Digital Financial Innovation, Bank Efficiency, And Sustainability: A Prisma Based Systematic Literature Review in the Banking Sector (2015–2025)

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Abstract. This research presents a systematic literature review (SLR) that integrates three main pillars—digital financial innovation, banking efficiency, and sustainability—using the PRISMA approach and the CIMO framework for the period 2015–2025. The digitalization of financial services and the adoption of fintech have become key drivers of the transformation of the global banking industry, impacting operational efficiency, profitability, risk management, and the sustainability agenda. Through a rigorous identification and selection process, this study analyzed 30 primary studies (60 reports) from Scopus and other relevant sources, mapping the geographic context, forms of digital intervention, mechanisms of influence, and resulting outputs. The results show that research is dominated by studies based in the Asian context, particularly China, with a focus on digital transformation, fintech adoption, and regulatory sandbox implementation. The main mechanisms identified include data-driven decision-making, digital governance, network effects, automation, and financial inclusion. Meanwhile, the dominant outputs are cost efficiency, profitability, risk stability, and improved ESG performance, although research related to the circular economy and social implications remains limited. The main contribution of this SLR is the development of CIMO-based mapping and a Tri-Dimensional Digital Banking Framework conceptual framework that connects digital technology, regulatory governance, and sustainability. These findings provide practical implications for banks, regulators, and policymakers regarding digital transformation strategies, risk governance, and ESG integration. Furthermore, this study opens a broader research agenda related to geographic equity, enriching methodologies, and expanding outputs toward efficient, inclusive, and sustainable digital financial innovation.

Keywords: Digital Financial Innovation; Bank Efficiency; Sustainability; CIMO Framework; PRISM; ESG; Fintech.

INTRODUCTION

Over the past decade, digital financial innovation has become a major driver of transformation in the banking system and the global economy. The adoption of technologies such as internet and mobile banking, digital payments, *fintech*, artificial intelligence (*AI*), and blockchain has transformed the way banks raise funds, distribute credit, manage risk, and interact with customers. The impact of this transformation is reflected not only in increased productivity and cost efficiency but also in expanded financial inclusion and strengthened resilience of the financial system.

Empirical research shows that banking digitalization contributes significantly to bank efficiency and performance. Yu et al. (2019) emphasized the importance of a quantitative framework based on Data Envelopment Analysis (DEA) to measure bank operational efficiency in the context of technology utilization. A study in Spain by Carbó-Valverde et al. (2024) found that information technology (IT) investments drive customer digital channel usage, although this does not always lead to full digital migration. A study in Vietnam (Le et al., 2022) showed that appropriate ICT investments can improve bank cost efficiency and profitability, while undirected ICT use actually reduces performance.

At the same time, digital financial innovation is also playing a role in reshaping the financial intermediation landscape. Y. Zhang et al. (2018) show that the development of *fintech* in China is driving financial disintermediation and expanding access to financing for

MSMEs, especially in regions with high levels of digitalization and marketization. Zuo et al. (2021) highlight how digitalization is transforming capital allocation and facilitating productive innovation in the banking sector. Recent studies by Yu and Liu (2025) and Wang et al. (2025) link digital transformation to a decrease in excessive risk behavior and reduced regulatory violations, indicating that digitalization not only supports profitability but also strengthens governance and compliance.

Another increasingly prominent dimension is sustainability. Global agendas such as the SDGs and climate commitments encourage banks to consider the environmental and social impacts of their intermediation activities. Digitalization opens up opportunities for the emergence of "*green fintech*" solutions and ESG-enabled digitalization, such as digital-based ESG reporting dashboards, AI-based climate risk assessments, and green financing products integrated into digital platforms. A bibliometric analysis by Gherțescu et al. (2024), for example, shows that the literature on bank digitalization strategies is shifting from simply focusing on financial efficiency to integrating sustainability dimensions.

Thus, a systematic understanding of the relationship between digital financial innovation, bank efficiency, and sustainability is becoming increasingly important. On the one hand, banks face pressure to increase cost efficiency, improve service quality, and maintain competitiveness amidst *fintech* and bigtech competition. On the other hand, they are required to respond to the sustainability agenda through green financing, climate risk management, and strengthened financial inclusion. The key question is to what extent digital financial innovation improves bank efficiency while supporting the sustainability agenda, and through what mechanisms does this influence occur in various regulatory and institutional contexts?

The need for a more structured answer to this question has become increasingly urgent as publications related to digital banking, *fintech*, and ESG in the financial sector have grown rapidly, particularly following the COVID-19 crisis and the acceleration of digital transformation in various countries. However, such a vast and fragmented literature requires a systematic synthesis to provide a clear picture of patterns, contradictions, and remaining research gaps.

