in the research base - ethics, governance, regulatory compliance - and where opportunities for cross-border collaborations and innovations exist (Gallego-Gomez & De-Pablos-Heredero, 2020; Goyal & Kumar, 2021). This work thus contributes to building a responsible and sustainable pathway forward for the adoption of AI in global banking.

1.2 WHY THE BANKING SECTOR ?

This study specifically emphasizes the banking industry due to its oppositional position and because it is one of the earliest and most utilized adoptors of Artificial Intelligence, Internet of Things, and Big Data Analytics. While global banking daily captures and generates a massive amount of structured (e.g. transaction histories) and unstructured data (e.g. customer behavioral patterns), the intelligent technologies with extensive experience using it are ready in quite possibly one of the best ground to deploy and effectively utilize the intelligent technologies (Jakšič & Marinč, 2019). The World Bank states that the financial services sector worldwide processes more than \$5.4 trillion dollars of transactions every day. Given that billion-dollar transactions occur every minute, operational capacity, efficiency, customer relations, accuracy, and security are critical in every aspect of the modern world (World Bank, 2022).

Banks have also been some of the largest investors in AI. Business Insider reports estimates that AI applications may have helped banks realize \$447 billion in potential cost savings and new streams of revenue by 2023 (Insider Intelligence, 2020). Likewise, engaging innovation—like chatbots, robo-advisors, and biometric authentication—have demonstrated significant process efficiencies and reduced fraud (Vijai, 2019). Banking is a particularly rich setting for studying AI due to challenges surrounding regulation and ethics, as banks' clients' financial data is especially sensitive, and there are systemic risks associated with algorithmic decision-making (Gallego-Gomez & De-Pablos-Heredero, 2020).

Therefore, focusing on the banking industry both allows us to examine a context that varies across

high levels of technological experimentation and economic importance, and is high in regulatory scrutiny, making banking an important test area for understanding emerging AI-supported digital transformation of financial services in a global environment.

1.3 WHY THE PERIOD OF 2018-2025 IS CHOSEN?

The years 2018–2025 provide the best coverage of the most recent and significant wave of technology in banking; around 2018, AI and Big Data applications in financial services started to shift from conversations about innovation to operationalizing that innovation, and coincided with the emergence of fintech ecosystem and neobank models (Jakšič & Marinč, 2019; Jain, 2023). If we set parameters for the review of the material to contemporary years, it ensures the analysis captures the rapid pace of change, regulatory discussions, and cross-sectoral synthesizing of actors common to this current phase of digital transformation in banking. The decision to cover to 2025 means we could capture the most up to date publications and assessments of thematic trends related to the transformative potential of AI, IoT, and Big Data for the banking and financial services sector (e.g., Vives & Ye, 2025; Donthu et al., 2021).

2. RESEARCH GAPS & QUESTIONS

While the number of studies that document the promising opportunities that AI, IoT and Big Data present is continuing to grow while the gaps in the literature remain the intact. The literature that examines limited dimensions of technology (fraud detection, customer service automation) is ubiquitous; however, literature that examines the interaction of technology is limited. The understanding of the extent to which technology is changing the operating model of traditional banks, as well as the operating model of an AI first neobank is not yet explored by academicians and researchers. There is little comparative literature on operational efficiency and ways of innovation with legacy banks and neobanks (Banerjee et al, 2022; Dehnert, 2020).

Additionally, bibliometric analysis as a research methodology has the potential to be highly effective at mapping up an intellectual structure, the evolution of themes and knowledge gaps in AI-finance research (Goyal & Kumar, 2021; Hua et al, 2019). Most studies are either based on a case study approach or qualitative review without documenting longitudinal changes in research trends and knowledge gaps.

