ASSESSING THE IMPACT OF FINANCIAL TECHNOLOGY ON THE EFFICIENCY OF BANKS: A SYSTEMATIC LITERATURE REVIEW APPROACH

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Abstract

The sudden expansion in financial technology (FinTech) has altered conventional banking immensely by transforming operations, customer services, and risk management systems. This research therefore employs a systematic literature review (SLR) approach that adheres to Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standards to assess the influence of FinTech on three bank performance indicators: operating efficiency, risk management, and customer service. A total of 41 peer-reviewed articles, published between 2018 and 2024, were shortlisted from Scopus and Web of Science (WoS). Out of these, 19 utilized frontier efficiency techniques like stochastic frontier analysis (SFA) and data envelopment analysis (DEA). The results indicate that FinTech improves operating efficiency when integrated optimally, as noted by Allen et al. (2022). Yet, outcomes differ by region and type of bank, as some Chinese banks have seen a decline in efficiency (Lee et al., 2023). In risk management, FinTech technologies such as artificial intelligence (AI) have been shown to decrease operational risk (Cheng & Qu, 2023). Customer satisfaction is enhanced further with digital services and personalization (Barbu et al., 2021). Although adoption poses additional risks, the research concludes that FinTech implementation, if managed strategically, will increase bank performance. This review thus offers actionable advice for policymakers and financial institutions to navigate digital transformation.

Keywords: FinTech, Systematic Literature Review, Bank Efficiency, Operational Efficiency, Risk Management, Customer Service, SFA, DEA

Authors' individual contribution: Conceptualization — X.H. and F.F.S.; Methodology — X.H. and F.F.S.; Formal Analysis — X.H.; Data Curation — X.H.; Writing — Original Draft — X.H.; Writing — Review & Editing — F.F.S.; Visualization — X.H.; Supervision — F.F.S.; Project Administration — F.F.S.

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1. INTRODUCTION

Financial technology (FinTech) refers to the use of innovative digital technologies to deliver and improve financial services. It includes tools, platforms, and systems that make financial processes faster, cheaper, more secure, and more accessible. With the rise of FinTech, the financial

industry has witnessed a profound transformation. It has reshaped the traditional banking system across the world. Financial intermediation is greatly influenced by innovation in FinTech, and with an increased focus on customer retention, acquisition, bank services, and social media platforms, trust remains central to banking. In the context of digital technologies, FinTech has emerged as a disruptive force. It has introduced innovations that have streamlined operations, reduced costs, and improved customer experience. Mobile banking, peer-to-peer (P2P) lending, AI-driven analytics, and blockchain are some developments that alter how banks manage risks, provide services, and maintain efficiency in their operations. Overall, it has the capacity to enhance financial inclusion. In this regard, with the rise of FinTech, the financial industry has witnessed a profound transformation. It has reshaped the traditional banking system across the world (AlHares & AlBaker, 2023; Mohsin et al., 2023). Therefore, such dynamic changes have prompted an increase in interest regarding how FinTech has both positively and negatively affected traditional banking sectors.

Integrating FinTech into banking operations has several far-reaching consequences, besides being a mere innovation. It impacts operational efficiency, a key factor in determining sustainability and competitiveness among financial institutions. Automating manual processes, optimizing allocation of resources, and improving decision-making reduces operational costs and provides faster services that are more reliable. FinTech also improves risk management practices across banks. It spans over streams such as credit risk management and credit scores, risk-sharing, challenges about regulation, the impact of lending on small businesses, and customer influence on the credit market. In this regard, innovations like artificial intelligence (AI) allow more precise forecasting, along with better strategies to mitigate the associated risks.

In this context, this paper explores the impact of FinTech on the operational efficiency of banks and focuses on risk management systems and customer satisfaction. For this purpose, the paper utilizes a systematic literature review (SLR) approach. To further deepen the analysis, the SLR will focus on studies across two different frontier analyses, broadly stochastic frontier analysis (SFA) and data envelopment analysis (DEA), to examine efficiency. This new segregated approach will contribute to existing literature in terms of a new perspective on measuring the impact on the corresponding variables. The study aims to answer the following question:

RQ1: What is the impact of FinTech on operational efficiency, risk management, and customer service of banks?

This study makes a distinct contribution by systematically comparing the application of SFA and DEA across FinTech-related efficiency studies, an approach not previously synthesized in this manner. By categorizing findings across operational efficiency, risk management, and customer service, it bridges methodological gaps in the literature and provides policymakers and researchers with a clearer understanding of how FinTech affects bank performance across diverse contexts.

The structure of this paper is as follows. Section 2 provides an extensive review of the literature prevailing in the field, highlighting financial innovation theory, efficiency theory, and the implications of digital transformation in banking. Section 3 describes the research process, such as the SLR method and the inclusion criteria in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, and the analytical methodologies of SFA and DEA. Section 4 presents the major findings and presents the thematic outcomes of the 41 selected studies, which are grouped by efficiency, risk management, and customer service results. Last but not least, Section 5 ends the paper by distilling the main findings, recognizing restrictions, and suggesting avenues for further research.