The growing literature on banking digitalization and bank efficiency indicates a significant paradigm shift. Initially, studies focused primarily on traditional structural factors—such as bank size, capitalization, and asset quality—as determinants of efficiency and profitability. With the penetration of digital technology, the research focus shifted to the integration of IT, fintech, and advanced data analytics as new sources of efficiency. Carbó-Valverde et al. (2024) found that IT investments increase the intensity of customer digital channel usage, but the effect on operational efficiency is not always linear, raising questions about the conditions and mechanisms that make digital investments truly productive. Bernini et al. (2022) added a reputational dimension by showing that a bank's digitalization strategy is positively related to the institution's public image, indicating that digital transformation is not just a technology project but also a communication strategy and market positioning.

Zhang et al. (2022) showed that fintech acts as a disintermediation agent that expands access to financing for MSMEs, but its effects are heterogeneous across regions depending on the level of digitalization, marketization, and securitization. Le et al. (2022) confirmed that robust ICT infrastructure is a key determinant of bank efficiency, while unintegrated ICT

applications can create new sources of inefficiency. From a methodological perspective, a trend is emerging toward using more sophisticated analytical approaches. Yu & Liu (2025) introduced a hybrid DEA–PPR model that combines projection regression and machine learning to predict bank efficiency, achieving higher accuracy than traditional artificial neural networks. Chao et al. (2024) developed a DEA framework with AI-based target setting that not only classifies efficiency but also provides clearer input adjustment recommendations for bank managers.

Another important trend is the relationship between digitalization, risk, and sustainability. Zhu & Guo (2024) showed that fintech can improve bank performance by increasing risk efficiency, while Jun & Ran (2024) found that government subsidies to fintech platforms were more effective than direct subsidies to MSMEs in promoting access to finance. Ayadi et al. (2025) revealed an inverted-U pattern between IT investment and cost and profit efficiency, suggesting that excessive digitalization without adequate strategy and governance can reduce efficiency benefits. Wang et al. (2025) noted that digital transformation can reduce bank regulatory violations by approximately 7.27% per one standard deviation increase in digitalization intensity, primarily through improved information discrimination and strengthened internal controls. Yang & Chen (2025) and Ayadi et al. (2025) also found that digitalization is associated with a lower risk profile (increased Z-score) and increased profitability, particularly for smaller banks and banks operating in regions with more advanced digital infrastructure.

On the other hand, the literature is beginning to highlight the impact of human capital and work quality in the digital era. Zeshan et al. (2025) use the Job Demands–Resources (JD-R) framework to explain the paradox of digitalization in Pakistan's banking sector, where digital technology can simultaneously increase efficiency and work demands, necessitating balancing mechanisms such as job crafting and strengthening employees' digital competencies. Overall, the trends observed from 2015 to 2025 highlight several key developments in the literature. First, digital financial innovation is increasingly positioned as a primary driver of both efficiency and competitive advantage within the banking sector. Second, the interconnectedness between digitalization, risk management, and sustainability has become a central focus, reflecting a growing recognition of their combined impact on long-term bank performance. Third, methodological approaches have evolved significantly, moving beyond traditional econometrics to incorporate more advanced techniques such as Data Envelopment Analysis (DEA), network DEA, and machine learning, enabling more nuanced and predictive insights. Finally, the academic and practical discourse has shifted from merely questioning whether digitalization is important to exploring how and under what conditions digitalization can yield optimal outcomes in terms of efficiency and sustainability, emphasizing contextual factors, implementation mechanisms, and governance structures.

Several previous studies have reviewed the literature on digitalization, bank efficiency, and performance measurement methodologies. Sofos et al. (2022) combined a systematic literature review with a comparative study of machine learning algorithms for predicting fluid properties, demonstrating the dominance of tree-based algorithms and the limitations of linear models and single-data simulations. While not in the banking context, this study provides an initial illustration of how SLR can be combined with a comparative evaluation of AI methods.

Ratner et al. (2023) conducted a systematic literature review of Network DEA from 2017–2022 and found an annual growth rate of approximately 47% in publications, dominated by two-stage models and applications in banking, supply chains, and education. However, this study focused on the methodological aspects of Network DEA without explicitly linking it to digitalization, sustainability, or policy themes. Gherțescu et al. (2024) presented a bibliometric analysis of bank efficiency in the context of digitalization and Industry 4.0 using the Web of Science and Scopus databases. They identified eight thematic clusters—such as risk, performance, sustainability, and technology—and demonstrated a shift in focus from traditional efficiency measures to the integration of digital technologies and sustainability considerations. However, this analysis remains at a macro level and does not link bibliometric findings to specific causal mechanisms linking digital innovation, efficiency, and sustainability outcomes.

Sousa & Almeida (2025) conducted a global bibliometric analysis of banking profitability and found that internal factors (size, liquidity, efficiency) and external factors (GDP, inflation) remain dominant, while digital innovation and electronic payments are emerging as significant contributors to profitability. However, this study still separates profitability analysis from sustainability issues and does not present a unified conceptual structure linking digitalization with ESG and financial inclusion.

In general, existing reviews make important contributions in the form of: (1) mapping publication growth; (2) identifying key themes; and (3) recognizing some methodological gaps. However, they suffer from a number of recurring limitations, including reliance on one or two databases (WoS, Scopus, Google Scholar), exclusion of non-English-language literature, focus on a single dimension (e.g., only efficiency or only digitization), and minimal integration of bibliometric findings with recent empirical evidence.

