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BANKING RISK MANAGEMENT IN THE DIGITAL ERA: A SYSTEMATIC LITERATURE REVIEW

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ABSTRACT

Digital technologies are changing how banks originate, monitor and transmit risk, yet the empirical evidence on whether they make banks safer is scattered across risk types, technologies and institutional settings. This article reports a systematic review, conducted under PRISMA 2020, of empirical studies on the relationship between digital technologies and bank risk or risk management. A Scopus search of English-language journal articles published in 2020–2026 returned 857 records. Title and abstract screening and eligibility assessment left 85 eligible studies, from which 28 were selected purposively to maximise variation in risk type, region and research design. Twenty-two of the 28 use archival bank-level panels, four rely on manager surveys, one is a country-level cross-section and one analyses central bank data descriptively. Half of the studies come from China. The synthesis points to three results. First, digitalization more often lowers than raises credit, operational, market and overall risk: among the 21 archival studies with a direct risk outcome, 12 report reductions, 4 report increases and 5 report mixed or non-linear effects. Second, bank-level and system-level results diverge, because the same technologies that reduce idiosyncratic risk can raise interconnectedness and contagion. Third, internal control, model governance, cybersecurity, regulation, and bank size and ownership repeatedly condition the outcome. Drawing on contingency theory and the resource-based view, the article proposes a Digital Risk Governance Framework and five propositions for future research. The evidence base is geographically narrow and relies mostly on adoption proxies, which limits generalisation beyond large emerging-market banking systems.

Keywords: Bank Risk Management, Digital Transformation, Fintech; Artificial Intelligence, Systematic Literature Review

ABSTRAK

Teknologi digital mengubah cara bank menyalurkan kredit, memantau, dan menularkan risiko, tetapi bukti empiris tentang apakah teknologi tersebut membuat bank lebih aman masih tersebar menurut jenis risiko, teknologi, dan konteks kelembagaan. Artikel ini melaporkan tinjauan pustaka sistematis berdasarkan PRISMA 2020 atas studi empiris mengenai hubungan antara teknologi digital dan risiko bank atau manajemen risiko bank. Pencarian di Scopus untuk artikel jurnal berbahasa Inggris tahun 2020–2026 menghasilkan 857 rekaman. Setelah penyaringan judul dan abstrak serta penilaian kelayakan, 85 studi memenuhi kriteria, dan 28 di antaranya dipilih secara purposif untuk memaksimalkan variasi jenis risiko, wilayah, dan desain penelitian. Dua puluh dua dari 28 studi memakai panel arsip tingkat bank, empat memakai survei manajer, satu merupakan studi lintas negara, dan satu menganalisis data bank sentral secara deskriptif. Separuh studi berasal dari Tiongkok. Sintesis

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menghasilkan tiga temuan. Pertama, digitalisasi lebih sering menurunkan daripada menaikkan risiko kredit, operasional, pasar, dan risiko keseluruhan: dari 21 studi arsip dengan luaran risiko langsung, 12 melaporkan penurunan, 4 melaporkan kenaikan, dan 5 melaporkan efek campuran atau nonlinier. Kedua, hasil di tingkat bank dan tingkat sistem berbeda, karena teknologi yang menurunkan risiko idiosinkratik dapat meningkatkan keterkaitan antarbank dan risiko penularan. Ketiga, pengendalian internal, tata kelola model, keamanan siber, regulasi, serta ukuran dan kepemilikan bank berulang kali memoderasi hasil. Berlandaskan teori kontingensi dan pandangan berbasis sumber daya, artikel ini mengusulkan Digital Risk Governance Framework dan lima proposisi untuk penelitian lanjutan. Basis bukti terkonsentrasi secara geografis dan sebagian besar memakai proksi adopsi, sehingga generalisasinya terbatas.

Kata Kunci: Manajemen Risiko Bank, Transformasi Digital, Fintech, Kecerdasan Buatan, Tinjauan Pustaka Sistematis

I. INTRODUCTION

Banks manage risk by collecting and interpreting information about borrowers, counterparties, markets and their own operations. Digital technologies change each step of that process. Online and mobile channels generate transaction data that were not previously available; machine learning and big data analytics alter how that information is converted into credit decisions and monitoring signals; cloud infrastructure and third-party platforms change where operational and cyber risk sit. Whether these changes make individual banks, and the banking system, safer is an open empirical question.

The evidence points in different directions. Studies of Chinese commercial banks report that digital transformation lowers overall risk-taking (Yu & Liu, 2025) and credit risk (Qin & Jing, 2025), while another study of the same banking system finds that it raises credit risk because digital lending relies less on soft information (Dong et al., 2026). Work on systemic risk is similarly divided: Huang et al. (2026) find a risk-reducing effect, whereas Huo and Li (2026) conclude that digital transformation can exacerbate systemic financial risk. Reading these studies side by side raises an obvious question about what explains the disagreement: the technology studied, the risk measured, the stage of adoption, the type of bank, or the institutional setting.