2. LITERATURE REVIEW

2.1. Efficiency theory: Technology-driven resource optimization in banking

Efficiency theory traditionally relies on optimal resource allocation. A consistent and strong positive relationship exists between development and FinTech, as inflation reduces and employment rates improve, unless such technologies are over-utilized. Efficiency is a crucial component of welfare economics that can broadly be assigned into two categories: Efficient allocation of resources and desirable distribution of income and commodities. Regarding banks, the former concept of efficiency seems to be more relevant. An efficiency frontier is a concept from production economics theory, referring to the maximum possible output that can be achieved from a given set of inputs, or the minimum input bundle necessary for producing a given level of output. The objective is to do the least amount of work to produce the most amount of output (Ibrahimov, 2024). For banks, optimal resource allocation will primarily include the assignment of human labor and financial resources that enhance innovation. FinTech enables banks to optimize the allocation of resources such that operating costs are reduced and overall efficiency increases. Innovation in these sectors has automated the workforce, which has transformed several job roles, increased skill requirements, besides changed the wage dynamics (He et al., 2024).

FinTech improves customer experience as it reduces errors, which is all in favor of increasing efficiency for the banks. Moreover, FinTech has improved financial literacy, thereby helping customers to identify the best savings and investment alternatives (Junianto et al., 2020). It has also increased competition, which, in turn, allows customers to have more choices in payment methods (Pinter et al., 2021). FinTech impacts and improves sectors of management and entrepreneurship, such as initiative, risk tolerance, investment, innovation, or acquisition of opportunities (Mohsin et al., 2023). Therefore, automated services and AI-driven analytics improve operational efficiency alongside decision-making. The former is easily achieved via automation. Total loans through digital channels in the US increased to 61% in 2021 from 39% in 2020, whereas remote check deposits rose by 35% and online transfers increased by over 50% (Valenti & Alderman, 2021). Automation and digitalization, thus, allow banks to cater to more customers at lower costs.

Thus, investing in financially innovative services to better performance is rather crucial and demands focus on creating and supporting the proliferation of technology-based systems that would improve bank performance (Nyamekye et al., 2023). The profitability of banks and their value will rise proportionally in the presence of cutting-edge technology *vis-à-vis* FinTech (AlHares & AlBaker, 2023). Additionally, it also increases investor expectations and has a positive impact on value creation by banks. This transition illustrates how technology optimizes the use of resources as it enables cutting down on costs incurred in physical infrastructure.

2.2. Financial innovation and banking efficiency

The financial innovation theory suggests that advancements in technology significantly improve the operational efficiency of banks. Technology that is designed to improve operational management controls organizational processes, such that productivity increases and firm performance improves. It does so by introducing new products and services at competitive prices (Saroy et al., 2020), which streamline operations and reduce costs. Several innovations in this context have significantly impacted lending and deposit services, P2P lending, alongside cryptocurrencies, cross-border payments, and much more (Gomber et al., 2018). Moreover, it has radically changed the competitive environment as branches of banks have reduced, and conditions for a multifunctional digital banking system have been created (Kurmanova et al., 2020). Innovations such as AI, mobile banking, and blockchain have played key roles in such developments. Combined with minimal human effort, such developments tend to reduce costs and increase overall efficiency of banks, allowing them to maintain their competitive position in the banking market (Dewasiri et al., 2023). Therefore, systems such as loan processing and fraud detection that are powered by FinTech allow banks to increase efficiency as they simultaneously minimize human error.

Additionally, blockchain technology has increased transparency and trust in financial operations with the use of distributed ledger technology (DLT), and together with AI, it has contributed to fast transactions and reduced security risks (Udeh et al., 2024; Nuhiu & Aliu, 2023). This further improves operational efficiency among banks. Additionally, strategic solutions that are driven by innovation entail a positive and robust correlation with employee performance (Vedapradha & Ravi, 2021). These result in increased efficiency in customer services that improve the bank's reputation, thereby adding to its operational efficiency factor. Moreover, it has been found that innovation and economic growth, which are two crucial aspects for economic development, are primarily driven by financial innovation (Laeven et al., 2015). Therefore, the real-world impact of financial innovation on banking efficiency is quite prominent. This discussion brings us to the first hypothesis of this study:

H1: *FinTech significantly improves the operational efficiency of banks across both stochastic frontier analysis and data envelopment analysis studies.*

2.3. Digital transformation: Enhancing customer satisfaction and risk management

Digital transformation advocates continuous adaptation to new technologies. This allows firms to remain competitive while increasing their efficiency in the financial landscape. It is crucial to implement such a transformation as it creates value for service firms, changes how firms interact with customers, and increases their competitive advantage overall (Shehadeh et al., 2023; Agustian et al., 2023). In this context, technological advancements such as AI-driven chat boxes and personalized financial products have significantly improved customer service provided by the firms. Such chat boxes not only increase efficiency but also enhance applicability and abstraction, as normal human intelligence cannot compound for all issues raised (Cimpeanu et al., 2023). AI tools, thereby, allow banks to manage many customer queries in real time. However, customer acceptance rates for chatbots tend to remain a little behind (Alt et al., 2021). It can still be enhanced with increased knowledge on the use of digital services that remain within achievable limits. Additionally, FinTech primarily aims to tailor products and services according to customer-centric needs (Benjamin et al., 2024). Therefore, it increases customer satisfaction by enhancing their experience and increasing retention rates and acquisition.