There is still a great deal of unexplored groundwork in relation to ethical governance, algorithmic fairness, compliance with regulation and the changing nature of the role of IoT in banking (Jain, 2023; Gallego-Gomez & De-Pablos-Heredero, 2020). The same can be said about IoT, a lot of its features related to banking security enhancement and improvement to banking security earlier on in the customer journey and more value is created from an organization placing charges on IoT to deliver real-time analytics in the financial services space, only a limited amount of research has examined it

The word cloud in Figure 1 generated from Biblioshiny clearly presents the most prominent terms in the data set, providing an overview of the most substantial terms with "artificial intelligence" taking the largest area and font size relating to its spatial and typological position on the cloud thereby reaffirming its conceptual importance. Other terms relative to the saliency of "artificial intelligence" included terms such as "fintech", "banking", "finance" and "machine-learning", which are provided meaning through their lexical prominence in relation to "artificial intelligence" and their relationship to each other as themes in the growing conversation in the literature. This visualization also showcases the underlying co-word structure by highlighting terms occurring together frequently, while simultaneously providing an intuitive snapshot of the intellectual geography of the field related to the science mapping rationale articulated by Cobo et al. (2011)

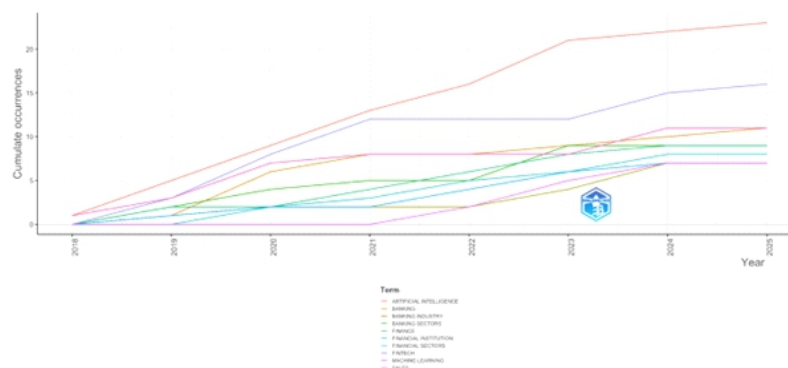


Figure 2. Keyword growth over time from 2018 - 2025. Each line represents a keyword such as Artificial Intelligence, Banking, Finance, Machine Learning, Sales etc. (Source: Biblioshiny using data from Scopus)

The chronological emergence of the keyword frequencies, provided in the Figure 2 illustrates an evolving pattern of growth in the areas of focus in the AI-fintech research corpus over the period from the year 2018 to 2025. "Artificial intelligence" shows the most pronounced and consistent upward growth, increasing from a single reference in 2018 to 23 by 2025, indicating the strengthening and orienting centrality of the field as the conceptual anchor. The rapid increase indicates an intensifying consolidation and trend of incorporation of AI across various aspects of both financial innovation and academic research.

"Fintech," likewise, showcases a similarly positive and upwardly sloped growth trajectory. Increasing from 3 references in 2019 to 16 by 2025 indicates an ongoing relevance of the domain to which various applications of AI are being understood. "Banking," "sales" and "finance" exhibit and increased frequency of mentions characterized by stable and moderate growth. Increased frequency suggests an increased refinement of research focus as scholars moved from conceptual discussions to the applied

area of inquiry; and explorations of actual customer engagement and organizational finance and institutional vectors of finance. The noteworthy is the increase and emergence of "machine-learning" which did not emerge in the literature until 2022 and rapidly moved toward a frequency of 7 references by 2025. This may suggest an emerging growth trajectory toward interest in specific artificial intelligence tools as operational and analytical devices.

The thematic growth of domain-specific constructs like "banking sectors," "financial institution," "banking industry" and "financial sectors" illustrates their gradual, but consistent emergence and growth reflective of a growing research agenda that increasingly unbundles financial infrastructures and studies their AI-associated changes. Their simultaneous growth also indicates converging institutional, technological and sectoral narratives which aligns with bibliometric readings that associate term co-growth with changing thematic dependencies (Donthu et al., 2021; Cobo et al., 2011). Taken together, the keyword growth trajectories highlight both the deepening and a broadening of the intellectual structure of AI-related financial research, serving as an indicator of a field that is experiencing dramatic epistemic expansion.

