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Research Article

The Impact of Industrial Revolution 4.0 and 5.0 on the Banking Industry

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ABSTRACT

Introduction: The Fourth and Fifth Industrial Revolutions (IR 4.0 and IR 5.0) have significantly influenced the digital transformation of the banking industry. While IR 4.0 has spurred the adoption of automation, artificial intelligence (AI), and data-driven decision-making, IR 5.0 introduces a more human-centric vision—one that prioritizes ethics, sustainability, and inclusive innovation. However, the extent to which these paradigms have shaped scholarly discourse remains underexplored.

Objectives: This study aims to map the intellectual and thematic evolution of banking research in the contexts of IR 4.0 and IR 5.0. It investigates dominant topics, influential contributors, and emerging trends, while identifying conceptual gaps that point toward future research opportunities, particularly those centered on trust, human-machine collaboration, and sustainable finance.

Methods: A bibliometric analysis was conducted on 19,192 articles related to banking, 9,472 articles on IR 4.0, and 393 articles on IR 5.0 indexed in Scopus from 2011 to 2023. Using VOSviewer and Biblioshiny, the study performed co-occurrence network analysis, thematic evolution tracking, and cluster mapping to assess scientific performance and visualize conceptual structures.

Results: IR 4.0 has become a dominant research theme in banking, with a high lexical overlap and thematic concentration on digital banking, AI, blockchain, and automation. These technologies have transformed banking operations and customer engagement models. Conversely, IR 5.0 remains early but introduces transformative values such as ethics, personalization, and sustainability. Thematic evolution gradually shifts from risk mitigation and regulatory compliance toward inclusive innovation and ethical AI. Strategic maps highlight the rise of niche and emerging themes, including CSR, ESG, and digital trust, signaling a paradigmatic transition toward human-centered banking.

Conclusions: Integrating IR 5.0 values—ethical governance, human-machine collaboration, and environmental responsibility—represents a critical next step for scholars and practitioners. While IR 4.0 has laid the technical foundation, IR 5.0 provides a framework for embedding purpose and trust into digital transformation. Future research should focus on operationalizing IR 5.0 within banking systems, bridging the efficiency of automation with the imperatives of equity and sustainability.

Keywords: Bibliometric Analysis; Ethical AI; Sustainability; Human-Centric Innovation; Digital Transformation.

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INTRODUCTION

The banking industry is a vital component of economic infrastructure, as it mobilizes public funds and channels them into productive activities. As financial intermediaries, banks facilitate capital allocation, promote economic development, and maintain systemic stability. However, in an increasingly dynamic environment, banks must maintain operational efficiency and safeguard public trust—an essential foundation for financial systems' long-term credibility and sustainability. (Thakor, 2020)

In the Fourth Industrial Revolution (IR 4.0) era, the banking sector faces unprecedented transformation driven by automation, digitization, and advances in integrating cyber-physical systems. The emergence of the Internet of Things (IoT), big data analytics, artificial intelligence (AI), and financial technology (fintech) has redefined how financial services are designed, delivered, and consumed. These innovations have reshaped customer expectations for convenience, speed, and personalization, while simultaneously disrupting traditional banking models (Lironi & Vandenberghe, 2015; Wibowo, 2022). Despite these trends, many banks continue to adopt digital technologies in a fragmented or superficial manner, often failing to integrate them into their strategic core.

The COVID-19 pandemic further underscored the urgency of digital transformation. Amid lockdowns and mobility restrictions, banks were compelled to adopt contactless and remote services to maintain business continuity rapidly. Nevertheless, technological readiness alone proved insufficient. Behavioral and institutional inertia—manifested through conservative managerial assumptions and customer resistance—remained significant barriers to establishing resilient, secure, and customer-centric digital ecosystems. These challenges highlight that. (Ali et al., 2022; Anouze & Alamro, 2019)digital transformation is not solely a technical endeavor but also a cultural and strategic shift.

While IR 4.0 emphasizes efficiency, automation, and scale, the Fifth Industrial Revolution (IR 5.0) introduces a complementary paradigm focused on human-centric innovation, ethical technology deployment, sustainability, and inclusive economic participation. (Breque et al., 2021; Xu et al., 2021). IR 5.0 offers an opportunity to reimagine how technology can empower—not replace—humans in the banking industry. However, the extent to which IR 5.0 principles have permeated banking research and practice remains underexplored, particularly in post-pandemic recovery and long-term competitiveness.

Although the literature on digital banking, fintech adoption, and technological innovation has grown rapidly, there is limited synthesis of how scholarly attention has evolved across the IR 4.0 and IR 5.0 timelines. A systematic bibliometric analysis is essential to map the intellectual landscape, identify research gaps, and uncover emerging trajectories at the intersection of industrial revolutions and the banking sector. Such insights are necessary to inform academic discourse and guide practical innovation in an era of volatility and transformation.

OBJECTIVES

To address this gap, the present study uses the Scopus database to conduct a bibliometric analysis of publications from 2011 to 2023. By employing performance analysis and scientific mapping techniques, the study aims to identify key research themes, influential contributors, structural patterns, and future research directions within the banking field in IR 4.0 and IR 5.0.

The following questions guide the research:

1. RQ1: How has banking research evolved in response to Industrial Revolutions 4.0 and 5.0?
2. RQ2: How do top-ranking research parameters, such as the most cited authors and contributing countries, provide insights into trends in banking-related research during IR 4.0 and IR 5.0?
3. RQ3: What is the underlying structure of research on banking in the context of IR 4.0 and IR 5.0, and how do key themes and topics interrelate?
4. RQ4: What key topics should future research explore, and how can they contribute to advancing the banking sector in the IR 4.0 and IR 5.0 eras?

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This study addresses these questions and offers both theoretical and practical contributions. It provides a comprehensive map of the current research landscape and outlines a roadmap for scholars and practitioners seeking to advance more ethical, sustainable, and technologically adaptive financial systems. In doing so, it supports the banking industry's strategic development in its transition toward the principles of IR 5.0.

METHODS

As of December 31, 2023, numerous bibliometric studies have examined various aspects of banking. Existing research has primarily focused on bank performance along with policy, shadow banking, sustainability, crises, and big data within the banking sector (Hsu & Chiang, 2020; Nobanee et al., 2021; Alam et al., 2021; Nath & Chowdhury, 2021; Galletta et al., 2022; Kumar et al., 2022; Zainuldin & Lui, 2022; Mehrotra et al., 2022; Hassanein & Mostafa, 2023). However, bibliometric studies examining the influence of Industrial Revolution 4.0 (IR 4.0) and Industrial Revolution 5.0 (IR 5.0) on banking are relatively scarce. Most research in this area has focused on technology, with limited studies addressing the banking sector directly.

In the broader fields of economics and business, several bibliometric analyses have explored Industrial Revolution 4.0 and its impact on economic systems and business practices (Ruiz-Real et al., 2020; Gajdzik et al., 2021). Additionally, some studies have explicitly examined the circular economy (Norouzi et al., 2021; Agrawal et al., 2022; Hettiarachchi et al., 2022; Ren et al., 2023; Liu et al., 2023). In contrast, bibliometric studies related to Industrial Revolution 5.0 within economics and business have focused on broader concepts such as sustainability (Grabowska et al., 2022) and future industry developments (Alshater et al., 2022).

This study employs a bibliometric analysis to systematically map the research landscape at the intersection of banking, IR 4.0, and IR 5.0. The bibliometric method allows for a quantitative evaluation of academic literature, revealing patterns in publication trends, influential contributors, key thematic areas, and gaps for future inquiry (Donthu et al., 2021), as illustrated in Figure 1.

In bibliometrics, word analysis is based on keywords. Authors use keywords to signal the topics of their research, and in this study, co-word analysis helps detect the topical and thematic diversity present in the literature (Donthu et al., 2021).

DATA SOURCE SELECTION

The Scopus database was selected as the primary data source due to its comprehensive coverage of peer-reviewed journals, robust metadata structure, and wide acceptance in bibliometric studies. Compared to other databases such as Web of Science, Scopus offers broader disciplinary inclusion and advanced filtering features that support nuanced bibliometric queries. (Cantú-Ortiz, Francisco J., 2018).

SEARCH STRATEGY AND INCLUSION CRITERIA

Data were collected on December 31, 2023, using a structured keyword search strategy: keywords for IR 4.0 and IR 5.0 were searched in the title, abstract, and keywords fields to capture broad conceptual associations. The keyword "bank" was restricted to the title field to ensure that banking was the primary focus of each document. The inclusion criteria were as follows:

- Article type: peer-reviewed journal articles (excluding reviews, editorials, and conference papers).
- Language: English.
- Timeframe: January 2011 to December 2023.
- Disciplinary focus: limited to economics, finance, management, and business-related subjects.

Articles not directly related to the banking industry's economic, regulatory, or technological aspects were excluded. After removing duplicates and irrelevant records, a final dataset comprising 19,192 articles on banking, 9,472 on IR 4.0, and 393 on IR 5.0 was obtained for analysis.