Moreover, digitalizing the banking experience allows banks to retain customer information that is crucial to personalize customer experience, along with products and services offered (Central Bank of Ireland, n.d.). Nearly 2/3 of customers across the world are either completely or partially satisfied with their primary bank, although satisfaction varies from nation to nation and remains quite relative (Srinivas & Ross, 2018). These results were found, given the diverse era of digital transformation. Thus, FinTech development improves the cost efficiency of banks while also enhancing the technology used (Lee et al., 2021). Thus, the relationship between digital transformation and increased efficiency is rather causal. Therefore, the overall increase in operational efficiency is further reiterated with these observations.

The effects of FinTech on the risk management practices of banks are also quite pronounced. AI and blockchain have revolutionized fraud detection and increased prevention in financial realms (Odeyemi et al., 2024; Habib et al., 2022). Moreover, machine learning (ML) approaches can provide instant alerts to suspicious activities as they are trained in data transactions. Additionally, risk management supports performance alongside customer engagement and flexibility in regulatory requirements (Sadraoui, 2025). Moreover, these technologies also provide real-time data analysis. Banks have access to big data sourced via massive amounts of transactions (Doko & Mishkovski, 2019). Massive amounts of data not only help in improving risk management but also enhance overall customer experience with the rise of FinTech. Hence, to harness the benefits of digital transformation, more mobile and e-banking services should be made available. The usage of automated teller machines (ATMs), mobile banking, and debit and credit cards, etc., is expected to have a positive short and long-run impact on the deposit

performance of banks (Ashiru et al., 2023). This relationship was also confirmed in terms of increasing profitability (Awan & Parveen, 2024). Thus, this brings us to the second hypothesis introduced by the study:

H2: FinTech adoption enhances customer service and risk management capabilities in banking.

3. METHODOLOGY

3.1. Research design and overview

This study employs an SLR approach to evaluate the impact of FinTech on banking efficiency, risk management, and customer service. To deepen the analysis, the conceptual and methodological frameworks of the study will revolve around frontier analysis techniques, namely SFA and DEA techniques. SFA is a parametric way of estimating the efficiency frontier, where explicit allowance of the functional form is made. The SFA model extracts the inefficiency effects from random noise by including a stochastic error term that allows for the influence of statistical noise and random forces on performance. This makes SFA especially powerful in places with big external shocks or data variability. This approach also allows the estimation of efficiency scores and sources of inefficiency within the banking system. On the other hand, DEA has simultaneously grown into a powerful analytical tool that evaluates performance by determining the efficiency of entities in utilizing resources to obtain desired outputs. It uses a non-parametric method to benchmark the performance of decision-making units (DMUs). Banks are quite relevant in this regard.

Frontier analysis has been very critical in the banking sector since it presents an organized method of measuring and comparing efficiency in banks. Through the comparison made, it can recognize best practices as well as areas that might call for improved performance by the banks, thereby formulating strategies for enhancing operational efficiency. It would further enhance the ability of regulators and policymakers to monitor bank performance toward operating at efficient levels, to ensure that banks effectively support financial system stability and competitiveness. Therefore, these models used across several studies quantify the efficiencies achieved by banks via FinTech adoption. In this context, this review will synthesize findings from studies that employ SFA and DEA for measuring efficiency. However, it will also include studies that measure the impact of FinTech on risk management or customer services. These indicators are usually not integrated into the SFA or DEA analytical studies. Therefore, this study will shed light on how FinTech enhances or diminishes operational efficiency, risk management, and customer services.

3.2. Search strategy

The literature search has been conducted across multiple databases. This ensures a wide coverage of existing studies. The databases used were Scopus and Web of Science (WoS) for some additional relevant articles. A total of 74 studies were reviewed, out of which 41 were short-listed. The search terms will focus on FinTech as well as frontier analysis methodologies for efficiency. All the search terms that have been used for different aspects of the study include:

- "FinTech" or "financial technology";
- "Bank efficiency" or "operational efficiency";
- "Stochastic frontier analysis (SFA)" or "data envelopment analysis (DEA)";
- "Risk management" and "digital transformation";
- "Banking customer service" and "technological innovation".

The Boolean operations, *and* and *or*, have been used to combine these keywords during searches. Note that the search has been restricted to studies that have been published in English. They span between 2018 and 2024, such that the latest contributions to literature are accounted for.

1) Inclusion criteria:

- Studies that have been published between 2018–2024.
- Studies are sourced from peer-reviewed journal articles, conference papers, and other credible industry reports.
- Studies employ either SFA or DEA to measure the efficiency of banks, which are particularly related to FinTech innovations.
- Studies analyze the impact of FinTech on operational efficiency, risk management, or customer service.
- The studies are based on empirical analysis or a case study on bank performance, or perhaps frontier analysis techniques.

2) Exclusion criteria:

- Studies that are not in English, as translation can cause differences in result interpretation.
- Studies that focus only on the technical aspects of FinTech. Those that do not determine their impact on banking efficiency.
- Articles that do not necessarily include SFA or DEA in their methodologies for measuring efficiency.
- Research that lacks empirical evidence.
- Studies that have been published on non-credible sites.