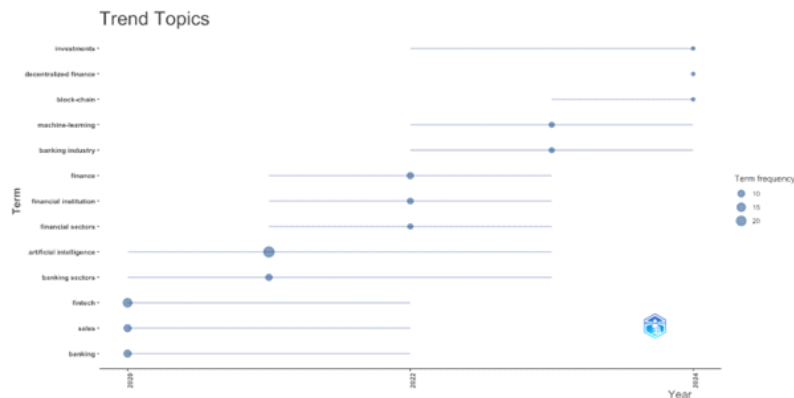


Figure 3. Trend Topic Analysis (Source: Biblioshiny using data from Scopus)

The trend topic analysis, as reported in Figure 3 , provides a comprehensive overview of how important topics evolved temporally, and when topics begin to converge based on their first mention (i.e., Q1), their median (i.e., median), and their later mention (i.e., Q3) or completion. Examples included fintech, banking and sales. These topics received their first mention and median mention in 2020. While conventional representations of these topics continued to be relevant in 2022, they mostly became abstract and irrelevant after this temporal period; thus indicating that they were the fundamental themes associated with the initial surge of AI-related financial academic research. In particular, they are the first inkling of the early operational and infrastructural concerns associated with the adoption of AI, which, at the time, focused on transaction systems mainly through institutions and interactions with the market

Conversely, “Artificial Intelligence,” also emerging in 2020 has a median presence in 2021, and extends to 2023 due to its gradual maturation from a specific technological enabler to an important epistemic category, around which specialized sub-themes were subsequently organized. The trends of the terms “banking sectors” and “finance” implied a second wave of thematic emergence in which the field has transitioned away from general institutional discourse and towards more specific analysis of sectors - marking a transitional point, parallel to the migration from exploratory to integrative uses of AI in financial systems.

Later emerging terms, including "banking industry", "machine-learning" and "financial sectors", show first quartile presence in 2022 and 2023, with third quartile presence extending to 2024. These terms signify the field's deepening methodological and sectoral complexity, with increased scholarly attention to the differentiating infrastructural mechanisms (e.g., machine learning techniques) and the adjoining macro-institutional implications (e.g., industry wide AI dissemination). Their clustering at the end of the timeline indicates a shift towards high-resolution analysis of the systemic effects of AI and a scholarly pivot towards regulatory, ethical and structural inquiries.

In all, the progression of these trend topics shows a clear thematic development: early stages of operational integration and topic initiation (2020–2021), onto sectoral and institutional embedding (2021–2023), to methodological development and ecosystemic theorizing (2023–2024). The phases of this thematic development show a dynamic and maturing field consistent with bibliometric expectations of intellectual development via conceptual diffusion, domain development and methodological development (Zupic & Čater, 2015; Donthu et al., 2021).