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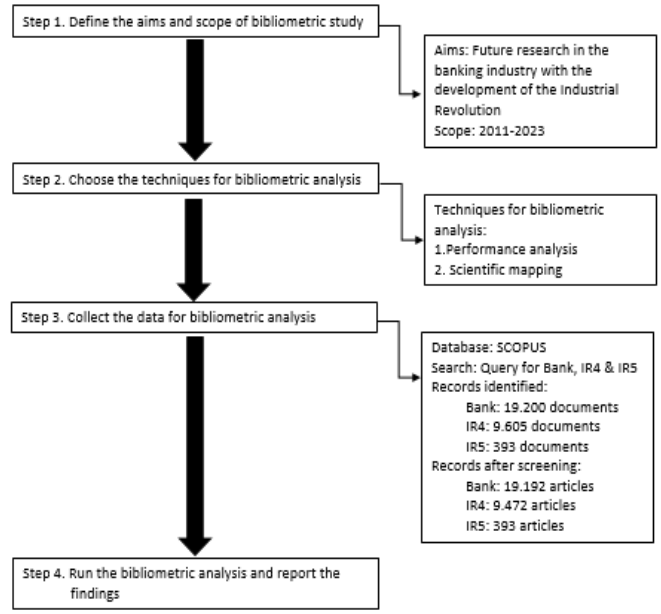
Figure 1. Bibliometric Methodological Procedure



Source: (Donthu et al., 2021)

DATA CLEANING AND VALIDATION

To ensure data quality, all records were reviewed for completeness of metadata, including author affiliations, publication years, keywords, and citation counts. Duplicate entries and documents with incomplete bibliographic fields were excluded. A second reviewer cross-validated the final dataset to minimize bias in inclusion and keyword mapping.

ANALYTICAL TOOLS AND TECHNIQUES

This study applies two complementary bibliometric techniques (Donthu et al., 2021):

- Performance Analysis: Used to measure the scientific productivity and influence of authors, institutions, and countries. It also captures trends in publication volume over time and identifies the most influential journals and citations.
- Scientific Mapping: Executed through co-word analysis, co-citation analysis, and keyword co-occurrence networks to reveal the intellectual structure and thematic evolution of the field.

TWO TOOLS WERE EMPLOYED

VOSviewer was used for constructing and visualizing bibliometric based on keyword co-occurrence, authorship networks, and thematic clusters (Aria & Cuccurullo, 2017).

Biblioshiny (an R-based application from the bibliometrix package) was used for performance metrics, strategic diagrams, and thematic evolution mapping.

LIMITATIONS

Restricting the search term "bank" to the title field may have excluded relevant articles where banking is a key component but not explicitly mentioned in the title. While this approach increases specificity, it also narrows the scope. Additionally, the reliance on a single database (Scopus) may introduce a degree of publication bias. These limitations are acknowledged and serve as areas for future methodological refinement.

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RESULTS

The following section presents the research findings derived from two bibliometric analysis approaches—performance analysis and scientific mapping—used to explore the development of studies on banking, the Fourth Industrial Revolution (IR 4.0), and the Fifth Industrial Revolution (IR 5.0) from 2011 to 2023.

DEVELOPMENTS IN RESEARCH ON BANKS, INDUSTRIAL 4.0, AND 5.0

A substantial number of studies have been conducted using the keyword 'bank,' particularly within economics and business, as summarized in Table 1. In contrast, research associated with the keywords 'Industrial Revolution 4.0' and 'Industrial Revolution 5.0' spans a broader range of disciplines and is not confined to a specific academic area.

[Table 1. Main Information About the Data]

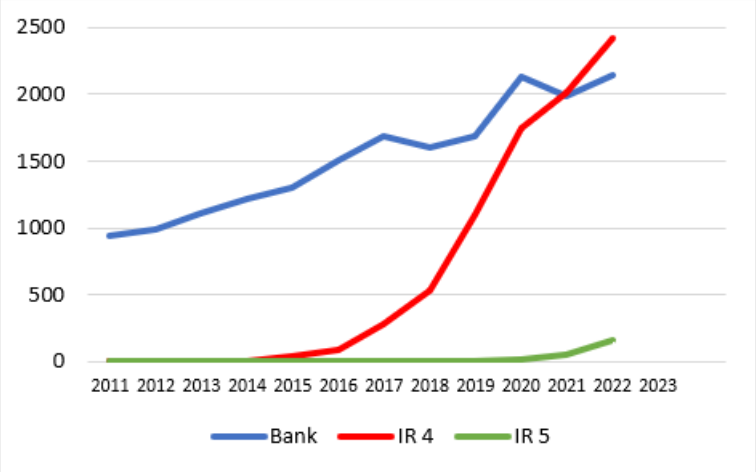
Description	Results		
	BANK	IR 4	IR 5
Timespan	2011:2023	2011:2023	2011:2023
Sources (Journals, Books, etc.)	1,675	1,997	208
Documents	19,200	9,605	393
Annual Growth Rate %	-0.23	106,43	50.86
Document Average Age	5.34	2,22	1.23
Average citations per doc	12.60	22,33	13.64
References	669,145	427,157	23,156
DOCUMENT CONTENTS			
Keywords Plus (ID)	1,674	24,370	2,607
Author's Keywords (DE)	26,503	20,665	1,479
AUTHORS			
Authors	27,647	24,957	1,455
Authors of single-authored docs	3,645	661	26
AUTHORS COLLABORATION			
Single-authored docs	4,595	739	26
Co-Authors per Doc	2.39	3,84	4.26
International co-authorships %	24.09	29,28	40.97
DOCUMENT TYPES			
Article	19,192	9,472	393

Source: Own elaboration-Biblioshiny

Table 1 shows that there were 19,200 studies on banking industry, 9,605 studies on IR 4.0, and 393 studies on IR 5.0, from 2011 to 2023.

[Figure 2. Annual Article Production]

Figure 2. Annual Article Production



Source: Own elaboration

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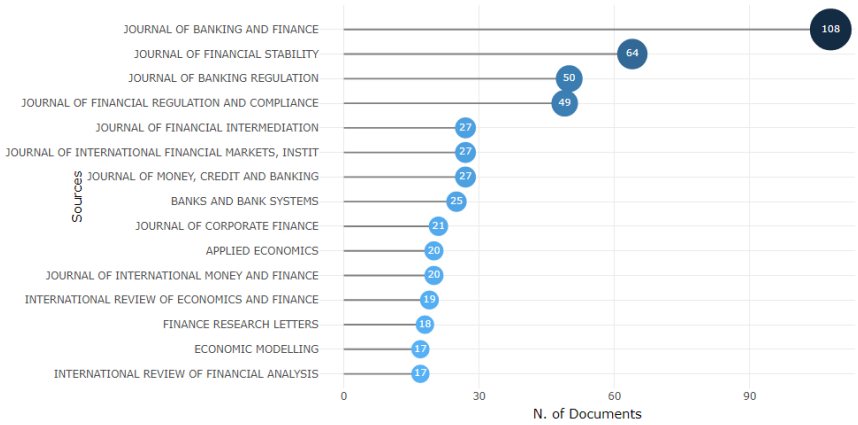
As illustrated in Figure 2, scholarly interest in the banking sector shows a positive and upward trend. Research related to the Fourth Industrial Revolution (IR 4.0) grew significantly in 2016. Meanwhile, academic discussions on the Fifth Industrial Revolution (IR 5.0) emerged several years before its formal recognition by European industrial institutions, as marked by Daniel Paschek's ideas in 2019. Peter Sachsenmeier (2016) identified early IR 5.0 research as focusing on synthetic biology and bioengineering. However, according to Vural Özdemir and Nezih Hekim (2018), the uneven pace of growth among critical factors, particularly technological infrastructure and cybersecurity, has limited the full realization of IR 4.0. They further contend that IR 5.0 must be positioned as a corrective response to these asymmetries, addressing the gaps left by the rapid advancements of its predecessor.

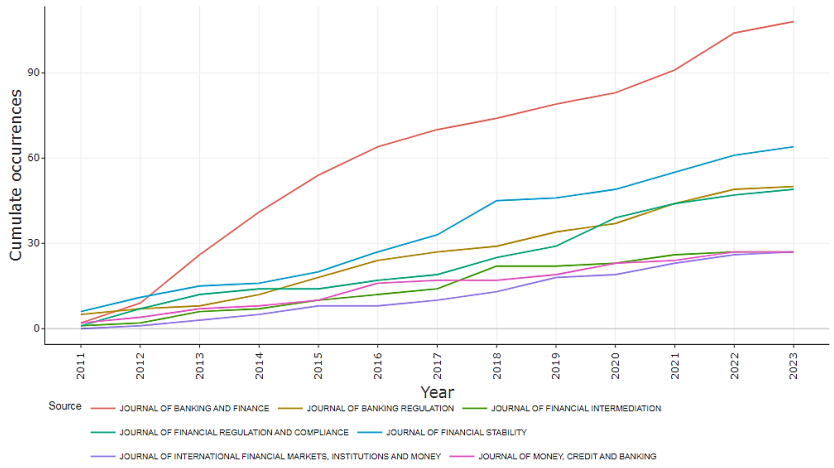
[Figure 3. Most Influential Journals]



Source: Own elaboration- Biblioshiny

The Journal of Banking and Finance emerges as the leading publication in the field, with 108 documents—far surpassing the output of other journals. This dominance suggests that the journal is a primary platform for research on a wide array of banking and finance topics, likely due to its broad reach and focus on key issues in the sector. Following this, the Journal of Financial Stability ranks second with 64 documents, indicating a growing interest in financial stability, likely reflecting concerns about the resilience of banking systems in the face of global economic uncertainties. The Journal of Banking Regulation and Financial Regulation and Compliance, with 50 and 49 documents, further underscores the importance of regulatory and compliance issues in the banking industry. This trend may respond to increased scrutiny and evolving regulatory frameworks in recent years.