Existing reviews do not answer that question. Recent syntheses have mapped machine learning applications in banking risk management (Heß & Damásio, 2025), the intellectual structure of computational risk analytics (Trigkas et al., 2025), emerging risks in fintech-driven digital banking (Gaviyau & Godi, 2025) and the "dark side" of FinTech (Asif et al., 2024). Others examine the effect of FinTech on bank performance and efficiency (Huang & Said, 2025; Xu et al., 2025) or the functions and challenges of FinTech in banking (Fau et al., 2026). Most of these are bibliometric, focus on performance rather than risk, or concentrate on the development of prediction algorithms. Among the reviews identified in the search reported here, none synthesises the bank-level empirical evidence on how digitalization shifts risk outcomes across risk types and settings.

This article fills that gap with a systematic review that follows the PRISMA 2020 reporting guideline (Page et al., 2021). It addresses three research questions:

RQ1. How have empirical studies related digital technologies to the main categories of bank risk?
RQ2. Which mechanisms and boundary conditions explain the divergence in reported findings?
RQ3. What gaps in evidence, measurement and context should guide future research?

The article makes three contributions. It provides a transparent, reproducible account of the evidence base on digitalization and bank risk; it distinguishes bank-level from system-level outcomes; and it proposes a framework and testable propositions that can organise further work.

The remainder of the article is organised as follows. The next section sets out the theoretical lenses. The research method section describes the review design, search and selection. The results and discussion section reports the selection process, characteristics of the included studies and the synthesis of findings, and then discusses the digitalization paradox, the role of governance and the proposed framework. The final section sets out the conclusion and limitations.

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II. LITERATURE REVIEW

Contingency Theory

Contingency theory holds that organisational performance depends on the fit between structure and environment (Donaldson, 2001). Applied to banking, it implies that the risk consequences of a technology are not fixed but vary with the bank's characteristics and setting, such as size, ownership, governance and the regulatory and institutional environment. This is the logic behind reading divergent findings as differences in fit rather than as contradictions.

Resource-Based View

The resource-based view treats valuable, hard-to-imitate capabilities as the source of advantage (Barney, 1991). Applied here, digital tools are resources whose risk consequences depend on the complementary capabilities, such as governance and internal control, that accompany them. A bank that adopts a technology without the supporting capability may therefore see little benefit or, in the early stages, higher risk.

Research Framework

Taken together, the two lenses lead to three analytical expectations that structure the review. First, the relationship between digitalization and bank risk should differ by risk category and by the type and depth of technology (RQ1). Second, governance, regulation and bank characteristics should condition the direction of the effect, which would explain part of the disagreement among studies (RQ2). Third, because the evidence on these questions comes from a small number of settings and measures, the review should identify where it is thin (RQ3). The analysis in this article is organised around these expectations, and the resulting framework is presented in the discussion.

III. RESEARCH METHOD

Review design and reporting standard

The review follows the PRISMA 2020 statement (Page et al., 2021) and the general logic of systematic reviews in management and related fields (Tranfield et al., 2003). Two features distinguish this review from a full-scale systematic review and are stated here so that readers can judge the results accordingly. The search was run in one database, and the final synthesis uses a purposive sample of the eligible studies rather than all of them (see Selection Process below).

Information source and search strategy

Scopus was the sole information source, chosen for its coverage of finance, economics and business journals and for the structured export of abstracts and keywords. The search was run in the Advanced Search interface on 21 October 2026 and applied to titles, abstracts and keywords. The search string combined three concept blocks (banks, risk categories and digital technologies) and was limited to journal articles in English published from 2020 to 2026.

The search returned 857 records, which were exported with abstracts and keywords. Because only one database was searched, no deduplication was required. The restriction to 2020 onward reflects the rapid change in the technologies studied, and the restriction to journal articles favours peer-reviewed evidence at the cost of excluding conference papers and working papers.

Eligibility criteria

Table 1 sets out the eligibility criteria. A study was eligible if it examined, empirically, the relationship between a digital technology and a bank risk outcome or the assessed effectiveness of bank risk management. Reviews and bibliometric studies were excluded from the synthesis but used to position the contribution.

Table 1. Eligibility criteria

Criterion	Inclusion	Exclusion
Population	Commercial, Islamic or other deposit-taking banks, analysed at bank, country or manager level	Fintech firms, platforms, insurers or non-bank institutions as the unit of analysis; studies of bankruptcy in non-bank firms

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Exposure	Digital transformation, FinTech adoption, artificial intelligence, machine learning, big data, cloud, blockchain or comparable digital technologies	Studies with no digital-technology component
Outcome	A bank risk measure (credit, liquidity, insolvency, market, operational, cyber, systemic or overall risk-taking) or an explicit assessment of risk management effectiveness	Outcomes limited to performance, efficiency, profitability, customer adoption or financial inclusion
Design	Empirical studies (archival panel, survey, mixed methods or secondary data) that test or estimate the digital technology–risk relationship	Prediction-model or algorithm development; purely conceptual, regulatory or descriptive papers; reviews and bibliometric studies (retained only for positioning)
Publication	Peer-reviewed journal articles in English, 2020–2026, indexed in Scopus	Books, chapters, conference papers, editorials, notes and other document types