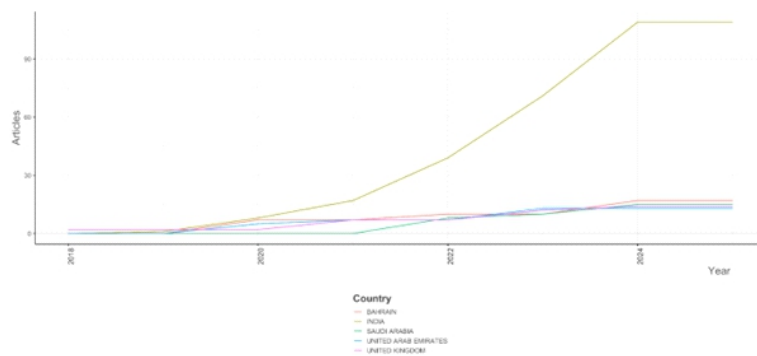


Figure 4. Country's Production over time (Source: Biblioshiny using data from Scopus)

The **Figure 4** shows the evolution of scientific output in artificial intelligence and fintech in banking sector for the selected countries over time. The graph presents accepted publications per year; thus facilitating a comparison of each national trajectory in scientific research. A temporal analysis of country-level scientific production gives us two different trajectories. The United Kingdom exhibits

steady growth in academic output, beginning with a consistent output of two articles between 2018–2020, followed by a rapid increase starting in 2021 with a peak of fourteen in both 2024 and 2025. This pattern suggests initial engagement and subsequent acceleration of research within the AI-finance domain. India is the leading contributor overall, however their engagement is slower than other contributors, as they begin their output with no publications for 2018 and one publication in 2019, which means while the engagement was delayed; it is growing rapidly, indicating a traction aspect of more recent engagement that is quickly growing - a characteristic that fairly represents emerging economies as they build institutional research capacity that coincides with strategic priorities within national digital finance initiatives.

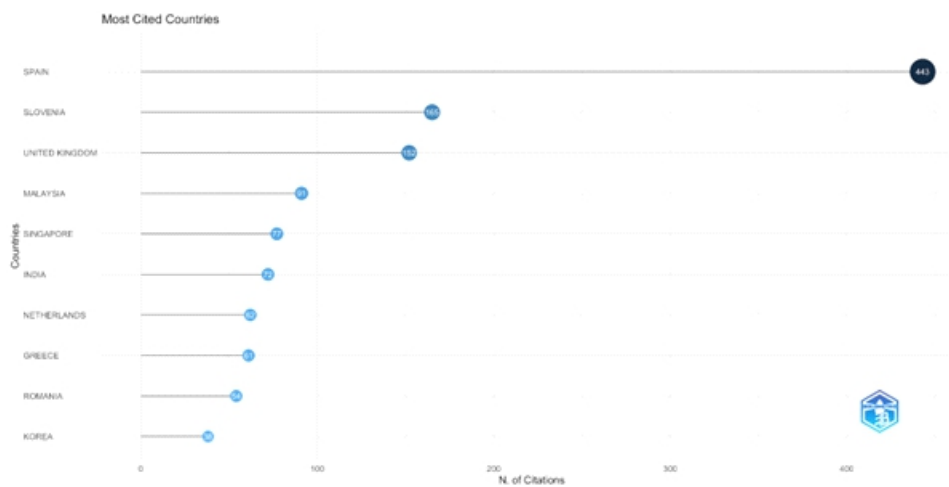


Figure 5: Most Cited Countries by Total and Average Citations
(Source: Biblioshiny using data from Scopus)

As illustrated in Figure 5; The identification of the most-cited countries, using total citations (TC) and Average Citation of Articles (ACA), illustrates a clear separation of the outputs of scholarship and citation impact and has revealed some surprises. While Spain is clearly at the top of total citations (443) with the average of citations per article at a high of 110.80, it is not just because of the excellent scholarship being produced or its prolific output; it is also among the articles having the most significant influence in some dimensions of scholarship of international educational travel and mobility. Slovenia, while contributing less than Spain with articles responded positively to their higher citation average (165.00) as outlined in the analysis highlighting that the significance of a small number of articles can greatly impact a field. The United Kingdom and Malaysia have both achieved significant citation averages as well with a respective average of 38.00 and 91.00, indicating a significant engagement with the material with both visibility and intellectual engagement.