[Figure 4. Most Productive Journals Each Year (Accumulated)]



Source: Own elaboration- Biblioshiny

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The Journal of Banking and Finance (red line) leads significantly in cumulative publications, showing steady growth from 2011, with a sharp rise starting in 2013. By 2023, it will reach nearly 100 publications, establishing itself as the most prolific and active platform for research in the banking and finance sector. It consistently attracts a high volume of publications each year. The Journal of Financial Stability (blue line) follows with steady growth, particularly after 2015, reflecting increasing attention to financial system stability, likely driven by the aftermath of the global economic crisis and the ongoing focus on risk management and resilience in the banking industry. By 2023, this journal holds a strong position, second only to the Journal of Banking and Finance. Meanwhile, the Journal of Financial Regulation and Compliance (green line) and the Journal of Banking Regulation (orange line) display similar growth patterns, with notable increases around 2015. While these journals have published fewer articles than the top two, their consistent upward trends highlight the growing emphasis on regulatory issues, compliance frameworks, and the evolving legal landscape surrounding the banking sector.

[Table 2. Most Influential Institutions or Affiliations]

Affiliations	Articles
INTERNATIONAL MONETARY FUND UNITED STATES	16
BANK OF ENGLAND UNITED KINGDOM	10
WASHINGTON DC UNITED STATES	10
MULTIMEDIA UNIVERSITY MALAYSIA	8
ABU DHABI SCHOOL OF MANAGEMENT ABU DHABI UNITED ARAB EMIRATES	7
FACULTY OF BUSINESS AND MANAGEMENT UITM KELANTAN MALAYSIA	7
FINANCIAL AND ECONOMIC ANALYSIS UNIT INSTITUTE FOR THE PROTECTION AND SECURITY OF THE CITIZEN EUROPEAN COMMISSION JOINT RESEARCH CENTRE	6
NIESR UNITED KINGDOM	6
SCHOOL OF MANAGEMENT HUAZHONG UNIVERSITY OF SCIENCE AND TECHNOLOGY WUHAN CHINA	6
AUBURN UNIVERSITY UNITED STATES	5
BANGOR BUSINESS SCHOOL BANGOR UNIVERSITY UNITED KINGDOM	5
DEPARTMENT OF INTERNATIONAL BUSINESS TAMKANG UNIVERSITY NEW TAIPEI CITY TAIWAN	5
DEPARTMENT OF MANAGEMENT STUDIES INDIAN INSTITUTE OF TECHNOLOGY DELHI NEW DELHI INDIA	5
FEDERAL RESERVE BANK OF NEW YORK UNITED STATES	5
INTERNATIONAL CENTRE FOR EDUCATION IN ISLAMIC FINANCE KUALA LUMPUR MALAYSIA	5

Source: Own elaboration- Biblioshiny

In the United States, the International Monetary Fund (IMF) tops the list with 16 published articles, which is expected given the IMF's central role in global financial stability, regulation, and policy-making. This high output highlights the organization's substantial influence on academic research, particularly in international finance, monetary policy, and crisis management. Following closely, the Bank of England (United Kingdom) and institutions in Washington, D.C. (United States) each contributed 10 articles. The Bank of England's prominent position reflects its critical role in global banking regulation and financial stability, solidifying its importance in academic discourse. The Washington D.C. figure likely encompasses key institutions, including think tanks, government bodies, and central banks, further emphasizing the U.S.'s leadership in shaping global financial research. Together, these institutions underscore the dominance of Western organizations in driving key discussions on financial regulation, stability, and policy.

TOP RESEARCH PARAMETERS ON BANKING INDUSTRY, IR 4.0, AND IR 5.0

One commonly used indicator in bibliometric analysis is citation frequency, which helps identify influential studies and highlight prevailing research themes. In the context of economic and business research within the banking sector, a bibliometric review reveals that the most frequently cited authors are Hahn and O'Brien (2012), whose study explores the link between business cycles and core bank earnings. The second most cited publication, with eight citations, is by Al-Rawashdeh et al. (2012), which investigates how information technology contributes to mitigating risks in electronic banking services. Ranked third is the work of Gillman and Kejak (2011), which analyzes the impact of inflation on firm growth, investment, and accurate interest rates.

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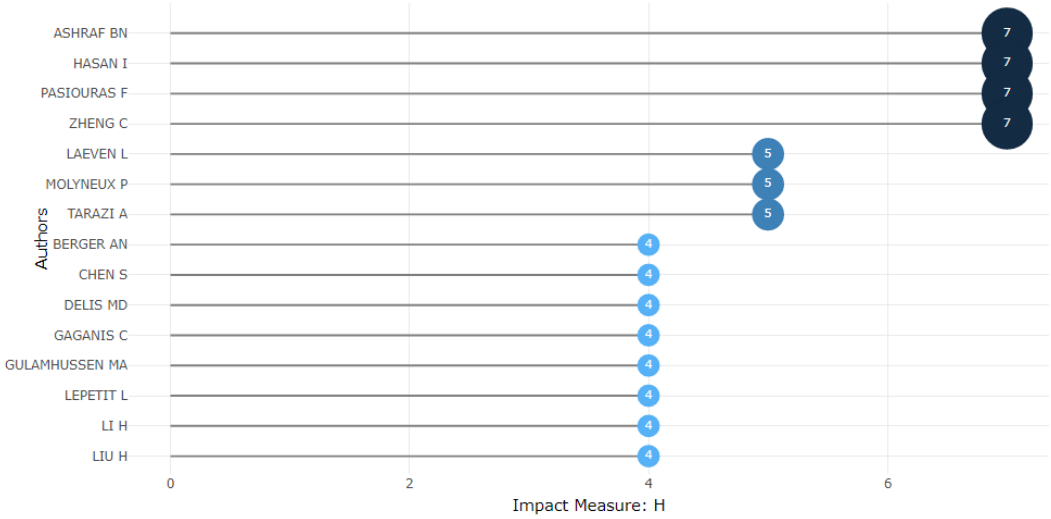
Bhattacharya and Ramachandran (2021) emerged as the most frequently cited authors in the bibliometric analysis of the Fourth Industrial Revolution. They focused on the significance of data-driven smart manufacturing for SMEs, highlighting its role in sustaining companies amidst the Fourth Industrial Revolution. Another highly cited author, Erro-Garcés & Hernández Palaceto (2021), explored the essential competencies required by students in this era, notably emphasizing the lack of digital competence among them. Oyekan's work (2021) delved into the comprehensive depiction integrated into IoT within building projects, aligning with sustainable building assets in the circular economy. The bibliometric analysis of IR 5 showed specific works from authors warranting citation have not yet been established due to the novelty of this topic.

[Table 3. Most Cited Authors]

Bank		IR 4.0		IR 5.0	
Authors	Articles	Authors	Articles	Authors	Articles
Hahn M	11	Bhattacharya I	46	Aliev K	1
O'Brien E	11	Ramachandran	46	Basavaraddi	1
Alrawashdeh	8	Erro-Garces A	10	De Angelis M	1
Areiqat A	8	Hernandez P	10	Elmagzoub	1
Dbbaghieh M	8	Oyekan J	9	Fraboni F	1
Abu-Errub	8	Stergioulas L	9	Franceschini	1
Gillman M	3	Turner C	9	Garg V	1
Kejak M	3	Baumler I	3	Gasanov M	1
Alvarez R	3	Kotzab H	3	Gervasi R	1
Bertin M	3	Li Y	3	Giusino D	1

Source: Own elaboration- Biblioshiny

[Figure 5. Most Cited Authors with the Highest Impact]



Source: Own elaboration- Biblioshiny

The H-index measures a writer's productivity and influence simultaneously (Aria & Cuccurullo, 2017). For example, Ashraf BN has seven articles published and cited at least seven times. Table 4 shows the details of author has seven articles published and cited at least seven times.