Selection process

Selection proceeded in three stages. In the screening stage, titles and abstracts of all 857 records were assessed against the criteria. Keyword-based flags for the presence of a bank focus, a digital-technology term and a risk term were used to organise the records, and every exclusion decision was assigned one of six reasons (see Study Selection below). In the eligibility stage, the 112 records that passed screening were assessed in more detail against the design and outcome criteria. In the inclusion stage, the eligible studies were reviewed for balance across risk type, region and design.

Eighty-five studies met all criteria. Because the aim was an interpretable synthesis rather than an exhaustive count, 28 of them were selected purposively, using a maximum-variation logic: the sample was built to include each major risk category (credit, liquidity, insolvency, operational, market, systemic and cyber), a range of research designs and several regions. This choice means that the synthesis describes the range and structure of the evidence and should not be read as a census. The 57 eligible studies that were not selected are listed, with reasons, in the supplementary workbook.

Data extraction, quality considerations and synthesis

For each included study, a structured form recorded the country or context, research design and data, digital technology and its measurement, risk outcome, main finding, and moderators or governance variables. No numerical quality score was assigned. Study heterogeneity in measures and designs makes a single scale uninformative, and the review instead codes design characteristics that bear on credibility, such as sample size, estimation approach and the use of mediation or heterogeneity tests, and discusses them in the synthesis.

Findings were synthesised narratively and thematically (Braun & Clarke, 2006). Studies were first grouped by risk category. Within each group, the direction of the reported effect (lower risk, higher risk, or mixed and non-linear) was coded for archival studies with a direct risk outcome. Mechanisms and moderators were then compared across groups to identify recurring explanations for divergent results. A meta-analysis was not attempted, because the digital technology measures and risk outcomes are not commensurable.

IV. RESULTS AND DISCUSSION

Study selection

Figure 1 summarises the flow of records. Of the 857 records screened, 745 were excluded at the title and abstract stage. The largest groups were records without a bank focus (n = 335), among them studies in which "bank" appeared only as part of another term, and records that did not examine the relationship between a digital technology and bank risk (n = 263). A further 101 records developed prediction models or algorithms, such as credit scoring or fraud detection classifiers, without testing a

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risk outcome for banks; 21 were reviews or bibliometric studies; 17 had no digital-technology component; and 8 had no risk dimension.

The 112 records assessed in more detail yielded 85 eligible studies. The 27 exclusions at this stage involved outcomes that were not bank risk measures, such as performance, efficiency or practice adoption (n = 16), conceptual or regulatory papers without bank-level evidence (n = 5), model-development papers (n = 3) and units of analysis other than banks (n = 3). Of the 85 eligible studies, 28 were selected for synthesis. The eligible pool was concentrated in recent years (2020: 2; 2022: 3; 2023: 11; 2024: 12; 2025: 19; 2026: 38), and the selected studies reflect that pattern.

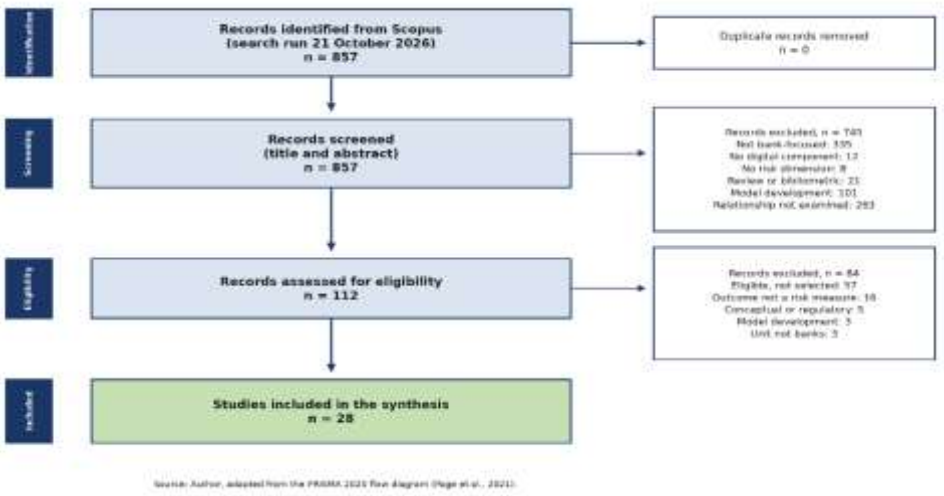


Figure 1. PRISMA 2020 flow diagram of the study selection process

Source: Author's analysis. The 84 records excluded at the eligibility stage comprise 27 that failed the criteria and 57 eligible studies that were not selected for the synthesis.