3.3. Screening and selection of articles

The review was conducted following PRISMA guidelines, which consist of 27 items on a checklist. Procedures involved:

1) initial search and screening of titles to exclude irrelevant articles;

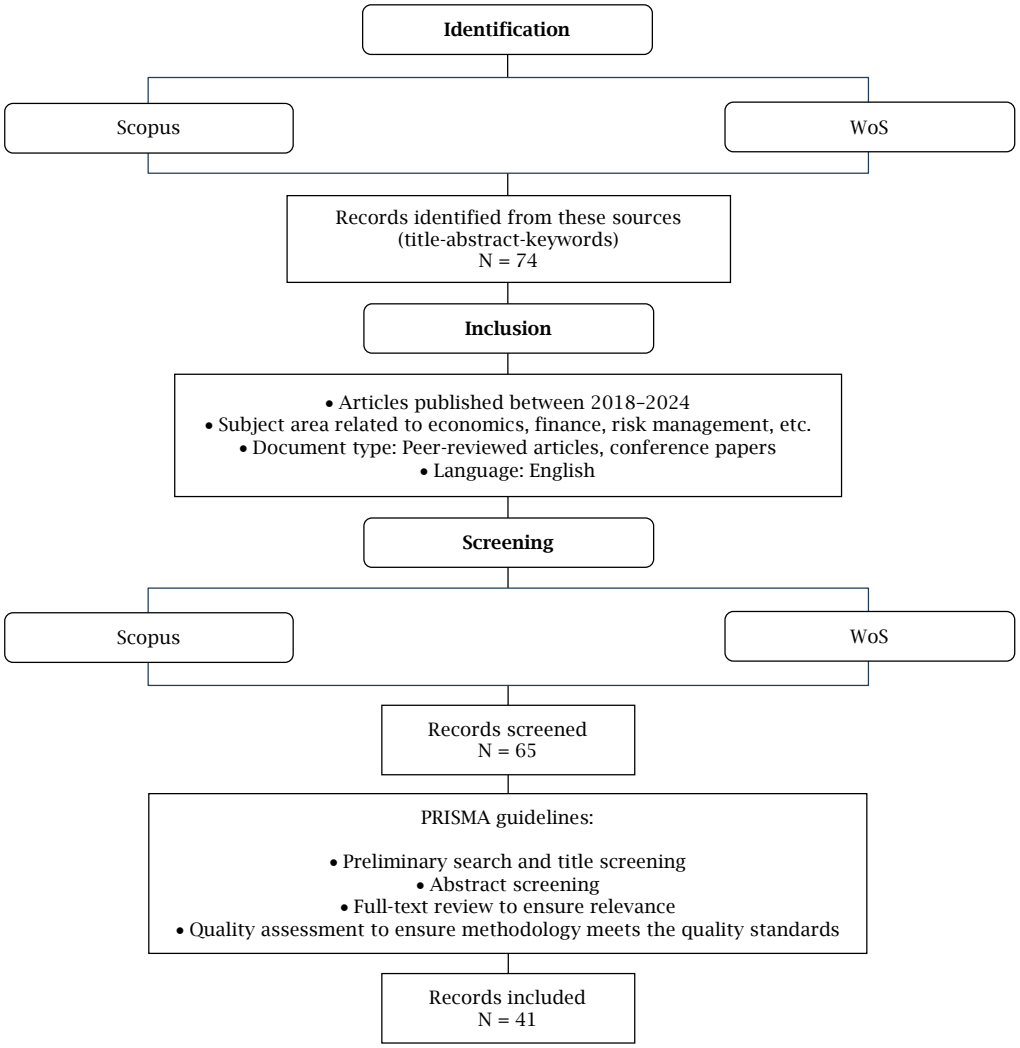
2) abstract screening for conformity with inclusion criteria;

3) full-text screening for confirmation of relevance and methodological quality;

4) assessment of quality to confirm research design, methodology, and relevance.

Key studies were integrated using thematic analysis to reveal recurring patterns and themes on FinTech adoption and effects. The screening process is reflected in Figure 1, and the distribution of studies by methodology and region is illustrated in Table 1.

Figure 1. Flowchart



Source: Authors' elaboration.

Table 1. Distribution of studies based on region and methodology

Region	***DEA***	***DEA and window analysis***	***Descriptive and inferential research***	***Dynamic panel data regression***	***Econometric model***	***Multi-method quantitative study***	***Panel data analysis***	***Panel system generalized method of moments (GMM) analysis***	***Primary data analyzed via partial least squares structural equation modelling (PLS-SEM)***	***Regression analysis***	***Review analysis***	***SFA***	***SFA and DEA***	***Web crawler technology and word frequency analysis***	***Behavioral perspective***	***Empirical tests***	***Instrumental variable approach; Variable: Urban innovation index***	***Quantitative research using survey questionnaires***	***Stimulus-organism-response (S-O-R) and PLS-SEM***	***Total***
Azerbaijan	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
China	3	0	0	0	0	0	1	0	0	1	0	4	0	1	0	0	1	0	0	11
China and Vietnam	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
India	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Indonesia	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	4
Jordan	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2
Kenya	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Malaysia	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2
Pakistan	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	2
Saudi Arabia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Thailand	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
UAE	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
UK	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Ukraine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Others	2	0	0	0	1	0	0	1	0	0	1	4	2	0	1	0	0	0	1	15

Source: Authors' elaboration.