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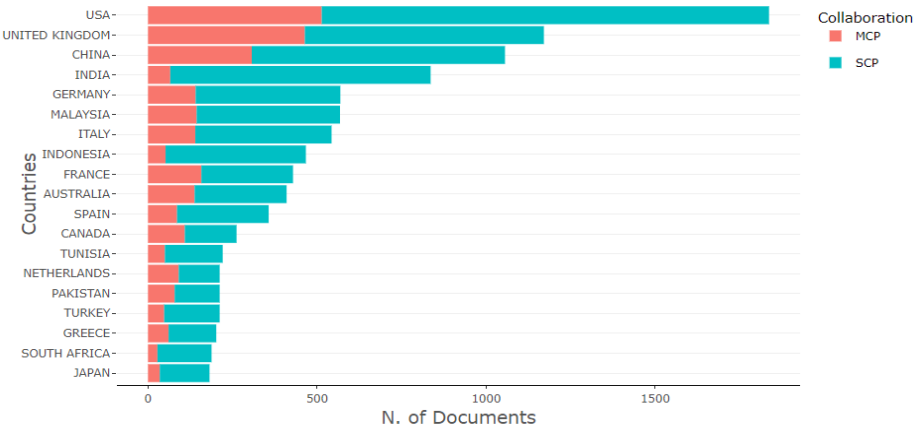
[Figure 6. Corresponding Cited Author's Country Regarding Banking]



Source: Own elaboration- Biblioshiny

[Table 4. List of Research Titles]

Author	Title	DOI
Zheng C	The Empirical Research of Banks' Capital Buffer and Risk Adjustment Decision Making: Evidence from China's Banks	10.1108/20441391211215833
Ashraf BN	Capital Regulation and Bank Risk-Taking Behavior: Evidence from Pakistan	10.3390/ijfs4030016
Ashraf BN & Zheng C	How Do Regulatory Ability and Bank Competition Affect The Adoption of Explicit Deposit Insurance Schemes and Banks' Risk-Taking Behavior?	10.1016/j.iref.2019.01.001
	Capital Requirements, The Cost of Financial; Intermediation and Bank Risk-Taking: Empirical Evidence From Bangladesh	10.1016/j.ribaf.2017.07.119
	Does The Ownership Structure Matter for Banks' Capital Regulation and Risk-Taking Behavior? Empirical Evidence From A Developing Country	10.1016/j.ribaf.2017.07.035
	How to Regulate Bank Dividends? Is Capital Regulation An Answer?	10.1016/j.econmod.2016.05.005
	Effects of National Culture on Bank Risk-Taking Behavior	10.1016/j.ribaf.2016.01.015
	Capital Regulation, Deposit Insurance and Bank Risk: International Evidence from Normal and Crisis Periods	10.1016/j.ribaf.2020.101188
Hasan I	What Determines Bank-Specific Variations in Bank Stock Returns? Global Evidence	10.1016/j.jfi.2014.06.002
	The Effects of Ratings-Contingent Regulation on International Bank Lending Behavior: Evidence from The Basel 2 Accord	10.1016/j.jbankfin.2015.04.016
	Earnings and Capital Management and Signaling: The Use of Loan-Loss Provisions by European Banks	10.1080/1351847X.2012.762408
	Banking Deregulation, Consolidation, and Corporate Cash Holdings: US Evidence	10.1016/j.jbankfin.2013.12.018
	Subordinated Debt, Market Discipline, and Bank Risk	10.1111/j.1538-4616.2011.00417.x
	Accounting Quality in Banking: The Role of Regulatory Interventions	10.1016/j.jbankfin.2018.10.005
	Real Effects of Bank Capital Regulations: Global Evidence	10.1016/j.jbankfin.2016.11.022
	The Determinants of Global Bank Credit-Default-Swap Spreads	10.1007/s10693-015-0232-z
	Short-Selling Threats and Bank Risk-Taking: Evidence from The Financial Crisis	10.1016/j.jbankfin.2023.106834
	Banking Reform, Risk-Taking, and Accounting Quality: Evidence from Post-Soviet Transition States	10.2308/JIAR-2021-087
	Are Bank Capital Requirements Optimally Set? Evidence from Researchers' Views	10.1016/j.jfs.2020.100772
	Bank Accounting Regulations, Enforcement Mechanisms, and Financial Statement Informativeness: Cross-Country Evidence*	10.1080/00014788.2017.1415801
Pasiouras F	Bank Productivity Change and Off-Balance-Sheet Activities Across Different Levels of Economic Development	10.1007/s10693-013-0181-3
	Regulations and Productivity Growth in Banking: Evidence from Transition Economies	10.1111/j.1538-4616.2011.00393.x
	What Drives Acquisitions in The EU Banking Industry? The Role of Bank Regulation and Supervision Framework, Bank-Specific and Market-Specific Factors	10.1111/j.1468-0416.2011.00165.x
	Regulations, Competition, and Bank Risk-Taking in Transition Countries	10.1016/j.jfs.2009.08.002
	Macroprudential Regulations and Bank Profit Efficiency: International Evidence	10.1007/s11149-021-09424-5
	Bank Profit Efficiency and Financial Consumer Protection Policies	10.1016/j.jbusres.2020.06.033
	Macroprudential Policies, Corporate Governance, and Bank Risk: Cross-Country Evidence	10.1016/j.jebo.2019.11.004

Source: Own elaboration- Biblioshiny

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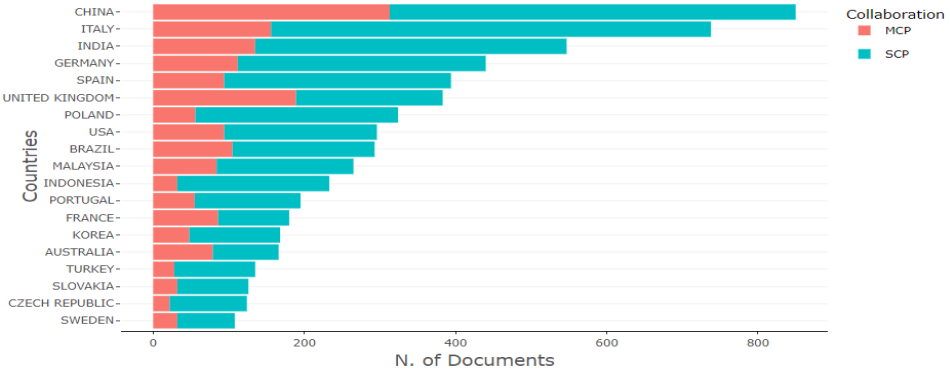
Countries like the USA and the UK, with their established dominance in banking research, will likely continue to lead the global academic landscape. However, they could further enhance their influence by fostering more international collaborations. The trends in the chart also highlight significant opportunities for countries like China, India, Germany, and Malaysia, which demonstrate strong domestic research output but have comparatively lower engagement in global partnerships. By expanding their international collaborations, these countries could enhance knowledge sharing and contribute more effectively to global research integration, fostering advancements across various sectors.

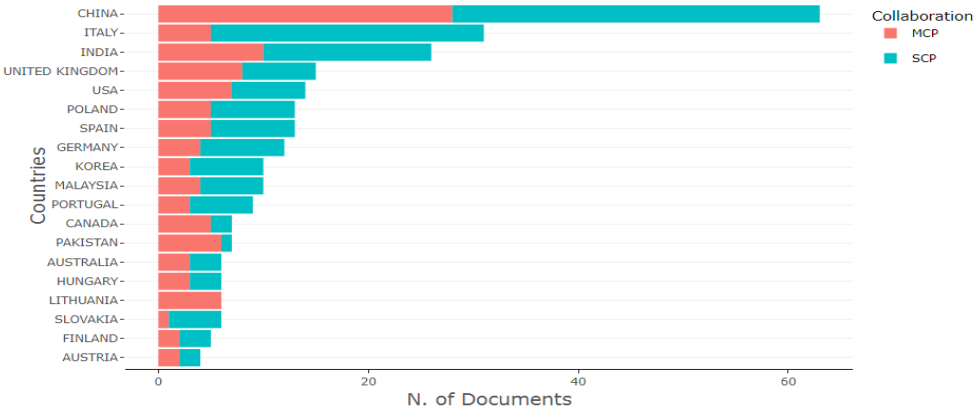
[Figure 7. Corresponding Cited Author's Country Regarding IR 4.0]



Source: Own elaboration- Biblioshiny

The graph indicates that countries like China, India, and Malaysia have significant opportunities to enhance their global research impact by increasing international collaborations. Expanding these partnerships would allow them to contribute to global research substantially. Meanwhile, countries with a more balanced collaboration profile, including Germany, Italy, and Spain, are well-positioned to continue influencing domestic and international research. Their active involvement in global collaborations suggests they will remain key players in driving interdisciplinary and cross-border studies in Industrial Revolution 4.0, further strengthening their positions in the international academic landscape.

[Figure 8. Corresponding Cited Author's Country Regarding IR 5.0]



Source: Own elaboration- Biblioshiny

China's strong focus on SCP in Industrial Revolution 5.0 research indicates that much of its work is conducted domestically, highlighting its robust internal research capabilities. However, the relatively lower level of MCP suggests a valuable opportunity for China to expand its international partnerships, which could broaden its research's global reach and impact. In contrast, the UK and the USA strongly emphasize international collaborations, positioning themselves as leaders in fostering cross-border research initiatives. Their active engagement in MCP

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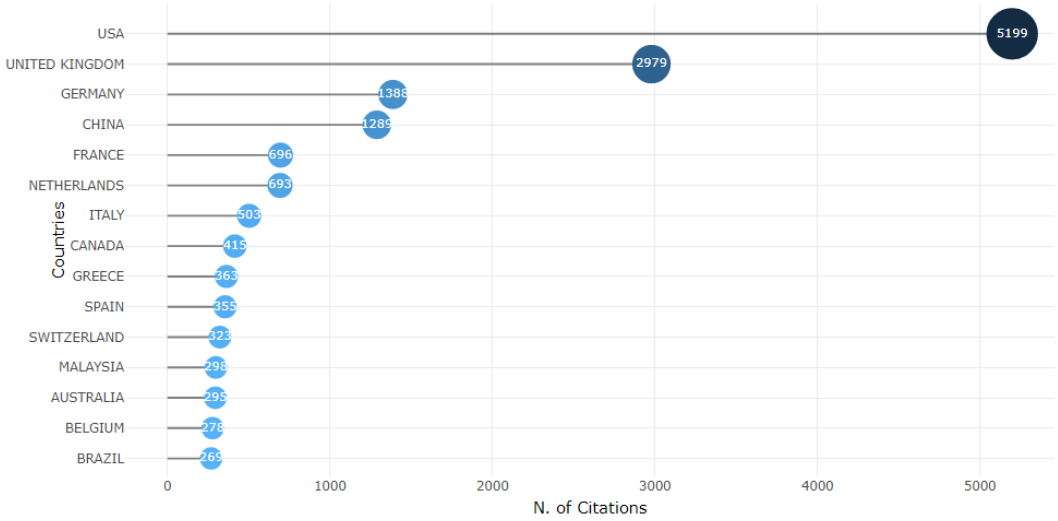
allows them to shape the direction of IR 5.0 research, particularly in fields that demand interdisciplinary and global cooperation, further strengthening their influence on the worldwide research landscape.