Characteristics of the included studies

Table 2 (Appendix A) lists the 28 included studies. They were published in 25 journals, and most are recent: two appeared in 2023, five in 2024, six in 2025 and fifteen in 2026. China dominates the sample with 14 studies, followed by Vietnam with two; the remaining 12 each concern a different setting, including Indonesia, Tanzania, Jordan, Yemen, Palestine, Iraq, the United Arab Emirates, South Asia, the Middle East and North Africa, a set of Asian and African dual-banking economies, and Europe. Indonesia is covered by one panel study of FinTech and credit risk (Yudaruddin et al., 2024) and one study of Indonesian and Malaysian Islamic banks (Afgani et al., 2024).

Twenty-two studies use archival bank-level panels with fixed-effects, system GMM or related estimators, four rely on surveys of bank managers or auditors analysed with PLS-SEM or mixed methods, one is a country-level cross-section of European banking systems (Iuga & Jafri, 2026), and one analyses central bank indicators descriptively (Abdo et al., 2026). Digital technology is measured in three main ways: text-mined indices of bank digitalization or FinTech adoption from annual reports, which are common in the Chinese studies; country-level or official indicators of ICT readiness and technology adoption; and managers' reported use of specific technologies such as artificial intelligence, big data, cloud computing and blockchain. Risk outcomes are equally varied, ranging from non-performing loans and insolvency risk indicators to market-based systemic risk indicators such as ΔCoVaR, and perceived risk management effectiveness.

RQ1: Digital technologies and categories of bank risk

Table 3 summarises the evidence by risk category. Across the 21 archival studies with a direct risk outcome, 12 report that digitalization lowers risk (Aftab et al., 2026; Alghadi & Al-Jayousi, 2026; Ally et al., 2025; Dai & Song, 2025; Dai & Song, 2026; He et al., 2023; Hoque et al., 2024; Huang et al., 2026; Khanchel et al., 2026; Qin & Jing, 2025; Yu & Liu, 2025; Zhang et al., 2026), four report that

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it raises risk (Dong et al., 2026; Huo & Li, 2026; Yudaruddin et al., 2024; Zhao et al., 2026), and five report mixed or non-linear effects (Banna et al., 2026; Liu & Liang, 2026; Wang et al., 2025; Wu et al., 2023; Zhao et al., 2024). The balance favours risk reduction, but the minority of adverse and non-linear results is too large to dismiss.

Table 3. Summary of evidence by risk category

Risk category	n	Studies	Dominant pattern in the evidence
Overall bank risk-taking	4	Yu and Liu (2025); He et al. (2023); Aftab et al. (2026); Banna et al. (2026)	Lower risk-taking in three studies, concentrated in particular bank types; a concave pattern for AI intensity in dual-banking systems, moderated by cybersecurity capacity
Credit, liquidity and insolvency risk	9	Wu et al. (2023); Qin and Jing (2025); Dong et al. (2026); Wang et al. (2025); Hoque et al. (2024); Ally et al. (2025); Khanchel et al. (2026); Yudaruddin et al. (2024); Zhang et al. (2026)	Credit risk: lower in four studies, higher in three, inverted U in one. Insolvency risk falls; liquidity effects are benign, null or, in one study, adverse
Operational, cyber and market risk	5	Dai and Song (2025); Alghadi and Al-Jayousi (2026); Alshari et al. (2026); Iuga and Jafri (2026); Dai and Song (2026)	Operational and market risk fall with digitalization; cyber risk depends on the technology (cloud raises it; blockchain shows the strongest association)
Systemic risk and contagion	5	Huo and Li (2026); Huang et al. (2026); Zhao et al. (2024); Zhao et al. (2026); Liu and Liang (2026)	Divergent: one study finds lower systemic risk, two find higher, one an inverted U, and one separates lower idiosyncratic risk from higher contagion risk
Enterprise risk management and governance	5	Sang and Anh (2026); Tanbour et al. (2025); Al Hammadi et al. (2024); Afgani et al. (2024); Abdo et al. (2026)	Generally favourable assessments of risk management effectiveness, conditional on infrastructure, skills and internal control

Source: Author's analysis. Counts refer to the 28 included studies. Directional counts in the text refer to the 21 archival studies with a direct risk outcome.

Overall risk-taking. Four studies examine composite measures of bank risk-taking. Yu and Liu (2025) find, in a panel of 238 Chinese commercial banks, that digital transformation lowers risk-taking through operational efficiency and corporate governance, with stronger effects for smaller banks and for strategic and business digitalization than for managerial digitalization. He et al. (2023) report a similar reduction for Chinese listed banks, but only for state-owned, small and medium banks and those with high non-interest income, and identify internal control quality as the channel. Aftab et al. (2026) find that FinTech investment intensity lowers risk-taking in South Asian banks, less so in larger ones. The exception is Banna et al. (2026), who find that AI intensity in dual-banking economies is associated with higher risk-taking in a concave pattern: risk rises during early deployment and is disciplined as model governance matures, with stronger cybersecurity attenuating the effect.