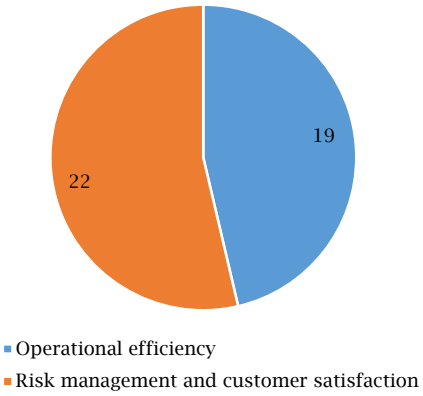
3.4. Alternative strategies

While the SLR approach, supplemented with frontier efficiency tools such as SFA and DEA, gives robust evidence regarding the impact of FinTech on banking, other methodologies could be applied to research this topic as well. A meta-analysis would be an excellent quantitative synthesis technique, especially to integrate effect sizes between studies to construct statistically meaningful conclusions regarding the impact of FinTech on operational efficiency, risk, and customer service. Another possible approach is case study analysis that allows for an in-depth examination of chosen banks or regions that have adopted FinTech technologies, providing rich contextual results and comparative analysis. Furthermore, panel data econometric methods such as fixed effects or GMM are often utilized in FinTech-based empirical work to control for unobserved heterogeneity and endogeneity across banking institutions over time.

4. FINDINGS AND DISCUSSION

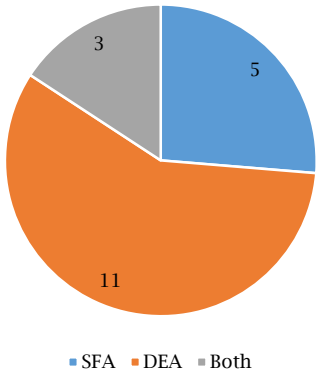
The calculations for this section are presented in Tables A.1 and A.2 (see Appendix). The SLR initially involved 74 studies, out of which 41 were shortlisted. 19 out of 41 studies, as shown in Figure 2a, determine the impact of FinTech on banks' efficiency using either SFA or DEA analysis methods or both. Five out of these studies use SFA to analyze operational efficiency, 11 use DEA, and three use both, as shown in Figure 2b. With the help of these studies, it was found that FinTech's influence on the operational efficiency of banks varies based on regional and sector-based contexts. Liao (2023), for instance, noted that bank efficiency improved due to FinTech. He utilized SFA and DEA methods in a two-staged analysis. However, the results he obtained were not substantial enough to generalize the positive impact of FinTech on efficiency. On the other hand, Lee et al. (2023) studied the same variables in the context of China, where they found that FinTech reduced overall banking efficiency across Chinese banks. Moreover, the rural and urban commercial banks were the most affected. Similarly, Pham et al. (2023) found mixed effects across banks in China and Vietnam. While some banks were positively impacted by FinTech, some witnessed negative impacts. Additionally, the secondary data obtained from the studies suggests that Fintech has a more pronounced impact on operational efficiency if it is correctly integrated in the banking system. Maryunita and Nugroho (2022), for instance, underscore that the greater the level of FinTech and digitalization across firms, more is the operational efficiency. Cho and Chen (2021) also report a 6.26% improvement in costs across Chinese banks. This reiterates how revolutionary methods, such as mobile services, contribute to increased efficiency. Moreover, automation using AI and the use of digital platforms also reduce costs. This was found by Allen et al. (2022). They accounted for a 9.77% increase in efficiency with an increase in FinTech scores. Therefore, *H1* of this study can be partially accepted. As the impact of efficiency across firms remains ambiguous, given the varying contexts, it would be wrong to generalize the applicability of the results. Moreover, it was also observed that a substantial number of studies utilized DEA to determine the impact of FinTech on technology. This bears testimony to the effectiveness of this method and allows a more thorough analysis of the impact of FinTech on efficiency across banks.

Figure 2a. Distribution of studies based on category



Source: Authors' elaboration.