India contributes significantly to the total number of articles across the globe, their average capitalization citations (3.00 citations per articles) indicates that while they have high levels of activities, suffice to say that globally speaking the low amount of engagement that Indian research has received in either an academic or educational setting indicates that on a citation basis, Indian research output has limited value. Other countries such as the Netherlands, Greece and Singapore have a similar publication with a lower number of research articles but these countries each have a higher citation average than India which also illustrates the phenomenon that while some research communities have higher levels of productivity, academic impact/contribution does not equate with the number of publications outputs. The divergence of quantity to impact has been captured in a larger bibliometric consideration, which has been advanced in prior literature, that provides a more relative measure of intellectual impact include potential measures that use measurable forms of scholarship productivity /quality adjustment, such as average number of citations (Donthu et al., 2021; Zupic & Čater,2015) as provided, demonstrate, this content analysis data has considerable merit while considering and assessing research communities through their respective engagement with and relation to international educational travel and mobility.

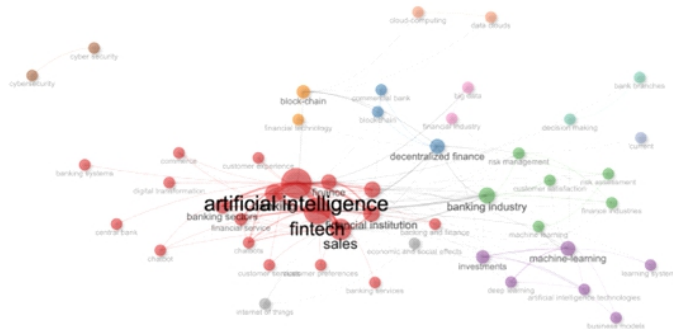


Figure 6. Co-occurrence Network Plot
(Source : Biblioshiny using data from Scopus)

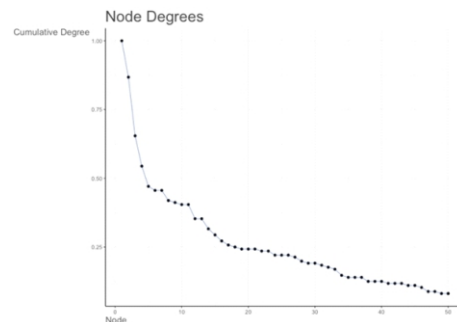


Figure 7. Co-occurrence Density Plot
(Source : Biblioshiny using data from Scopus)

As shown in **Figure 6** (the co-occurrence network plot), and Figure 7 the co-occurrence density plot), the co-occurrence network provides a nuanced structural depiction of thematic relationships within the AI-finance research corpus. The network plot (Fig. 1) shows artificial intelligence at the centre of Cluster 1 as the largest node, co-existing with capable terms related-to fintech (betweenness = 190.802; PageRank = 0.082) and sales (158.275; 0.068) which act as secondary and tertiary hubs, engaging and meditating the meaningful discussion between core technologies and applied financial contexts.

The density plot **Figure 7** displays further evidence of interconnectedness between terms, revealing that there is a dense connected thematic core across banking, financial sector and financial institution, which has moderate, but structurally important, connectivity, indicating that these terms are part of the dominant narrative corresponding to the contexts above. In comparison, peripheral nodes such as chatbots and financial service have little overall centrality and lower density, implying that these might either be emerging sub-themes, or niche pathways in the literature associated with this growing field.

As a whole, these visualizations exhibit a network with a centralized structure, a high degree of thematic cohesion and a hierarchically structured arrangement of knowledge, in agreement with bibliometric science mapping guidance, where high centrality and PageRank are core ideological constructs, and low-density terms are considered the boundaries of a horizon of scholarship (Donthu et al., 2021; Cobo et al., 2011).