Credit, liquidity and insolvency risk. This category contains the most conflicting evidence. Four studies find that digital technologies reduce credit risk: FinTech adoption lowers the non-performing loan ratio of Chinese banks by about 0.9 percentage points (Qin & Jing, 2025), digital transformation lowers credit risk in Vietnam through better risk management capacity and less information asymmetry (Hoque et al., 2024), FinTech reduces non-performing loans in all categories of Tanzanian banks (Ally et al., 2025), and technology adoption lowers credit and liquidity risk in 155 MENA banks (Khanchel et al., 2026). Three find the opposite. Dong et al. (2026) show that digital transformation raises credit risk in Chinese banks, particularly where SME lending is high, because it reduces reliance on soft

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information. Wu et al. (2023) find that bank FinTech raises credit and liquidity risk while lowering insolvency risk, and Yudaruddin et al. (2024) find that sector-level FinTech development raises credit risk in Indonesia, especially for small and private national banks. Wang et al. (2025) reconcile some of this disagreement by showing an inverted U-shaped relationship in urban commercial banks, with credit risk rising in early FinTech development and falling as it matures. On liquidity, digital transformation reduces liquidity hoarding (Zhang et al., 2026) and has no significant effect on liquidity risk in Vietnam (Hoque et al., 2024), but business innovation raises liquidity risk in the Chinese sample of Wu et al. (2023).

Operational, cyber and market risk. Evidence on operational risk is favourable. Dai and Song (2025) find that digital transformation lowers operational risk in Chinese listed banks, with the exception of management digitalization, and that the reduction raises market value; Alghadi and Al-Jayousi (2026) find that ATMs and internet and mobile banking reduce operational risk in Jordanian banks while point-of-sale systems have no significant effect. For market risk, Dai and Song (2026) report that higher digitalization lowers market-risk economic capital through financial innovation and risk management channels. Cyber risk is the category in which technology type matters most. In a survey of Yemeni managers, blockchain has the strongest influence on cyber risk, followed by big data (Alshari et al., 2026). In European country-level data, cloud computing is positively associated with ICT-related cyber risk and strengthens the link between AI adoption and cyber risk (Iuga & Jafri, 2026). Only three of the 28 studies treat cyber risk as an outcome or a central moderator (Alshari et al., 2026; Banna et al., 2026; Iuga & Jafri, 2026), a small number given its prominence in supervisory agendas.

Systemic risk and contagion. The five systemic-risk studies, all from China, disagree. Huang et al. (2026) find that digital transformation lowers systemic risk, more so for national banks, although they note that the relationship is asymmetric and that excessive transformation may raise it. Zhao et al. (2024), using a machine-learning-based systemic risk measure, find an inverted U-shaped effect. Huo and Li (2026) find that digital transformation raises systemic risk through expanded interbank business and earnings-management incentives, with external regulation and internal control mitigating the effect. Zhao et al. (2026) distinguish market-driven from regulator-led FinTech: the former raises systemic importance through interconnectedness and faster risk transmission, while the latter is linked to lower vulnerability. Liu and Liang (2026) give the most direct statement of the divergence between levels of analysis, finding that FinTech lowers idiosyncratic risk through lower credit risk and better management efficiency while raising contagion risk through interbank linkages.

Enterprise risk management and governance. Five studies assess risk management effectiveness rather than a market or accounting risk measure. In Vietnam, all five components of internal control improve bank risk management and AI application contributes, whereas big data capability has little effect on AI application (Sang & Anh, 2026). Palestinian internal auditors report that AI improves credit and operational risk management but contributes little to market risk, owing to infrastructure, expertise and strategic constraints (Tanbour et al., 2025). In nine UAE Islamic banks, FinTech adoption and capabilities improve risk management effectiveness while digital transformation alone does not (Al Hammadi et al., 2024). Among Indonesian and Malaysian Islamic banks, digitalization mediates the link between risk management practices and performance (Afgani et al., 2024), and in Iraq, dimensions of AI-enabled smart governance are associated with better risk management over a short observation window (Abdo et al., 2026). These studies share a message that technology adds value when complemented by capabilities and controls, but they rely on perceptions or short windows and therefore carry less causal weight than the panel studies.

RQ2: Mechanisms and boundary conditions

Three groups of mechanisms recur across the studies. The first is *information and screening*. Better data and analytics are said to reduce information asymmetry and improve loan assessment (Hoque et al., 2024; Qin & Jing, 2025), whereas the opposite mechanism, a loss of soft information in digitalized lending, explains adverse credit results (Dong et al., 2026). The two accounts need not conflict: which dominates plausibly depends on the borrower base and on whether the technology complements or

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replaces relationship lending. The second is *efficiency and control*. Lower operating cost, better monitoring and stronger internal control are the most frequently cited channels for risk reduction (He et al., 2023; Hoque et al., 2024; Huang et al., 2026; Qin & Jing, 2025; Yu & Liu, 2025). The third is *interconnectedness and exposure*. Digital business expands interbank linkages, accelerates transmission and concentrates dependence on shared infrastructure, which explains why systemic and cyber outcomes diverge from bank-level outcomes (Huo & Li, 2026; Iuga & Jafri, 2026; Liu & Liang, 2026; Zhao et al., 2026). Five boundary conditions explain much of the remaining heterogeneity.