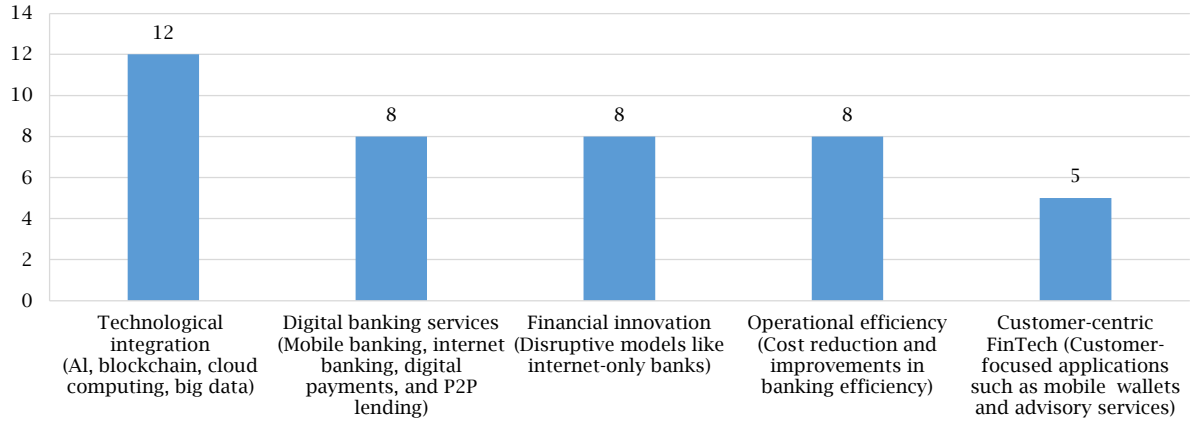
Figure 2b. Distribution of studies based on methodology



Source: Authors' elaboration.

Note that FinTech has been defined and measured via different mechanisms across all 41 studies. Based on the trends of conceptualization and operationalization, the definition and measurement of FinTech has been categorized into five different heads for each head. Figure 3 reveals that there are five core themes in terms of definitions. These are technological integration, digital banking services, financial innovation, operational efficiency, and customer-centric approaches. The heavy dominance of technological innovation reveals reliance on advanced technologies such as AI, blockchain, and big data that drive operational transformation. However, it is also visible that customer-centric approaches are somewhat limited. This reveals a gap in terms of understanding how customer experiences and retention are impacted by FinTech. Thus, future studies need to focus more on such innovations, particularly because of growing competition from FinTech startups that focus on customer use-centric models.

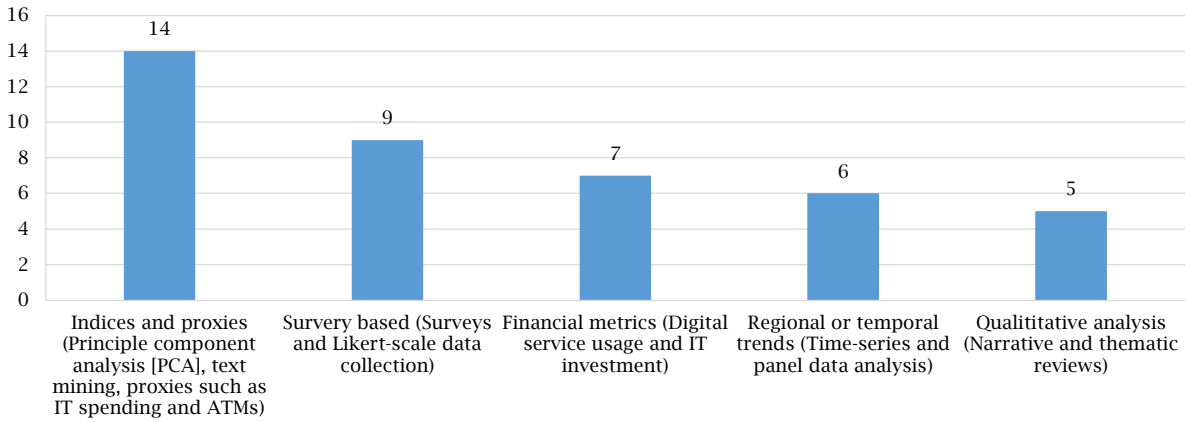
Figure 3. Studies are divided based on FinTech definitions



Source: Authors' elaboration.

Figure 4 shows that indices and proxies have primarily been used to measure the adoption of FinTech. This entails a preference for quantitative and objective indicators such as FinTech indices, information technology (IT) expenditures, and ATM counts. However, qualitative analysis and survey-based metrics underscore a methodological imbalance. As quantitative measures are over-relied on, customer-centric perceptions, yet again, tend to be overlooked alongside cultural influences and contextual challenges. Thus, a more balanced approach is required that would combine qualitative and quantitative methods. This would offer a rich understanding of the broader impacts of FinTech. This is particularly relevant for regions where the adoption of digital banking remains relatively scarce.

Figure 4. Distribution of studies based on FinTech measures



Source: Authors' elaboration.

The impact of FinTech on risk management is also quite pronounced. Although it was difficult to find studies that focused on the impact of FinTech on risk management in isolation, the studies that were shortlisted captured this relationship extensively. Innovations such as AI and blockchain are crucial in improving risk management across firms. Cheng and Qu (2023) showed how operational risk was reduced by 1.414 units with the help of FinTech. AI by itself reduced risks 4.033 times. Similarly, studies such as Deng et al. (2021) and Alsahlawi (2021) showed how FinTech upheld inclusive finance. It improves risk management behavior through hedging and derivative mechanisms. Additionally, the impact of FinTech on risk management was not universally positive. Wu et al. (2023), in this context, found that while FinTech reduced the risk of insolvency, it increased credit risk and liquidity risks. Therefore, the impact on risk was ambiguous overall. This was also consistent with the results recorded by Wei (2021). He found that the immediate positive impact of FinTech was limited on risk management. It also potentially induces additional risks. Furthermore, customer service also benefited from the adoption of FinTech. The reports on customer service are more prominent across news articles and company reports, but this was beyond the scope of the study. Yet, articles by Barbu et al. (2021) and Murad and Ahmad (2023) record how FinTech increases customer satisfaction. It improves perceived value, trust, and speed of services as well. This, in turn, increases customer satisfaction and retention rates. Moreover, digital platforms enable firms to manage many customer queries. Chen (2020) accounts for how the employment of FinTech professionals improves customer satisfaction 0.893 times with every unit increase. Kemunto and Kagiri (2018) show that FinTech increased interaction and loyalty from customers. Bashayreh and Wadi (2021) confirm that FinTech positively affects customer service through the channels of better performance and efficiency.