The state of the art in the literature on digital financial innovation, bank efficiency, and sustainability reveals a multi-layered research landscape. At the empirical level, a growing number of studies examine the impact of digitalization on operational efficiency, profitability, and risk across diverse countries such as China, Vietnam, Pakistan, and various European nations. These studies increasingly incorporate novel variables, including regional fintech indices, digital maturity indicators, regulatory sandbox policies, and ESG scores, enriching the analytical depth of the field. At the review level, several systematic literature reviews (SLRs) and bibliometric analyses have been conducted, yet their focus remains fragmented: some SLRs concentrate on specific methodologies like Network DEA, while others map bank efficiency within the context of Industry 4.0 or discuss bank profitability in general terms. However, a significant gap persists, as no existing SLR has comprehensively integrated the three core dimensions—digital financial innovation, bank efficiency, and sustainability—into a unified analytical framework, particularly for the current period spanning 2015 to 2025.

Several key research gaps can be identified in the current literature. First, the thematic scope remains fragmented; most reviews address only one dimension—such as digitalization and efficiency, profitability, or sustainability—without simultaneously linking all three. No study has systematically mapped how digital financial innovation simultaneously impacts bank efficiency and sustainability outcomes, including ESG performance, financial inclusion, and climate risk. Second, the theoretical perspective is often partial, with many studies relying on a single paradigm such as the resource-based view or the Technology Acceptance

Model, without integrating other relevant lenses like institutional theory, sociomateriality, or dynamic capabilities. As a result, the mechanisms explaining how and why digital innovation drives efficiency and sustainability remain inadequately elucidated. Third, there are significant limitations in geographic context, as research is heavily concentrated on developed economies or individual countries like China, while evidence from key fintech hubs in Southeast Asia, Africa, and Latin America remains under-synthesized. This constrains generalizability and obscures the role of contextual factors such as regulatory quality, digital infrastructure, and financial inclusion levels. Fourth, synthesis approaches are often limited; existing reviews tend to be descriptive narratives that do not employ structured frameworks such as CIMO (Context–Intervention–Mechanism–Outcome) to organize evidence, and they rarely combine qualitative and quantitative analyses systematically. Fifth, there is a lack of explicit focus on intermediary mechanisms and potential trade-offs. While most studies report that digitalization improves efficiency and performance, few explore the underlying mechanisms—such as digital governance, infrastructure maturity, or human resource capabilities—or examine trade-offs between short-term efficiency and long-term sustainability, such as risks of digital exclusion, market concentration, or algorithmic bias. These gaps underscore the need for a more integrative systematic literature review that not only maps what has been studied but also examines where, with what interventions, through what mechanisms, and toward what outcomes, precisely as emphasized by the CIMO framework.

Based on these gaps, this article introduces several major novelties. First, it adopts an integrated thematic focus, explicitly examining digital financial innovation, bank efficiency, and sustainability within a single analytical framework—unlike previous SLRs that treated these topics separately. Digital financial innovation here encompasses bank–fintech collaboration, AI and advanced analytics in risk management, digital channel development, and ESG-enabled digitalization programs. Second, it employs the CIMO (Context–Intervention–Mechanism–Outcome) framework as the primary lens for synthesis, enabling the identification of configurations related to context (e.g., bank type, region, regulatory level), intervention (forms of digital innovation), mechanism (e.g., network effects, data-driven decision-making, digital governance), and outcome (efficiency, profitability, risk, and sustainability indicators). This structured approach is rarely applied in banking SLRs and offers a richer conceptual foundation. Third, the article is oriented toward the current period of 2015–2025, capturing the accelerated digital transformation driven by the Fourth Industrial Revolution and the COVID-19 pandemic, including emerging trends like green fintech, regulatory sandboxes, open banking, and big data–driven climate risk assessments. Fourth, it integrates efficiency and sustainability dimensions by explicitly linking bank efficiency indicators (e.g., cost-to-income ratio, ROA, DEA/network DEA scores, Z-scores) with sustainability indicators (ESG ratings, green loan growth, financial inclusion, emissions reduction), examining not only whether digitalization improves efficiency but also how it supports sustainability outcomes. Fifth, based on the CIMO synthesis, the article proposes an initial conceptual framework—the Tri-Dimensional Digital Banking Framework—that links digital technology dimensions, institutional factors (regulation, digital governance), and sustainability outcomes to bank efficiency, providing a basis for further empirical research and policy design.