[Figure 9. Most Countries Researching Regulations]



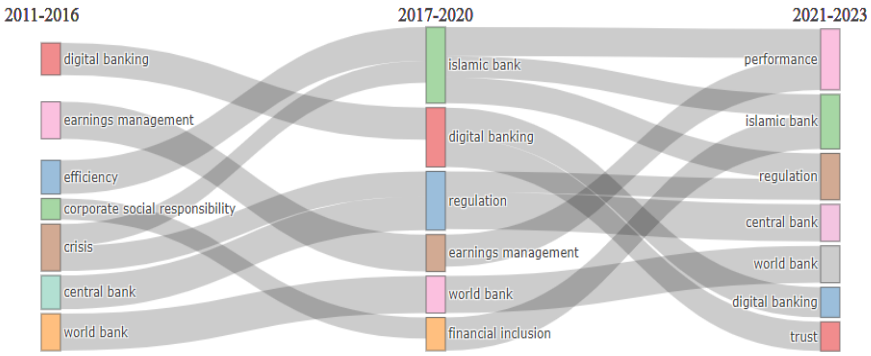
Source: Own elaboration- Biblioshiny

The USA leads with 5,199 citations, significantly outpacing other countries, indicating that its research on bank regulation is prolific and highly influential in shaping global discourse. Given the USA's central role in global finance, this dominance is expected, particularly during the 2008 financial crisis, where its regulatory frameworks became key points of reference in international debates and reforms. The United Kingdom follows with 2,979 citations, reflecting its status as a central global financial hub and its critical role in post-crisis banking regulations, led by institutions like the Financial Conduct Authority (FCA) and the Prudential Regulation Authority (PRA). Germany (1,388 citations) and China (1,285 citations) come next, each playing vital roles in bank regulation research.

RESEARCH STRUCTURE ON BANKING INDUSTRY, IR 4.0, AND IR 5.0

Structural analysis of research topics will show the relationships and interrelationships between topics. This study will compare the research topics related to the banking industry, Industry 4.0, and Industry 5.0.

[Figure 10. Thematic Evolution of Banking]



Source: Own elaboration- Biblioshiny

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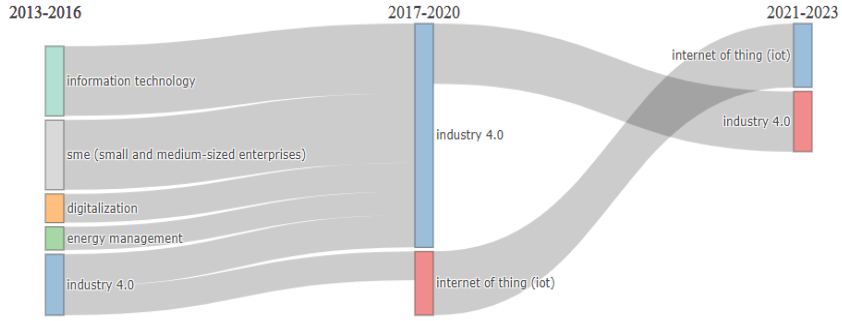
The thematic evolution of bank-related research highlights how the focus has shifted in response to global financial trends and technological advancements. Initially centred on efficiency, crisis management, and earnings management, research has increasingly moved toward future-oriented topics like digital banking, regulation, and trust. The continued prominence of Islamic and digital banking reflects a growing interest in alternative financial systems and the digital transformation of traditional banks. Additionally, the recent emergence of trust as a key theme underscores the importance of maintaining customer confidence in an era of expanding data sharing and digital services, which is crucial for the ongoing success of the banking sector.

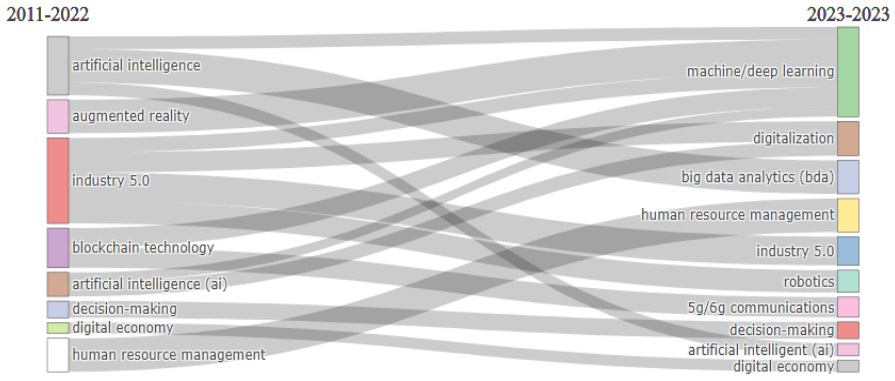
[Figure 11. Thematic Evolution About IR 4.0]



Source: Own elaboration- Biblioshiny

The thematic evolution depicted in the graphic illustrates how the focus of research has narrowed over time, reflecting a growing understanding and refinement of the key technologies driving the Industrial Revolution 4.0. In the early stages, research covered diverse topics, including digitalization, energy efficiency, and advancements in information technology. As the field matured, these themes converged under the broader framework of Industry 4.0, with the Internet of Things (IoT) emerging as a crucial enabler of the digital and innovative manufacturing transformations that define this era. This shift highlights the consolidation of research efforts around the most impactful technologies shaping modern industries.

[Figure 12. Thematic Evolution About IR 5.0]



Source: Own elaboration- Biblioshiny

The thematic evolution demonstrates how research in Industry 5.0 (IR 5.0) has progressed from foundational topics like artificial intelligence, digitalization, and blockchain technology to more advanced areas such as machine learning, big data analytics, robotics, and 5G/6G communication technologies. This shift reflects the increasing adoption and integration of these technologies within industries, driving the need for research to focus on optimizing their

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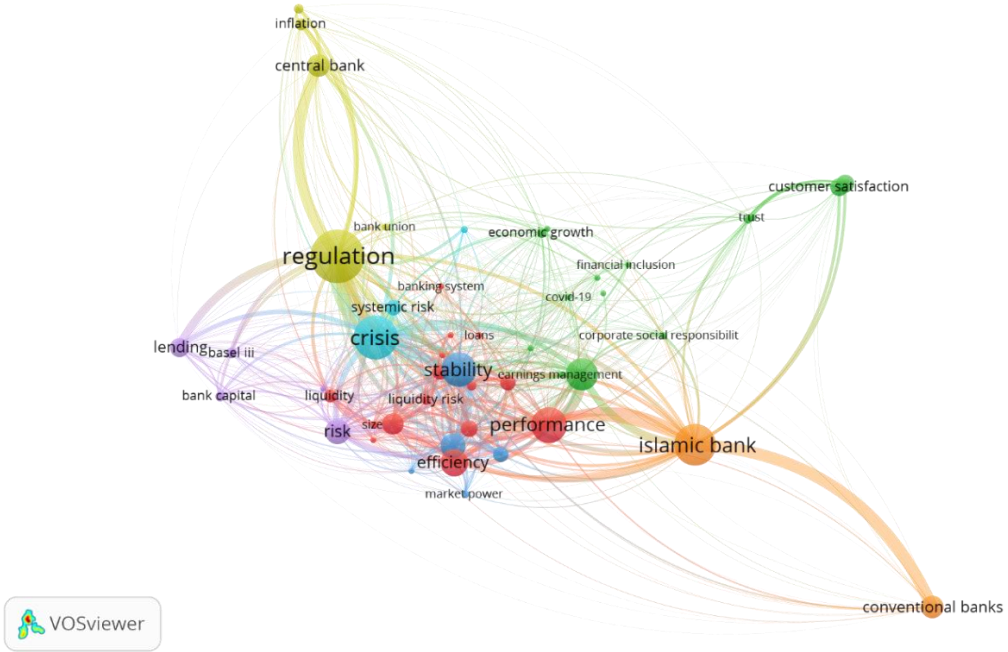
application. The current emphasis aligns with the core goals of IR 5.0, which prioritize human-technology collaboration, sustainability, and the advancement of automation. Subsequent analysis employs a co-occurrence network approach, aiming to extract insights by mapping the relationships among keywords within the document corpus.