Therefore, the positive impact of FinTech on customer service across banks is widely accepted. Furthermore, although certain studies record an ambiguous impact in the context of risk management, the negligibility in their proportion against the studies that record positive impacts is prominent. Therefore, we accept *H2*, which states that FinTech improves risk management and customer services across banks.

5. CONCLUSION

This research presents a critical synthesis of literature on the influence of FinTech adoption across three major dimensions of banking performance: operating efficiency, risk management, and customer services. The results show that FinTech has overall enhanced efficiency by automation, AI decision tools, and digital platforms (Allen et al., 2022), but its impact differs based on institutional and regional environments. Specifically, advanced economy commercial banks are more likely to benefit compared to regional or rural banks that commonly suffer from infrastructure and integration issues. In risk management, FinTech has made it possible to implement more sophisticated fraud detection and credit scoring mechanisms, but added new vulnerabilities like cybersecurity threats and liquidity risks. Customer service has experienced most steady improvements, fueled by digitalized personal interactions, increased response speeds, and data-based service models.

Although, adoption of FinTech significantly alters banking performance, but not uniformly. Those metrics facing customers (i.e., satisfaction, take-up, retention) improve, whereas efficiency and risk impacts are conditional — bank type, market structure, regulatory environment, and the FinTech capability adopted vary. Three main causes can be presented, regarding the inconsistencies observed and how they relate to reliability:

- Contextual variance: Differences in supervision intensity, digital maturity, competitive pressure, and ownership/size create heterogeneous treatment effects. Findings from large, digitally mature markets are not automatically portable to smaller or state-dominated systems, limiting external validity.
- Measurement heterogeneity: FinTech' is proxied differently (IT spend, adoption dummies, platform numbers, patenting, API availability), and "efficiency" (cost vs. technical vs. total factor productivity [TFP]) or "risk" (credit, liquidity, operational, insolvency) types of outcomes are measured differently. This lowers construct validity and makes it difficult to compare effect sizes between studies.
- Methodological disparity: Frontier techniques (DEA/SFA) and non-frontier econometrics are based on contrasting assumptions regarding technology, noise, and selection. DEA's homogeneity and returns-to-scale assumptions tend to exaggerate gains in unbalanced settings; SFA's distributional assumptions and functional-form specifications tend to bias estimates in the event of misspecification; panel regressions can be subject to endogeneity (reverse causality: better banks innovate previously). These aspects impinge upon internal validity and account for conflicting findings.

The time window is centered on the post-2018 acceleration, which might downweigh longer-run adjustment dynamics. Heterogeneous constructs and reporting prevented a formal meta-analysis. Even systematic screening leaves residual publication bias (under-reporting nulls) a possibility. Lastly, even though we systematically coded studies, some judgment calls (e.g., having to map varied risk proxies to standard categories) raise classification risk.

This paper is valuable for future research. First, it structures a disjointed field into a clear three-outcome lens (efficiency, risk, customer) and a method map (DEA vs. SFA vs. econometrics), so clearly delineating where conclusions are sturdy, and where they hinge on assumptions. It brings to the surface concrete gaps in measurement and design that future work can fill: adopt standardized taxonomies for FinTech and outcomes; report comparable effect sizes and uncertainty; deploy quasi-experimental designs — such as staggered difference in differences (DID), instruments and synthetic controls — to address selection; run method-comparison studies holding data constant while varying DEA/SFA specifications; and build multi-country panels to distinguish technology from regulatory and competitive context.

The implications include the following. For banks, it is imperative to pair digital investments with model-risk oversight, cybersecurity, and credit-risk management, and monitor value beyond cost metrics (e.g., lifetime value, inclusion). For regulators, promote data-sharing and assessment standards, require model validation/fairness audits, and harmonize sandboxes with measurable outcome frameworks. For researchers, publishing codebooks and replication files will drive cumulative science and facilitate future meta-analysis.

Nonetheless, the research is constrained by its use of secondary data and geographic concentration of available research, especially that from China. Such constraints limit the extent to which results can be generalized to low-income nations and smaller financial institutions. Future research should employ primary data and survey understudied regions and technologies like blockchain and AI. Second, customer-centric indicators, such as trust, digital literacy, and access, must be given greater prominence, as they are still not well explored in the efficiency-led metrics. Guaranteeing regulatory backing and protection for customers will be crucial in order to unlock the full potential of FinTech-driven transformation in banking.