In line with its novel contributions, this study pursues several main objectives. First, it aims to systematically map the empirical and conceptual literature on digital financial innovation in the banking sector as it relates to efficiency and sustainability over the period 2015–2025. Second, it seeks to identify various forms of digital interventions—such as bank–fintech collaboration, AI applications in risk management, and ESG-enabled digitalization—that have been implemented across diverse banking contexts in both developed and developing countries. Third, the study intends to classify the mechanisms that bridge the relationship between digital innovation and its outcomes—including efficiency, risk, and sustainability—by employing the CIMO (Context–Intervention–Mechanism–Outcome) framework. Fourth, it will explore contextual factors—such as regulation, market structure, digital capacity, and data quality—that may strengthen or weaken the impact of digital innovation on bank efficiency and sustainability. Finally, the research aims to develop forward-looking research agendas and evidence-based policy recommendations for regulators, bank managers, and other stakeholders. The scope of the study encompasses multiple dimensions: sectorally, it includes commercial banks, development banks, micro-financial institutions with intermediary functions, and, where relevant, Islamic banking units; geographically, it covers both developed and developing countries, with particular attention to emerging economies in Asia, Africa, and Latin America as fertile grounds for fintech innovation; methodologically, it considers empirical articles (using panel data, cross-sectional analyses, DEA/network DEA, case studies, and experiments), conceptual reviews, and research reports published in indexed journals, supplemented selectively by grey literature from official institutions; and thematically, it examines a range of digital innovations, including digital service channels (mobile/internet banking), digital payments and credit, bank–fintech collaboration, AI and machine learning in risk management, open banking/APIs, and ESG-enabled digitalization programs.

MATERIALS AND METHODS

This study used a Systematic Literature Review (SLR) design structured according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines as developed by Moher et al. (2009). The use of PRISMA is intended to ensure a transparent, replicable, and selection-bias-free review process , while simultaneously strengthening the quality of reporting and review methodology. This approach aligns with the recommendations of Panic et al. (2013), Siddaway et al. (2019), and ter Huurne et al. (2017), who position PRISMA as the gold standard in reporting cross-disciplinary systematic reviews.

Different from most previous SLRs in the banking sector which tend to be descriptive and focus on one dimension (for example only digital banking, only DEA, or only profitability), this SLR explicitly: (1) integrates three main pillars, namely digital financial innovation , bank efficiency , and sustainability /ESG ; (2) using the CIMO (Context–Intervention–Mechanism–Outcome) framework to map the study's contributions; and (3) placing the time span 2015–2025 to capture the current wave of digital transformation in the banking sector.

The literature identification stage was conducted primarily through the Scopus database , which was chosen due to: (1) its strict journal selection standards, (2) its complete

metadata (title, abstract, keywords, citations) that facilitate further filtering and analysis, and (3) its multidisciplinary coverage relevant to the topic of digital financial innovation. Scopus was used as the primary database , while Google Scholar was not used as the primary source due to high duplication, weak quality control, and the risk of predatory journals and non-peer-reviewed documents entering , which could reduce the validity of the findings (Hariningsih et al., 2024).

In addition to Scopus, additional searches were conducted through:

a. Watase database (Wahyudi, 2024) as an internal repository that has mapped articles related to digital financial innovation and bank efficiency;

b. Grey literature such as financial authority reports, central bank reports, and conference proceedings relevant to digitalization, fintech, and sandbox policies.

This step is intended to reduce publication bias and capture studies that are not yet fully indexed in mainstream journals, especially those related to developing country contexts.

The search strategy was designed to reflect the research's primary focus, namely the intersection of digital financial innovation and bank efficiency. The main keyword combinations used were:

("digital financial innovation" OR "digitalisation" OR "digitalization") AND

(" bank efficiency " OR " bank performance " OR " banks' efficiency "). To increase the coverage, some additional terms are included, such as:

- FinTech , financial technology
- digital transformation , digital banking , neobank
- AI-driven risk management , blockchain , cryptocurrency
- ESG , sustainability , financial inclusion

These terms are adapted from vocabulary that frequently appears in key articles (e.g., Zhang et al., 2022; Cao et al., 2022; Zhu & Guo, 2024; Ayadi et al., 2025).

The search was limited to 2015–2025 to capture the main wave of digital transformation following the global financial crisis and the acceleration of digitalization following the COVID-19 pandemic. English -language articles only. included, in line with common SLR practice in finance and management.

Eligibility stage uses a combination of inclusion–exclusion criteria as follows:

Inclusion criteria:

1. Journal articles (Q1–Q4 Scopus) or reputable conference proceedings that:
   a. discussing digitalization, fintech, or digital transformation in the banking context;
   b. measure or discuss efficiency, financial performance, stability, or ESG/ sustainability;
2. Empirical studies (quantitative, qualitative, mixed methods) and conceptual studies that provide a clear theoretical framework;
3. Have abstracts and methods that can be evaluated;
4. Published between 2015–2025.

   Exclusion criteria:

   1. Editorials, comments, or letters to the editor without primary data;
   2. Articles that are purely opinion based without a clear methodology;
   3. Studies that address non-banking fintech without an explicit connection to the

banking sector (e.g. pure retail crypto with no ties to banks);

4. Articles that do not provide sufficient information for CIMO mapping (e.g. unclear context, intervention, or outcome).

The selection process follows the PRISMA 2020 flow, which in this study can be summarized as follows:

1. Identification
   - Initial record from Scopus: 124 articles.
   - Auto duplication: 0 (no duplication found).
   - Deletion by automation tools (filter year 2015–2025 and document type): 2 articles.
   - Other deletions (did not meet quality criteria, outside Q1–Q4, or not relevant): 33 articles.
   - Footage remaining for screening: 89 articles.