The co-occurrence network in banking research highlights several key clusters of interest. The regulation cluster (yellow) places "regulation" at its core, closely linked to terms like "systemic risk," "crisis," and "liquidity risk." This yellow cluster indicates that much of the research in this area focuses on how regulatory frameworks enhance financial stability and mitigate risks, especially in the aftermath of major crises like the 2008 economic collapse. The Islamic banking cluster (orange) centres on "Islamic bank," with connections to "performance," "corporate governance," and "Sharia compliance," reflecting the growing body of research concerned with aligning financial operations to Islamic principles while maintaining effective governance and performance standards. In the crisis and stability cluster (blue), terms like "crisis," "stability," and "liquidity risk" are frequently discussed together, signalling an emphasis on how banks manage crises and maintain liquidity to ensure stability.

[Figure 13. Co-occurrence Network Keywords About Banking]



Source: Own elaboration- VOSviewer

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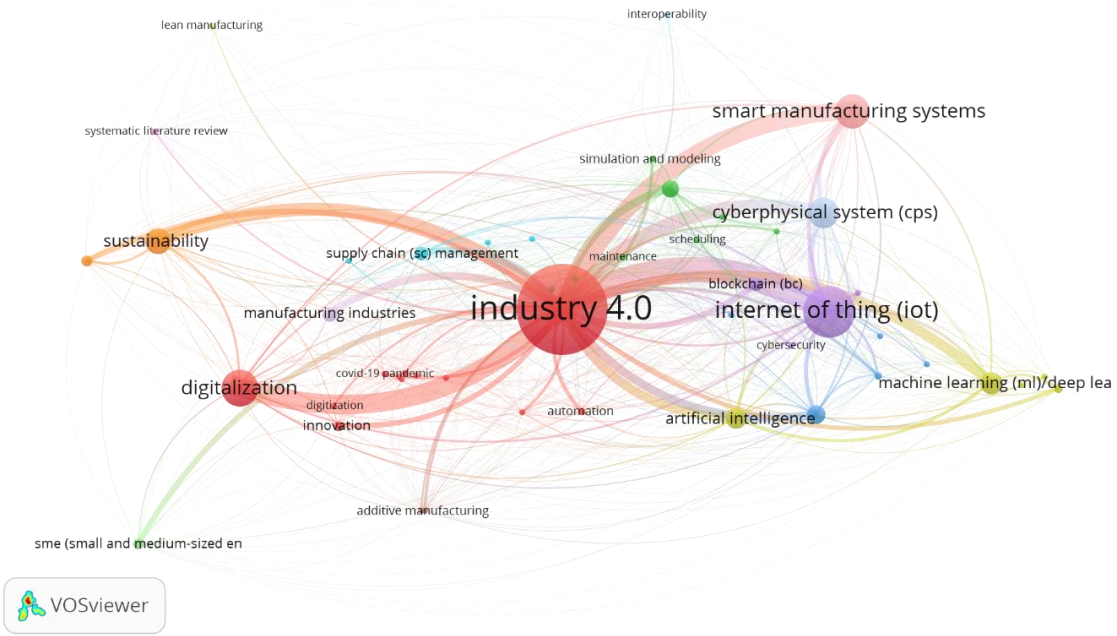
[Figure 14. Co-occurrence Network Keywords About IR 4.0]



Source: Own elaboration- VOSviewer

This cluster also links to "performance" and "efficiency," suggesting that effective crisis management is closely tied to overall bank performance. The customer satisfaction cluster (green) highlights the significance of "customer satisfaction," particularly concerning "digitalization," "banking services," and "customer behaviour." This area of research focuses on how the digital transformation of banking affects customer experiences, especially as banks continue to modernize their services. The performance cluster (red) emphasizes "performance" and "efficiency," linking these to "earnings management" and "liquidity risk." This red cluster suggests that research here often explores how banks manage their financial health and operational efficiency, particularly during periods of instability. Lastly, the emergence of COVID-19 as a keyword across clusters indicates that the pandemic has been a major topic of study, influencing research on crisis management, risk, liquidity, and customer satisfaction during an unprecedented global event.

The Industry 4.0 theme, represented by the red cluster, is the largest and most central in the network, reflecting its dominance in the research landscape. As the core concept, it connects to multiple keywords such as “digitization,” “innovation,” “digital transformation,” and the “COVID-19 pandemic,” indicating a broad focus on how industries are adopting digital technologies and reshaping operations, particularly in response to pandemic-driven disruptions. The Internet of Things (IoT), in the blue cluster, is another key theme closely linked to “artificial intelligence,” “cybersecurity,” and “machine learning.” This blue cluster highlights the central role of IoT in enabling smarter and more efficient industrial processes, with a strong emphasis on secure data exchange and decentralized systems, as seen with the inclusion of “blockchain.” The pink cluster, featuring "manufacturing" and "cyber-physical systems," underscores the importance of automation, robotics, and integrated systems in transforming production lines, focusing on scheduling and maintenance to optimize operational efficiency. The orange cluster, centred around “sustainability,” reflects the growing interest in how Industry 4.0 technologies can promote sustainable industrial practices, focusing on energy efficiency and the circular economy to reduce waste and optimize resources. This cluster also touches on broader applications, extending to the supply chain and agriculture. Finally, the green cluster emphasizes “digitization” and “innovation,” highlighting how digital technologies drive new business models and industrial processes, strongly focusing on leadership and organizational adaptation to digital transformations in the digital economy.

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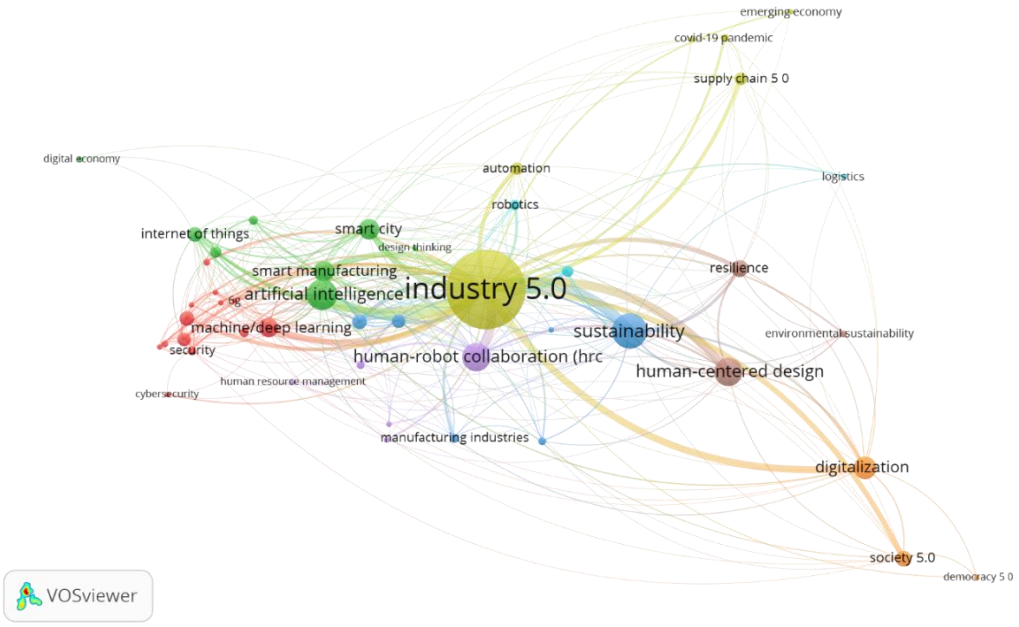
[Figure 15. Co-occurrence Network Keywords About IR 5.0]



Source: Own elaboration- VOSviewer

The Industry 5.0 theme, represented by the yellow cluster, is the network's most prominent and central node, highlighting its dominance in the research field. It is closely linked to key concepts such as "human-centric manufacturing," "sustainability," "collaboration," and "smart manufacturing," reflecting the shift in Industry 5.0 towards integrating advanced technologies like AI with human expertise to foster seamless collaboration between humans and machines. The focus on sustainability signals an increased emphasis on aligning industrial advancements with environmentally responsible practices. In the red cluster, artificial intelligence (AI) is strongly associated with "machine learning," "smart manufacturing," and "automation," emphasizing AI's central role in enabling smart factories through advanced data analysis, predictive maintenance, and efficiency improvements. The purple cluster focuses on "sustainability," "human-centred," and "collaboration," underscoring the human-centric approach of Industry 5.0, which contrasts with the more automation-focused Industry 4.0. This shift emphasizes making industries more socially and environmentally responsible. In the orange cluster, "digitalization" and "5G" are closely related, showcasing how advanced connectivity is essential for implementing Industry 5.0 initiatives. 5G networks enable real-time communication and data transfer between machines and humans, which is critical for the seamless functioning of smart factories. Lastly, the green cluster emphasizes "smart manufacturing," "cyber-physical systems," and "human-machine collaboration," which focus on the integration of digital and physical systems in manufacturing processes. This cluster highlights the importance of AI in optimizing and automating these systems to create more adaptive and efficient manufacturing environments.