Stage and depth of digitalization. Four studies report non-linear effects (Banna et al., 2026; Huang et al., 2026; Wang et al., 2025; Zhao et al., 2024). Risk appears to rise as banks deploy technologies they do not yet fully control and to fall once capability matures. Linear specifications that average across stages can therefore produce opposite signs in different samples.

Type of technology and of digitalization. Effects differ by technology and by scope. Strategic and business digitalization matter more than managerial digitalization in some studies (Huo & Li, 2026; Yu & Liu, 2025), ATMs and mobile banking differ from point-of-sale systems (Alghadi & Al-Jayousi, 2026), and cloud and blockchain have distinct cyber consequences (Alshari et al., 2026; Iuga & Jafri, 2026). Measurement matters as well: studies that code a bank's own digital capability (Dong et al., 2026; Qin & Jing, 2025; Wu et al., 2023) are not directly comparable with those that measure sector-level FinTech development (Yudaruddin et al., 2024), which also captures competitive pressure from outside the bank.

Governance and internal control. Internal control quality mediates the effect in He et al. (2023) and moderates it in Huo and Li (2026), corporate governance is a mediator in Yu and Liu (2025), model governance and cybersecurity condition the AI effect in Banna et al. (2026), and internal control is the strongest driver of risk management in Sang and Anh (2026).

Regulation. Capital regulation pressure (Dai & Song, 2025), macroprudential policy (Liu & Liang, 2026; Zhao et al., 2026), external regulation (Huo & Li, 2026) and regulatory quality (Khanchel et al., 2026) all condition outcomes. The evidence on macroprudential tools is cautionary: Liu and Liang (2026) find them only partly effective against contagion risk. One study finds that the regulatory environment did not moderate the relationship in UAE Islamic banks (Al Hammadi et al., 2024).

Bank characteristics and institutions. Size and ownership appear in most studies but with inconsistent direction. Risk reduction is concentrated in smaller banks in several studies (Ally et al., 2025; He et al., 2023; Yu & Liu, 2025) and weaker for larger banks in others (Aftab et al., 2026; Dai & Song, 2026), yet small banks bear the adverse credit effect in Indonesia (Yudaruddin et al., 2024). State-owned banks manage credit risk better in Wu et al. (2023) but gain less than non-state banks in Qin and Jing (2025). Institutional depth also matters: the benefit is larger in countries with deeper financial systems and stronger banking regulation (Khanchel et al., 2026).

RQ3: Gaps in the evidence

Six gaps emerge from the included studies. First, *geographic concentration*: half of the studies concern China, while none of the 28 concerns Latin America and sub-Saharan Africa is represented by a single study. Indonesian evidence is limited to two studies, neither of which examines operational or cyber risk. Second, *measurement*: text-mined indices, ICT readiness scores and survey scales capture adoption rather than the depth or quality of use, and there is no common metric. Third, *identification*: most panel studies rely on fixed-effects or GMM estimators and robustness tests, and few use quasi-experimental designs such as the difference-in-differences approach of Zhao et al. (2026). Fourth, *risk coverage*: credit risk is studied extensively, market and liquidity risk less, and cyber risk rarely as an outcome. Fifth, *technology coverage*: none of the 28 studies examines generative AI explicitly, although its adoption in banks is moving quickly. Sixth, *time horizon*: most archival samples end in or before 2023, so the effects of recent technologies are largely unobserved.

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DISCUSSION

A digitalization paradox

The central pattern in the evidence is a paradox: the technologies that make an individual bank safer can make the system less safe. Studies that look at a bank's own credit, operational or overall risk mostly find reductions, whereas studies of systemic and contagion risk are split and several find increases (Huo & Li, 2026; Liu & Liang, 2026; Zhao et al., 2026). The studies of Liu and Liang (2026) and Zhao et al. (2026) show why. Digitalization reduces idiosyncratic weaknesses but raises the correlation between banks by expanding interbank exposure, speeding transmission and concentrating dependence on similar models and infrastructure. A bank-level fixed-effects regression will not detect this, because the cost falls on other institutions. Reviews and empirical work that examine only bank-level risk therefore risk overstating the net benefit.

A second element of the paradox is temporal. Several studies report that risk rises before it falls (Banna et al., 2026; Wang et al., 2025; Zhao et al., 2024). A bank that adopts digital tools may initially increase exposure through rapid loan growth, thinner soft-information screening or untested models, and reap the control benefits only after governance catches up. This reading is consistent with contingency theory (Donaldson, 2001): the effect of technology depends on the fit between technology, structure and environment, and fit takes time to build.