2. Screening (Title & Abstract)
   - 89 titles and abstracts were manually screened by two independent reviewers.
   - At this stage no articles were eliminated, as all were still considered relevant at the title/abstract level.

3. Eligibility (Full-text Assessment)
   - 89 articles were requested for full text; 59 were inaccessible (e.g., behind a paywall without institutional access, or the documents were no longer available online).
   - 30 articles were successfully retrieved in full and tested for their suitability against the inclusion-exclusion criteria.
   - All 30 articles met the eligibility criteria; none were eliminated at this stage.

4. Inclusion
   - Studies included in review from other sources as many as 30 primary studies.
   - Many studies produced more than one report (e.g. working paper + journal article), so a total of 60 reports were used in the final analysis stage.

This numerical summary is visualized in a PRISMA flowchart that depicts the Identification–Screening–Eligibility–Inclusion flow sequentially.
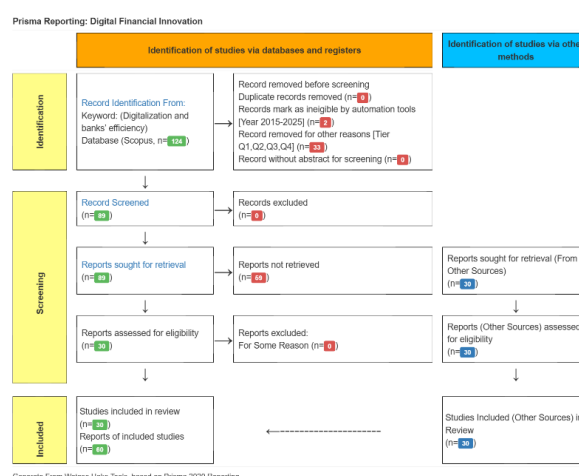
Figure 1. PRISMA Flow Diagram of Study Selection Process
Source: Researcher's analysis based on PRISMA guidelines (2025)

The next stage is the extraction of structured data and mapping it into the CIMO framework. The extraction matrix includes:

- study identity (author, year, journal, country/region);
- context characteristics (bank type, level of economic development, regulatory framework, developing/developed country focus);
- types of digital interventions (fintech adoption, digital banking, AI risk management, blockchain, ESG digitalization);
- proposed or tested mechanisms (network effects, data-driven decision making, digital governance, green-data feedback loops, dynamic capabilities);
- reported outcomes (cost efficiency, profitability, stability, risk, financial inclusion, ESG, circular economy).

Each study was then mapped to a specific CIMO combination and associated with a previously formulated research question (RQ):

1. RQ1 – Context & Intervention: the geographic, regulatory, and institutional context in which DFI is implemented;
2. RQ2 – Mechanisms: mechanisms activated by the intervention.
3. RQ3 – Outcomes: financial and non-financial outcomes;
4. RQ4 – Mediating mechanisms: mechanisms that mediate the effectiveness of the intervention;
5. RQ5 – Future research agenda: research gaps and future research directions.

The analysis was carried out in two layers: descriptive–bibliometric and thematic–CIMO.

1. Descriptive & bibliometric analysis
   - Annual publication trends (2015–2025);
   - Geographic distribution and type of institutions (commercial banks, microfinance, etc.);
   - Distribution of journal tiers (Q1–Q4) and main outlets (Business Strategy and the Environment, Economic Modeling, Finance Research Letters, Technological Forecasting and Social Change, etc.);
   - Methods used (DEA, panel data econometrics, PLS-SEM, ML/ANN, design science, qualitative studies);
   - Data collection patterns (secondary vs primary, survey vs panel data, databases such as CSMAR, Wind, World Bank, bank annual reports).

2. Thematic analysis and CIMO-based synthesis
   - Following the steps of Braun & Clarke's (2006) thematic analysis modified with the Watase Uake System (Wahyudi, 2024): familiarization, initial coding, theme grouping, review, and theme naming.
   - Grouping of findings into categories of Context, Intervention, Mechanism, Outcome and identification of dominant CIMO configurations.

To maintain validity and reliability, several steps were taken:
- Double screening: two researchers assess the title/abstract and full-text independently,

differences are resolved through discussion until consensus is reached;

- Audit trail: all decisions on selection, coding, and grouping of themes are documented;
- Theoretical relevance: the themes formed were re-evaluated against the CIMO-based RQs to ensure consistency.

From an ethical standpoint, this SLR does not involve personal data or direct respondents, and therefore does not require specific ethics approval. The entire selection procedure was conducted transparently, and a PRISMA table was prepared to document the reasons for inclusion and exclusion.

RESULTS AND DISCUSSION

This section presents the main results of the SLR which are divided into: (1) a general profile of the literature, and (2) a CIMO -based synthesis of digital financial innovation, bank efficiency, and sustainability.