4. FINDINGS

The combination of AI, IoT and Big Data has clearly altered the research landscape in banking, with AI taking the leading role as the thematic core. Bibliometric trends indicate a progressive shift from early-stage discussions about fintech and banking (2018–2020) to an exploration of applications in the sector and the particularities of AI tools (2021–2025). Research themes have progressed from general emergent operational integration of AI and digital invention to more specific themes of sectoral integrations, regulation and policy implications and ethics. While institutional involvement is robust and dominated by located institutions in India and emerging economies, citation impact and research activity still present en bloc, territorial effect, which suggests that there may be a gap between research activity, output and the capacity to have global academic impact.

5. LIMITATIONS OF THE STUDY

Despite promising future avenues, the present systematic bibliometric review of AI, IoT, and Big Data applications in banking has limitations. This study confined itself to the Scopus database as the data source, any English-language related published articles, and articles published in their final stage. Consequently, relevant studies, if exist, published in languages other than English could have been excluded as well as relevant publications in non-Scopus indexed databases, which may present an alternative view of literature on AI, IoT and Big Data in banking. Bibliometric tools like Biblioshiny provide respectively good quantitative perspective on the literature as identified, without opportunity to evaluate the qualitative depth of the articles in the review, and further the citation-based approach taken does not consider the height of impact that newly published materials may have, considering the time horizon we cited. Next, the manual screening process used in this review is based on a thorough "thread/open process", which has sizing limitations, and while this is true, these thematic relevance

assessments get subjective.

6. CONCLUSION

This research aimed to explore the influence of Artificial Intelligence (AI), Internet of Things (IoT), and Big Data Analytics on research trajectories, thematic pathways and institutional impacts in banking research from 2018 to 2025. The bibliometric analysis strongly evidenced how AI has emerged as the central thematic delimiting in the domain of banking research, with research slowly evolving through early explorations of fintech and operational integration (2018–2020) through to more advanced categorizations of sectorial implications, ethical governance and regulatory perspectives (2021-20225).

Thematic mapping revealed three paradigmatic shifts: (i) initiation - AI was mainly couched within fintech and transactional systems; (ii) embedding - major themes such as fraud detection, customer engagement, and credit scoring emerged as specific application areas; and (iii) maturation--the discourse began to shift towards structural and systemic issues such as techniques in machine learning, ethical AI, and industry adoption. The growth of AI, IoT and Big Data progressively redefined not just the technological approach to banking research, but the institutional and regulatory dimension too.

Institutional contributions demonstrate a bifurcated pattern: on the one hand, India has become the most productive in raw published volumes, but citation analysis demonstrates that some European countries, such as Spain and Slovenia, have higher academic impact. The tension between India and Europe is essential to highlight because it shares a core finding of this study—research productivity and research influence do not necessarily overlap, which suggests the need for more global collaboration and sharing of knowledge.

In trying to answer the research question, this study demonstrates that the way in which AI, IoT, and Big Data have integrated has turned banking research into a multi-layered field: it is now technologically driven, institutionally expanding, and increasingly concerned with ethics and regulation. The findings illustrate the opportunities as well as the spaces—as evidenced by gaps in cross-border collaboration, regulatory oversight, and IoT security—that deserve continued academic and professional inquiry. This study, by documenting the evolution of the field, contributes as the first step in beginning a systematic understanding of how emerging technologies have altered the intellectual and operational infrastructures of the banking community.

7. FUTURE IMPLICATIONS

Implications of this research provide substantial details for academia, industry and regulators. As AI technologies shape how banking functions, future research should be focused on the ethics of AI, regulation and accountability in algorithmic purposes. There should also be a reinvigoration regarding

the study of IoT, especially in the use of analytics in real-time and as security improvements. There should be cooperation and information exchange through cross-border initiatives to circumvent problems of regional silos. For practitioners, following the path for the banks in layman's terms would require aligning AI strategies with changing customer expectations, data governance principles and sectoral regulations. Finally, there should continue to be bibliometric tracking to identify emerging technologies including generative AI as evolving a role within new financial ecosystems.

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