Governance as the hinge

Viewed through the resource-based view (Barney, 1991), digital technology is a resource whose risk consequences depend on complementary capabilities. The studies support this reading. Internal control quality, corporate and model governance, cybersecurity capacity, and staff skills mediate or condition the effect in several of the included studies (Al Hammadi et al., 2024; Banna et al., 2026; He et al., 2023; Huo & Li, 2026; Sang & Anh, 2026; Tanbour et al., 2025; Yu & Liu, 2025). The finding that digital transformation alone did not improve risk management in UAE Islamic banks, while FinTech capabilities did (Al Hammadi et al., 2024), illustrates the point: adoption without capability is not enough. For supervisors, this implies that the quality of governance around a technology is as informative as its presence.

Digital Risk Governance Framework and propositions

Figure 2 integrates the findings. Digital capability, defined by the type, depth and scope of technology, activates risk-reducing mechanisms (better screening, automation and monitoring, cost efficiency) and risk-increasing mechanisms (loss of soft information, interconnectedness, cyber exposure and model or concentration risk). These feed through to bank-level and system-level outcomes, and a set of moderators governs both the balance between mechanisms and the transmission to outcomes. The framework is a synthesis of the reviewed evidence and has not been tested as a model.

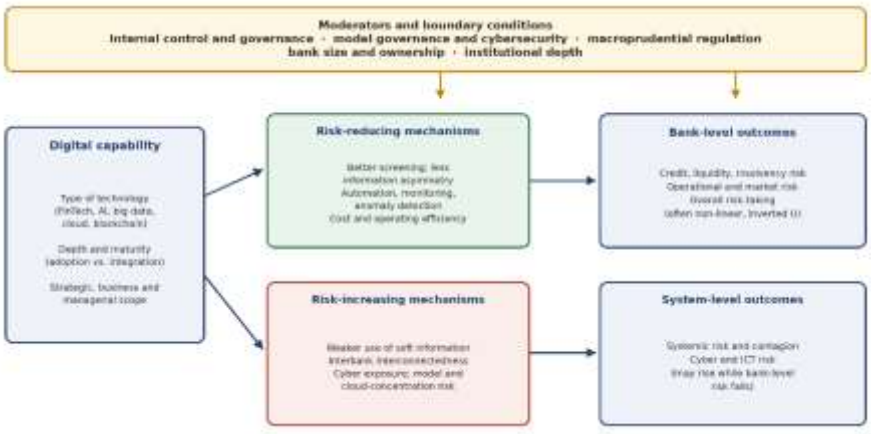


Figure 2. Digital Risk Governance Framework

Source: Developed by the authors from the synthesis of the 28 included studies.

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Five propositions follow, each grounded in the cited evidence and offered for testing:
P1 (non-linearity). The relationship between digital capability and bank-level risk is non-linear: risk rises during early deployment and falls as capability and governance mature (Banna et al., 2026; Wang et al., 2025; Zhao et al., 2024).
P2 (soft information). Digitalization raises credit risk to the extent that it displaces soft-information screening, and the effect is strongest for banks with a large share of SME lending (Dong et al., 2026).
P3 (level of analysis). Digitalization lowers idiosyncratic risk but raises systemic and contagion risk through interconnectedness, and macroprudential tools offset only part of the increase (Huo & Li, 2026; Liu & Liang, 2026; Zhao et al., 2026).
P4 (governance). The risk-reducing effect of digitalization is stronger where internal control, model governance and cybersecurity capacity are stronger (Banna et al., 2026; He et al., 2023; Huo & Li, 2026; Sang & Anh, 2026).
P5 (technology specificity). Digital technologies differ in their risk profiles, so aggregate adoption indices obscure opposing effects across technologies (Alghadi & Al-Jayousi, 2026; Alshari et al., 2026; Iuga & Jafri, 2026).

Implications

For bank managers, the evidence suggests sequencing and governance: deploying a technology before control capacity is in place may raise risk in the short run, and models and third-party infrastructure need explicit oversight. For supervisors, it suggests monitoring digital exposure at the system level, since bank-level indicators may understate contagion channels, and distinguishing technologies rather than relying on a generic digitalization measure. For researchers, it suggests measuring depth and quality of use, separating bank-level from system-level outcomes, and extending the evidence beyond China. For banks and regulators in emerging markets such as Indonesia, the thin local evidence base means that conclusions from large Chinese banks should be applied cautiously.

V. CONCLUSION

This review set out to establish what empirical studies since 2020 say about the relationship between digital technologies and bank risk. The evidence indicates that digitalization more often lowers than raises bank-level credit, operational, market and overall risk, but that the effect is conditional on the stage and type of digitalization, the quality of governance and internal control, regulation, and the characteristics of the bank and its setting. At the system level, the picture is less reassuring, because several studies show that interconnectedness and contagion risk can rise as individual bank risk falls.