1. General Profile of Literature

a. Publication Trends and Geographic Distribution

Trend analysis shows a sharp increase in the number of articles discussing digital financial innovation in the banking sector. At the beginning of the period (around 2015–2018), the number of articles was relatively small, often consisting of case studies or single-country analyses. Entering 2019–2025, publications increased significantly, reaching dozens of articles per year, with a wider distribution spanning over 30 countries.

Geographically, empirical evidence is heavily concentrated in China, which accounts for about a third of the sample and has become a key "laboratory" for fintech policy and digital banking transformation (Zhang et al., 2022; Zhu & Guo, 2024; Tian et al., 2025). Other Asian countries such as Pakistan, India, Iran, Turkey, and Indonesia also feature prominently, particularly in the context of bank efficiency and financial inclusion.

Contributions from Africa and the Middle East (e.g., Ghana, Angola, Kenya, and MENA) are still limited, with only one or two studies focusing on the role of fintech in the informal sector and efficiency at the provincial level (Abdulai et al., 2024); (Cangombe et al., 2025) ; (Bu et al., 2025) . Meanwhile, studies from developed countries (Europe, the US, Japan, and Korea) generally highlight the relationship between IT investment, profitability, and banks' digital reputation (Ayadi et al., 2025; Cao et al., 2022; Bernini et al., 2022) .

b. Content Pillars and Keywords

Keyword frequency analysis shows four main pillars:

1. Digitalization / digital transformation (42 and 22 occurrences)
2. Fintech & related technologies (FinTech, blockchain, cryptocurrency, AI, big data, machine learning)
3. Banking performance & efficiency (profitability, bank stability, DEA, panel data)
4. Societal impact (financial inclusion, sustainability, circular economy, ESG)

Supporting subthemes include regulatory instruments (CBDC, sandbox, cybersecurity), delivery channels (digital payments, digital wallets, neobanking), and

methodological approaches (DEA, panel data, bibliometric analysis). This pattern indicates that recent research focuses on how to leverage digital tools to improve bank efficiency and performance, while linking them to financial inclusion and sustainability goals.

c. Methodology and Analysis Techniques

More than 80% of studies used quantitative designs, dominated by:

-   Data Envelopment Analysis (DEA) and its derivatives (network DEA, Malmquist-DEA, stochastic DEA) to measure technical efficiency and productivity; (Cao et al., 2022; Li et al., 2020; Yu & Liu, 2025; Zuo et al., 2021; (Sari et al., 2022).
-   Panel data econometrics with fixed effects, difference-in-differences, IV, GMM, and VAR models to assess the impact of digitalization, fintech, and regulation on bank performance (Zhang et al., 2022; Chao et al., 2024; Ayadi et al., 2025; Tian et al., 2025).

PLS-SEM method (for example in the study (Zeshan et al., 2025) was used to test a model based on the Job Demands–Resources (JD-R) theory that examines the impact of digitalization on the workload of bank employees. Machine learning and ANN approaches are still sporadic (Ghenai et al., 2024); (Mehdi et al., 2025) , but is starting to be directed towards risk prediction and energy/digital network optimization. Qualitative methods and mixed methods are still minimal, although several studies (Zeshan et al., 2025); (Poppe et al., 2022) show great potential to reveal institutional and behavioral mechanisms that are not captured by numerical secondary data.

d. Data Collection Pattern

The majority of studies (more than two-thirds) used secondary data from commercial databases (CSMAR, Wind, Bloomberg) and official sources (World Bank, China Statistical Yearbook, bank annual reports). Relatively few studies used questionnaire surveys, for example (Zeshan et al., 2025) which examined bank employee workload in Pakistan, and (Abdulai et al., 2024) which examined digital payment usage in Ghana. The rich context generated by these surveys demonstrates the importance of primary data in capturing behavioral and institutional aspects that secondary data cannot fully capture.

2. CIMO-Based Synthesis: Context, Intervention, Mechanism, Outcome

a. Context (C)

Most studies focus on commercial banks and fintech ecosystems in countries with relatively high levels of digitalization. Approximately 70% of the sample comes from the formal banking and fintech sectors, with a focus on bank performance and stability (Zhang et al., 2022; Zhu & Guo, 2024; Yu & Liu, 2025). Regionally, China and South/East Asia dominate for the following topics:

-   the impact of digital transformation on efficiency and risk (Zhang et al., 2022; (Wang et al., 2025) ; Ayadi et al., 2025),
-   the role of fintech in reducing financing constraints for SMEs (Zhang et al., 2022; Jun & Ran, 2024; Iatzaz et al., 2025),

- implementation of regulatory sandboxes and national digital policies (Bu et al., 2025).