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[Figure 16. Keyword Diagram for Bank, IR 4.0, IR 5.0]

Source: Own elaboration

The diagram highlights that while Industry 4.0 is already deeply integrated into banking research, Industry 5.0 is only beginning to emerge in this context. This cluster reflects the early.

The adoption stage of Industry 5.0 principles emphasizes human-machine collaboration, sustainability, and ethics. The significant overlap between IR 4.0 and Banking suggests substantial research on how digitalization, artificial intelligence (AI), and other advanced technologies are transforming banking by enhancing operational efficiency and reshaping customer experiences. In contrast, the limited overlap between IR 5.0 and Banking indicates that human-centric approaches and sustainability, core to Industry 5.0, have yet to be extensively explored within the banking sector. This diagram represents a promising area for future research as the banking industry evolves to incorporate more socially and environmentally responsible practices.

Table 5 presents a list of keywords extracted from the analyzed documents, ranked by frequency of occurrence. The keyword 'regulation' emerges as the most frequently cited term in banking-related research, closely followed by 'crisis.' These two terms are strongly interrelated, reflecting the persistent scholarly focus on the regulatory challenges that arise during financial instability. A prominent example is the 2008 global financial crisis, which was triggered by banks' inability to maintain a stable monetary system. As emphasized by Greenbaum et al. (2019), the primary objective of banking regulation is to safeguard the soundness of financial institutions and preserve the financial system's overall stability."

"In the context of the Fourth Industrial Revolution (IR 4.0), the transformation of business models toward digital platforms and integrating digital technologies in production processes has become critical. Among these technologies, the Internet of Things (IoT) plays a central role by interconnecting devices and systems, enabling real-time monitoring and the implementation of intelligent operations in both manufacturing and service sectors (Khan & Javaid, 2022). This capability for enhanced operational efficiency and innovation has made 'Internet of Things (IoT)' and 'digitalization' widely used keywords in studies addressing IR 4.0."

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Table 5. List of the Top 25 Keywords on Banking, IR 4.0, and IR 5.0

Bank	IR 4.0	IR 5.0
Regulation	Internet of thing (IoT)	industry 4 0
Crisis	Digitalization	Sustainability
Islamic Bank	Smart Manufacturing Systems	Human-Robot Collaboration
Performance	Cyber-Physical System (CPS)	Digitalization
Efficiency	Machine /Deep Learning	Artificial Intelligence
Corporate Governance	Sustainability	Human-Centered Design
Stability	Artificial Intelligence	Smart City
Competition	Digital Twin (DT)	Machine/Deep Learning
Profitability	Big Data (bd)	Smart Manufacturing
Risk	Supply Chain Management	Digital Twins (DTS)
Commercial Bank	Blockchain (bc)	Society 5 0
Lending	Manufacturing Industries	Industrial Internet of Things
Central Bank	Innovation	Blockchain Technology
Credit Risk	Small and Medium-Sized Enterprises	Robotics
Ownership Structure	Circular Economy	Automation
Systemic Risk	Predictive Maintenance (PdM)	Internet of Things
Risk-Taking	Automation	Manufacturing Industries
Digital Banking	Simulation and Modeling	Resilience
Liquidity	Robotics	Supply Chain 5 0
Loans	Security and Privacy	Big Data Analytics (BDA)
Customer Satisfaction	Augmented Reality (ar)	Human Factors
Mergers and Acquisitions	Cloud Computing	Security
Economic Growth	Additive Manufacturing	Covid-19 Pandemic
Service Quality	Covid-19 Pandemic	Energy Efficiency Optimization
Trust	5g/6g mobile communication	Cyber-Physical Social Systems

Source: Own elaboration- VOSviewer

"Meanwhile, the Fifth Industrial Revolution (IR 5.0) is conceptualized as a complementary evolution of IR 4.0, shifting the emphasis toward sustainability, human-centric innovation, and organizational resilience (Xu et al., 2021). Research under the theme of IR 5.0 typically builds upon the technological foundation established by IR 4.0, while introducing new perspectives prioritizing human–technology interaction and long-term sustainability. These shifts in focus have led to the frequent appearance of keywords such as 'sustainability,' 'human–robot collaboration,' and 'resilience' in literature related to IR 5.0.

As presented in Table 6, the keyword 'regulation' appears most frequently in scholarly discussions concerning banking, the Fourth Industrial Revolution (IR 4.0), and the Fifth Industrial Revolution (IR 5.0). This reflects the growing importance of regulatory frameworks in managing the challenges posed by technological advancements. Given their pivotal role in driving economic growth, banks must exercise caution to avoid triggering financial instability in response to rapid digital transformation. The implications of IR 4.0 demand that banking stakeholders re-evaluate and reformulate financial and non—financial regulatory policies to ensure institutional resilience. In this context, regulatory authorities are expected to proactively monitor data-related risks, market dynamics, customer satisfaction, and innovations in financial products to enable continuous policy adaptation (Agarwal et al., 2020).

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Table 6. List of the Top 25 Keywords in the Intersection of Banking, IR 4.0, and IR 5.0

Bank-IR 4.0	Bank-IR 5.0	IR 4.0-IR 5.0	Bank-IR.40-IR.50
Regulation	Regulation	Digitalization	Regulation
Crisis	Performance	Sustainability	Performance
Islamic bank	Efficiency	Artificial Intelligence	Efficiency
Performance	Trust	Manufacturing Industries	Trust
Efficiency	Risk Management	Innovation	Risk Management
Corporate Governance	Innovation	Circular Economy	Innovation
Stability	Transparency	Automation	Transparency
Competition	Smes	Robotics	Gender
Profitability	Gender	Cloud Computing	Job Satisfaction
Risk	Job Satisfaction	Additive Manufacturing	Productivity
Lending	Productivity	Covid-19 Pandemic	Sustainability
Digital Banking	Sustainability	Cybersecurity	Uncertainty
Liquidity	Uncertainty	3D Printing	Commitment
Customer Satisfaction	Commitment	Digitization	Economic Development
Mergers and Acquisitions	Economic Development	Edge Computing	Analytic Hierarchy Process
Economic Growth	Analytic Hierarchy Process	Systematic Literature Review	Human Capital
Service Quality	Human Capital	Optimization	Strategy
Corporate Social Responsibility	Information Technology	Anomaly Detection	Technologies
Trust	Strategy	Education	Profits
Risk Management	Artificial Intelligence (AI)	Interoperability	Ethics
Mobile Banking	Ethics	Maintenance	Customer Experience
Emerging Markets	Customer Experience	Higher Education	Organizational Performance
Financial Inclusion	Organizational Performance	Literature Review	Social Capital
Independence	Social Capital	Logistics	Covid-19 Pandemic
Conventional Banks	Covid-19 Pandemic	Industrial Revolution	Digitalization

Source: Own elaboration- VOSviewer

FUTURE BANK RESEARCH TOPICS

Bibliometric analysis can present four quadrants containing keywords. These four quadrants are:

1. Motor Theme Quadrant: the keywords that are currently still relevant and developing.
2. Niche Theme Quadrant: the keywords that are currently less relevant but still growing.
3. Basic Theme Quadrant: the keywords that are still relevant today and can still develop.
4. Decline Theme Quadrant: the less relevant and less developed keywords, either because they have just new or no longer in demand.

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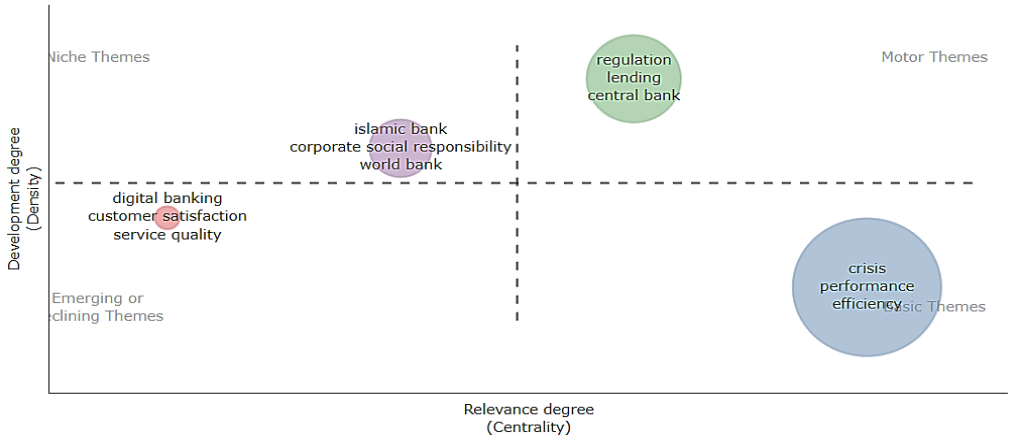
[Figure 17. Quadrant of Relevance and Development of Bank Research]



Source: Own elaboration-Biblioshiny

Motor themes such as regulation and lending highlight that current research primarily focuses on the impact of financial regulations and the pivotal role of central banks in ensuring economic stability. These topics are essential to the future of banking, particularly as the sector grapples with evolving financial technologies and global economic challenges. Niche themes, including Islamic banking and corporate social responsibility, signal a growing interest in specialized areas focusing on alternative monetary systems and ethical considerations. Although less central, these themes are gaining momentum as societal expectations for corporate responsibility and ethical finance continue to rise. Basic themes like crisis management and efficiency remain foundational to banking research, though they are not witnessing rapid development. These topics are crucial for understanding how banks manage financial crises while maintaining operational performance, but their lower density suggests they are well-established areas of study. Emerging or declining themes like digital banking and customer satisfaction may reflect shifting research priorities. As digital banking technologies are widely implemented, the research focus is likely transitioning towards more complex issues, such as regulatory compliance or AI integration, making these themes less prominent in the current academic landscape.