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APPENDIX

Table A.1. Studies shortlisted based on efficiency across banks

Author	*Variable(s) studied*	*Measurement method*
Liao (2023)	Bank efficiency	Proxies: Log(ATMs), IT investment, mobile payment adoption
Lee et al. (2023)	Bank efficiency	Banks' public reports (big data, cloud computing) + Baidu FinTech Index
Le et al. (2021)	Bank efficiency	Log(FinTech credit per capita), 80 countries (2013–2017), Global Alternative Finance Database
Maryunita and Nugroho (2022)	Operational efficiency	FinTech dummies via DEA and panel GMM
Cho and Chen (2021)	Operational efficiency	Share of mobile transactions, third-party payment volume
Allen et al. (2022)	Operational efficiency (cost)	PCA + probit; validated via clustering, Securities and Exchange Commission (SEC) filings, capital data
Yeh et al. (2022)	Bank efficiency	Developed FinTech score
Pham et al. (2023)	Bank efficiency	FinTech Index (third-party payment, credit, insurance); instrumental variable GMM (IV-GMM), log transforms, 31 provinces
Ahmad et al. (2023)	Bank efficiency and stability	DEA-Malmquist; stability impacts via GMM
Syaputra and Abidin (2022)	Bank efficiency	Adoption of digital banking tech (e.g., transaction volumes, IT spend)
Thonglim (2022)	Operational efficiency	FinTech adoption dummy; digital payments, IT-enabled advancements under FSMP phases
Zuo et al. (2023)	Operational efficiency	Digital Financial Index via text mining (six dimensions)
Akhtar et al. (2022)	Scale efficiency	DEA (constant returns to scale [CRS], variable returns to scale [VRS], Window Analysis) for 47 banks (2009–2018)
Ibrahimov et al. (2021)	Bank efficiency	DEA for 14 banks (technical, pure technical, scale efficiency)
Lee et al. (2021)	Operational efficiency (cost)	FinTech Index via PCA (capital, rounds, firm count; categories: credit payment, investment, market support)
Sun and Salim (2020)	Bank efficiency	Semi-parametric input distance frontier (multiple inputs/outputs, environmental factors)
Fang et al. (2023)	Innovation, bank efficiency, and risk	Patent analysis (ML) + propensity score matching (PSM) and DID for impact
Zhang and Chen (2023)	Efficiency and risk management	FinTech Index via web crawling + PCA; assessed via translog cost function and SFA
Wei (2021)	Operational efficiency and risk	TFP and capital risk via empirical models (2011–2019) with heterogeneity analysis

Source: Authors' elaboration.

Table A.2. Studies shortlisted based on the impact of FinTech on bank performance, particularly in terms of risk management and customer service

Author	*Variable(s) studied*	*Measurement method*
Deng et al. (2021)	Risk management	Bank TFP and capital risk via empirical models (2011–2019)
Alsahlawi (2021)	Risk management	Survey of FinTech adoption: digital platforms, AI risk analytics, blockchain
Cheng and Qu (2023)	Operational risk	FinTech Index (AI, blockchain, cloud, mobile) via manual data; regression
Cheng and Qu (2020)	Credit risk	Bank FinTech Index via web crawler and word frequency (2008–2017)
Saha et al. (2024)	Risk management	Narrative analysis: mobile wallets, P2P lending, green finance adoption
Wu et al. (2023)	Risk management	Bank FinTech Index via text mining of 148 banks' reports (2007–2019)
Mishchenko et al. (2021)	Risk management	Intl. guidelines + Collective Risk Insurance Fund contributions
Kayed et al. (2025)	Bank efficiency and risk	Panel data (2010–2019) of 13 banks; profitability, risk, stock returns
Yao and Song (2021)	Risk management	FinTech App Index (text mining, Baidu Index); PCA composite score
Wang et al. (2023)	Performance and risk	IT personnel/software/hardware inputs; effect on non-performing loans (NPL) ratios
Saleem (2021)	Risk management	Questionnaire on digital lending, mobile transactions, internet banking
Hammadi et al. (2024)	Risk management	Multi-item scale: automation, blockchain, AI, UAE digital alignment
Dasilas and Karanovic (2025)	Performance and risk	Annual FinTech firm count; impact on net interest margin (NIM) and yield on earning assets (YEA)
Mitra and Karathanasopoulos (2020)	Firm value and risk	Pairs trading data; FinTech effect on value growth and risk
Raza and Mahmood (2025)	Customer experience and risk	Secondary review: digital payments, P2P lending, microfinance
Barbu et al. (2021)	Customer service	Survey on ease of use, value, support, assurance, speed, innovation
Murad and Ahmad (2023)	Customer adoption	Likert survey on product adoption, transformation, usage
Baber (2020)	Customer retention	26-item survey on payments, advisory, compliance, financing
Chen (2020)	Customer service	Bank efficiency/performance changes (2009–2014 vs 2015–2018)
Kemunto and Kagiri (2018)	Competitiveness	Survey on mobile, e-banking, agency, automation; statistical analysis
Bashayreh and Wadi (2021)	Performance	ATMs, internet, phone banking (2012–2018) via panel data
Anagnostopoulos (2018)	Disruptive potential	Qualitative study on digital loans, payments, regulatory impact

Source: Authors' elaboration.