Contributions from Africa, Latin America, and the Pacific remain low; this presents an important contextual gap, as the dynamics of digitalization in regions with weak infrastructure and different regulations may result in dissimilar mechanisms and outcomes.

b. Intervention (I)

Key interventions identified include:

1. Fintech adoption & bank–fintech collaboration , such as: Digital payment adoption (e-wallet, QR-code) (Zhang et al., 2022); Blockchain-based services (smart contracts, DeFi) ((Jun & Ran, 2024)Gomber et al., 2018); AI-driven credit scoring and machine learning for risk management (Chen et al., 2022) .
2. Digital transformation of banking, including ICT investment, neobank development, core banking system updates, and digital-only channels that affect efficiency and profitability (Cao et al., 2022; Ayadi et al., 2025; Liu et al., 2024).
3. Regulatory instruments and sandboxes, including Regulatory sandbox for fintech product trials, data privacy policies (GDPR, PDPA) and exploration of CBDC and cybersecurity frameworks (Arner et al., 2017; Böhme & Moore, 2020; Jun and Ran, 2024).
4. ESG-enabled digitalization, including green-fintech platforms, sustainability dashboards, DEA networks that incorporate undesirable outputs (carbon emissions), and green financing models (Zuo et al., 2021; Al-Qazzaz et al., 2025 ; Ghertescu et al., 2024).

c. Mechanism (M)

The various mechanisms that mediate the intervention–outcome relationship can be grouped as follows:

1. Data-driven decision making & risk analytics: the use of big data and AI in credit scoring and fraud detection improves the accuracy of decision making and reduces credit risk (Chen & Li, 2021; Ghenai et al., 2024) .
2. Automation & process standardization: digitalization of back-office processes reduces costs and errors, increases service speed and cost efficiency (Cao et al., 2022; Bu et al., 2025).
3. Network effects & platformization: bank–fintech collaboration creates an ecosystem that strengthens the user base, lowers marginal costs, and increases fee-based revenue, especially in emerging markets (Zhang et al., 2022; Jack & Suri, 2014).
4. Digital governance & compliance: the integration of digital oversight systems reduced regulatory violations by about 7% in Chinese banks (Wang et al., 2025; Yu & Liu, 2025), while strengthening regulators' trust.
5. Financial inclusion mechanism: mobile money services, branchless banking, and offline-first solutions enable access for the unbanked, women, and rural populations (Cangombe et al., 2025; Jack & Suri, 2014; Morduch & Schneider,

2020; Klapper et al., 2020; Abdulai et al., 2024).

d.   Outcome (O)

Outcomes reported in this SLR literature include:

1. Efficiency and financial performance outcomes include increased ROA, ROE, and NIM; decreased cost-to-income ratio; increased technical efficiency scores (DEA/network DEA); improved stability (Z-score), and decreased NPLs (Cao et al., 2022; Zuo et al., 2021; Ayadi et al., 2025).
2. Financial inclusion outcomes include increased account ownership and mobile money usage; and reduced gender and geographic disparities in financial access (Jack & Suri, 2014; Abdulai et al., 2024).
3. Risk and stability outcomes are mixed results related to credit risk and profitability volatility—some studies show increased short-term risk, but also improved long-term risk management through technology (Chen & Li, 2021; Kumar & Lee, 2021; Tian et al., 2025).
4. Sustainability/ESG outcomes such as increasing ESG scores, green credit growth, reducing portfolio carbon intensity, and circular economy indicators (Zuo et al., 2021; Al-Qazzaz et al., 2025).

This section discusses the SLR findings within the CIMO framework and relates them to theory development, practical implications, and remaining research gaps.

1)   Dominant CIMO Configuration

Overall, mapping of 30 studies (60 reports) showed a relatively consistent CIMO pattern:

*   Context: heavy focus on commercial banks in Asian countries with strong digital infrastructure and pro-fintech policies (China, India, Pakistan, Turkey), with some additions from Europe and the US; African and Latin American context is minimal.
*   Intervention: interventions dominate fintech adoption, internal bank digital transformation, and regulatory sandbox implementation; ESG-digitalization has only appeared in a small number of pioneering studies (Zuo et al., 2021; Al-Qazzaz et al., 2025).
*   Mechanism: The most frequently studied mechanisms are resource efficiency (RBV/DEA), network effects, and digital governance; mechanisms related to AI ethics, trust formation, or change management are still very rare.
*   Outcome: Around 60% of studies are oriented towards financial performance, while outcomes related to sustainability, circular economy, and social justice (gender, access) are still neglected.

This configuration shows that the digital financial innovation literature is still dominated by the logic of efficiency and profitability, despite strong indications towards ESG integration and financial inclusion in recent years.

2)   Contribution to Theory

From a theoretical perspective, this SLR confirms several things:

1. The Resource-Based View (RBV) and DEA remain the dominant frameworks for

explaining how IT investments and digitalization improve bank efficiency (Cao et al., 2022; Zhang et al., 2022). However, without integration with Dynamic Capabilities, the RBV tends to be static and fails to fully explain how banks learn, reconfigure, and adapt in a rapidly changing digital environment.

2. Institutional theory has emerged primarily in studies on sandboxes, data privacy policies, and fintech regulation (Arner et al., 2017; Bu et al., 2025), but has focused on the national level. Cross-border mechanisms (cross-border fintech standards, regulatory harmonization) have been rarely explored.

3. Stakeholder and ESG frameworks are only beginning to be integrated with digitalization in several studies that combine network DEA with undesirable outputs (Zuo et al., 2021; Ghertescu et al., 2024). This opens up significant scope for developing integrative theoretical frameworks that integrate efficiency, risk, and sustainability.