Banking regulation in the context of the Fourth Industrial Revolution remains an open and evolving area of research. Regulatory frameworks play a dual role, as they can either accelerate or hinder the adoption of innovation and technology—both of which are fundamental to the advancement of Industrial Revolution 4.0 and Industrial Revolution 5.0 (Martin & Parigi, 2013; Adib & Nabiha, 2016; Mutiara et al., 2019; Lee et al., 2020; Ahiabenu, 2022).

DISCUSSION

Industry 4.0 (IR 4.0) has emerged as a mature and dominant theme in banking research, focusing on digitalization, automation, and artificial intelligence (AI). The co-occurrence network analysis reveals a substantial lexical overlap, amounting to 3,440 words, between IR 4.0 and banking, indicating an advanced stage of scholarly attention and application. This overlap is primarily centered on digital banking, AI-driven innovations, and operational efficiency, which have become integral for banks aiming to maintain competitiveness, enhance customer experience, and ensure service continuity. These findings confirm that IR 4.0 technologies have been successfully assimilated into the core architecture of modern banking systems.

In contrast, Industry 5.0 (IR 5.0) remains in its infancy within the banking research landscape, evidenced by a significantly lower lexical intersection of only 231 words. However, this early-stage presence does not diminish its potential impact. Thematic evolution analysis indicates a gradual shift in research priorities—from efficiency and crisis mitigation toward more forward-looking themes such as trust, personalization, and sustainability. This transition reflects a growing awareness of the need to embed human values, ethics, and social responsibility into the future design of banking systems, especially in the wake of accelerating AI adoption.

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Cluster analyses further illuminate this evolutionary trajectory. While earlier clusters in banking research emphasized financial stability, crisis management, and regulatory compliance, particularly in response to systemic disruptions like the 2008 financial crisis and the COVID-19 pandemic, recent clusters highlight digital transformation, customer engagement, and inclusive innovation. Simultaneously, IR 4.0 research clusters underscore the transformative power of blockchain, IoT, and AI technologies. These technologies have enabled banks to streamline operations and personalize services at scale. However, IR 5.0 introduces a qualitative shift: from technology-centered innovation to innovation explicitly designed to augment human potential, uphold ethical standards, and align with environmental, social, and governance (ESG) objectives.

The emergence of IR 5.0 marks a paradigmatic reorientation. Rather than replacing human labor with automation, banks are increasingly encouraged to leverage human-machine collaboration. This synergy aims not only to enhance decision-making capabilities, such as in risk analysis, credit scoring, and fraud detection, but also to preserve essential human attributes such as empathy, ethical judgment, and contextual reasoning. Here, IR 5.0 complements the technical strengths of IR 4.0 with human-centric values, fostering a more holistic framework for banking innovation.

Strategic thematic mapping confirms this shift. Motor themes—such as regulation, lending, and central banks—remain well-developed and central, reflecting persistent institutional concerns over compliance and monetary stability. Basic themes, including efficiency and crisis management, remain relevant, supporting operational resilience. Meanwhile, niche themes such as Islamic banking and corporate social responsibility (CSR) are gaining visibility, aligning closely with IR 5.0's emphasis on inclusivity and sustainable finance. Emerging themes like digital banking and customer satisfaction suggest realigning research interests toward balancing technological advancement with user trust and ethical governance.

Three interconnected concepts—sustainability, human-machine collaboration, and ethics—are particularly salient in the context of IR 5.0. These are not peripheral considerations; they represent foundational redefinitions of long-term value in banking. The growing importance of sustainability is evident in the shift toward green finance, ESG disclosure mandates, and climate-related risk assessments. Banks are now expected to offer credit, manage risks, and play an active role in transitioning to a low-carbon, inclusive economy. CSR initiatives have similarly expanded in scope, encompassing responsible lending practices, ethical use of AI, and support for community resilience, consistent with IR 5.0's ethical imperatives.

Human-machine collaboration further reconfigures work. Rather than framing automation as a replacement for human effort, IR 5.0 advocates for systems where machines and humans operate symbiotically. In banking, this entails using AI to handle repetitive, data-intensive tasks while preserving human oversight for ethical and strategic decisions. This dual-capability model reinforces trust, a critical asset in financial services.

Ethics, as a research focus, has re-emerged in response to public scrutiny over data privacy, algorithmic transparency, and digital surveillance. As financial institutions become more reliant on automated decision-making systems, concerns over fairness, accountability, and inclusivity grow. IR 5.0 elevates these concerns from operational compliance to strategic priorities, emphasizing the need for transparent and explainable AI, equitable financial access, and principled governance.

This integrative approach is essential in navigating regulatory complexity. As Barth (2010) notes, U.S. bank regulations have historically been reactive, fragmented, and crisis-driven—an approach that often leads to inconsistency and overlap. Such lessons underscore the need for proactive, principles-based regulation that anticipates rather than merely responds to disruptions. This is particularly relevant in the age of rapid digital transformation, where regulatory lag can undermine innovation and stakeholder trust.

Looking ahead, research must more actively explore how IR 5.0 principles can be operationalized within banking. Key questions include: How can banks redesign service delivery to prioritize human dignity, transparency, and environmental stewardship? How can ethical AI frameworks be embedded into risk management and customer service? What regulatory models best balance innovation with accountability? There is also a need to investigate how banks can strengthen their ESG strategies and align their operations with global sustainability targets.

Furthermore, research should examine how to bridge the paradigms of IR 4.0 and IR 5.0. While IR 4.0 optimized efficiency through digitization, IR 5.0 challenges banks to infuse this efficiency with meaning and purpose. This includes evolving cyber-physical systems, AI, and IoT into tools that support human development, societal inclusion, and environmental regeneration.

In conclusion, the banking sector stands at a critical inflection point. To remain competitive and trustworthy in an increasingly complex and digitized environment, banks must integrate IR 5.0 principles into their strategic architecture. This calls for a transition from technology-driven innovation to values-driven transformation—where human welfare, ethical governance, and sustainability are not constraints but catalysts for long-term performance.

CONCLUSION

This bibliometric study provides a comprehensive overview of the evolution and intersection between Industry 4.0 (IR 4.0), Industry 5.0 (IR 5.0), and the banking industry from 2011 to 2023. The findings demonstrate that IR 4.0 has played a dominant role in banking research, particularly in themes such as digital banking, artificial intelligence, automation, and blockchain. These technologies have transformed operational efficiency and customer interaction models, signaling a mature phase of digital transformation within the banking sector.

However, the presence of IR 5.0 in banking literature remains relatively limited, though its conceptual contribution is increasingly relevant. By emphasizing human-centric innovation, ethical technology, and sustainability, IR 5.0 introduces a new paradigm that extends beyond efficiency toward social value and long-term trust. This marks a potential research frontier, especially as financial institutions seek to rebuild trust and legitimacy in a post-pandemic and digitally complex world.

The thematic evolution—from regulation and risk management toward digital trust and innovation—illustrates a shifting academic and practical focus. Notably, the emergence of themes such as customer satisfaction, corporate social responsibility (CSR), and sustainability underlines the need for a banking model that integrates technological advancement and human values. In this regard, IR 5.0 offers a promising framework to bridge digital transformation with ethical and sustainable banking practices.

From a practical standpoint, the study suggests that banks and regulators must accelerate digital adoption and embed IR 5.0 values—human-centered design, ethical AI, and environmental-social governance (ESG)—into their strategies. The future of banking lies not solely in automation and analytics but in building inclusive, transparent, and resilient financial ecosystems that are aligned with societal goals.

POLICY IMPLICATIONS

The findings of this study carry important implications for policymakers, banking regulators, and industry leaders. First, policy frameworks must evolve to accommodate the integration of IR 5.0 principles into the financial sector, especially in areas such as ethical AI deployment, digital inclusion, and ESG reporting. Regulatory guidelines should support technological innovation and ensure that such innovations uphold ethical standards and societal values. Second, governments and central banks should promote cross-sectoral collaboration and invest in digital upskilling initiatives to prepare the workforce for human-machine collaboration envisioned in IR 5.0. Finally, national innovation policies should explicitly recognize the strategic role of banking in achieving broader sustainable development goals, encouraging financial institutions to act not only as economic intermediaries but also as agents of social transformation.

LIMITATIONS

This study is subject to several limitations. First, the bibliometric analysis is based solely on data from the Scopus database, which may exclude relevant studies indexed in other databases such as Google Scholar or Web of Science. Second, the analysis is limited to specific keywords, which may not capture all variations in terminology used to describe IR 4.0, IR 5.0, or banking innovations. Third, while the study identifies trends and thematic clusters, it does not offer a deep qualitative assessment of individual articles' theoretical frameworks or methodological rigor. As such, future studies are encouraged to complement bibliometric findings with systematic literature reviews or meta-analyses.

Research Article

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