3) Practical Implications

For banks and regulators, the SLR findings imply that:

1. Digital financial innovation has been shown to increase efficiency and profitability, especially when IT investments are combined with a clear business strategy and strong digital governance (Ayadi et al., 2025; Yu & Liu, 2025).

2. A sound regulatory sandbox policy and data privacy framework accelerate fintech adoption while protecting consumers, but need to be complemented by an AI ethics framework and cross-border interoperability standards.

3. The integration of ESG and digitalization—for example, through green-fintech platforms, digital environmental impact reporting, and green financing—is still in its infancy but has the potential to be a strategic differentiator for banks seeking to align with the SDGs agenda.

4) Literature Limitations

This SLR also confirms a number of structural limitations of the literature:

1. Secondary data bias: more than 65% of studies rely on large-scale secondary data, with little exploration of primary data (surveys, interviews, case studies) that could reveal behavioral and institutional dynamics.

2. Geographical disparities: empirical evidence is concentrated in China and a few Asian countries; Africa, Latin America, and the Pacific are significantly underrepresented.

3. Methodological limitations: the dominance of DEA and panel data results in non-linear mechanisms, ecosystem networks, and user behavior dimensions being under-explored.

4. Lack of long-term sustainability measurement: ESG and the circular economy are generally measured at a single point in time (cross-sectional), rather than as a long-term trajectory.

4. Future Research Directions

Based on the CIMO mapping and identified gaps, some important future research directions are:

a. Expanding Context

1) Geographically, by shifting focus to Africa, Latin America, and the Pacific to understand how digital financial innovation works in weak infrastructure and heterogeneous regulatory environments (Abdulai et al., 2024; Cangombe et al., 2025), as well as conducting cross-country and cross-border studies of fintech standards, including the impact of regulatory harmonization on regional financial integration (Watase, 2023).

2) Institutional, by exploring the role of non-bank institutions (independent fintech, bigtech platforms) in shaping the digital banking ecosystem and its implications for systemic stability.

b. Enriching Intervention

1 ESG– Digital Integration, such as developing and testing ESG–digitalization integration programs in banks, for example green credit scoring, digital carbon tracking, and circular-economy financing.

2 AI Ethics & Fairness, by examining algorithmic bias and ethical implications of AI-driven credit scoring, especially regarding gender discrimination, low-income groups, and remote areas (Mehdi et al., 2025).

3 Cross-border Fintech & CBDC, by examining how CBDC design and cross-border interoperability standards affect efficiency, risk, and financial inclusion in an economically integrated region.

c. Deepening the Mechanism

1. Dynamic Capabilities & Change Management, by integrating Dynamic Capabilities theory with empirical data to explain how banks build adaptive capabilities (sensing, seizing, transforming) in DFI implementation.

2. Trust, Behavior, and Sociomateriality, which uses a qualitative and mixed methods approach (in-depth interviews, organizational ethnography, lab experiments) to study trust formation, user journeys, and internal negotiations between business units, IT, and regulators.

3. Network & Ecosystem Mechanisms, with adopting network analysis and agent-based simulations to model the network effects of fintech, banks, regulators, and end-users, especially in the context of cross-jurisdictional sandboxes (Jun & Ran, 2024).

d. Expanding Outcomes

1. Long-term Sustainability Trajectories, by combining the DEA panel and green productivity index to track the evolution of banks' ESG performance over a 5–10-year horizon, rather than just a one-year snapshot (Zuo et al., 2021).

2. Social Impact & Inequality measures the impact of DFI on access gaps, poverty,

and gender inequality, including the potential for digital exclusion.

3. Systemic Risk & Macroprudential Outcomes is conducted by examining the implications of DFI on systemic risk and the need for new macroprudential policies, such as bigtech supervision, real-time data integration, and cyber risk control.

CONCLUSIONS

This systematic literature review (SLR), employing PRISMA and CIMO frameworks, synthesizes research on digital financial innovation in banking from 2015–2025, focusing on bank efficiency and sustainability. It reveals a concentration on commercial banks and fintech in Asia (especially China), with sparse empirical work from Africa, Latin America, and the Pacific; dominant interventions include fintech adoption, digital transformation, and regulatory sandboxes, driven by mechanisms like operational efficiency, network effects, and digital governance, while AI ethics, trust, and ecosystem dynamics receive limited attention. Outcomes prioritize profitability and efficiency over ESG, circular economy, and social impacts. The SLR's key contribution is a CIMO-based mapping integrating theories such as RBV, DEA, Institutional Theory, Stakeholder/ESG, and Dynamic Capabilities into frameworks like the Tri-Dimensional Digital Banking model, offering practitioners guidance on governance-ESG integration and regulators insights into risk-managing sandboxes. For future research, scholars should pursue geographically balanced studies across underrepresented regions, adopt methodologically diverse approaches (e.g., mixed methods, machine learning, network/agent-based models), and expand outcomes to encompass financial inclusion, sustainability, and systemic stability.

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