The review contributes a transparent account of the evidence, a distinction between bank-level and system-level outcomes, and a framework with five propositions that can guide empirical testing. Future work should extend the evidence beyond China, measure the depth and quality of digital capability, give more attention to cyber and liquidity risk and to generative AI, and use designs that support causal inference. Until then, claims that digitalization makes banking safer should be qualified by risk type, level of analysis and governance context.

Limitations

Several limitations qualify the findings. The search covered one database, so relevant studies indexed elsewhere may be missing; the restriction to English-language journal articles introduces a further publication and language bias. The synthesis rests on a purposive sample of 28 of 85 eligible studies, and a different sample could shift the balance of directional counts, and the synthesis was not tested against the 57 eligible studies that were not selected. Screening was carried out by a single reviewer using keyword-based flags, which may have produced misclassification, particularly among the 263 records excluded because the digital technology–risk relationship was not examined. Data extraction relied on information reported in the studies and no formal quality score was assigned, so the review cannot rule out that differences in rigour account for part of the divergence in findings.

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Directional counts are descriptive and do not weight studies by sample size or credibility. Finally, the evidence is dominated by Chinese banks, and the results should not be assumed to hold elsewhere.

DATA AVAILABILITY

The screening record for all 857 retrieved records, including the decision and reason for each, the data extraction table and the PRISMA counts are available in the supplementary workbook.

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Appendix A

Table 2. Characteristics and main findings of the 28 included studies

#	Study	Context	Design and data	Digital technology measure	Risk outcome	Main finding
Overall bank risk-taking						
1	Yu & Liu (2025)	China	238 commercial banks, 2010-2021; panel regression with mediation and heterogeneity tests	Digital transformation (strategic, business and managerial digitalization)	Overall bank risk-taking	Digital transformation lowers risk-taking; operational efficiency and corporate governance mediate the effect; gains are larger for smaller, urban/rural and eastern banks; strategic and business digitalization matter more than managerial digitalization
2	He et al. (2023)	China	36 listed banks, 2011-2021; unbalanced panel	Bank's own FinTech adoption	Bank risk-taking	FinTech adoption reduces risk-taking, but only in state-owned, small and medium banks and banks with high non-interest income; improved internal control quality is the channel
3	Aftab et al. (2026)	South Asia (seven countries)	90 listed banks, 2010-2024; dynamic GMM	FinTech investment intensity index (PCA)	Bank risk-taking	FinTech investment intensity lowers risk-taking; the effect is weaker in larger banks
4	Banna et al. (2026)	17 Asian and African dual-banking economies	5,806 bank-year observations, 2012-2022; panel analysis	AI intensity	Bank risk-taking	AI intensity is associated with higher risk-taking in a concave pattern (risk ramp-up in early deployment, discipline as model governance matures); stronger cybersecurity attenuates the effect; Islamic banks peak earlier than conventional banks
Credit, liquidity and insolvency risk						
5	Wu et al. (2023)	China	148 commercial banks, 2007-2019; text-mined index, panel analysis	Bank FinTech index (technological application and business innovation)	Credit, liquidity and insolvency risk	FinTech raises credit and liquidity risk but lowers insolvency risk; state-owned banks control credit risk better; technological application lowers insolvency risk while business innovation raises liquidity risk
6	Qin & Jing (2025)	China	Unbalanced panel of commercial banks, 2013-2023; text-mined, entropy-weighted index	Bank FinTech adoption index	Credit risk (NPL ratio)	FinTech adoption lowers the NPL ratio by about 0.9 percentage points through cost and asset efficiency; effect is stronger in non-state banks and regions with less developed service sectors
7	Dong et al. (2026)	China	214 commercial banks, 2011-2023; panel regression	Digital transformation of banks	Credit risk	Digital transformation increases credit risk because it reduces the use of soft information; the effect is stronger where SME loan share is high and weaker where digital capability is strong
8	Wang et al. (2025)	China	134 urban commercial banks, 2011-2023; panel regression	FinTech development	Credit risk	Inverted U-shaped relationship: credit risk rises in early FinTech development and falls as it matures;

						board size strengthens the effect; fewer new branches is one channel
9	Hoque et al. (2024)	Vietnam	26 commercial banks, 2013-2022; OLS, PCSE and FGLS	Official ICT readiness index (digital transformation)	Credit, insolvency and liquidity risk	Digital transformation lowers credit risk through better risk management capacity and less information asymmetry, and lowers insolvency risk through lower costs; no significant effect on liquidity risk
10	Ally et al. (2025)	Tanzania	30 commercial banks, 2010-2021; two-step system GMM	FinTech index	Credit risk (non-performing loans)	FinTech reduces non-performing loans in all bank categories, most strongly in small banks
11	Khanchel et al. (2026)	MENA region	155 banks, 2010-2021; system GMM	Technology adoption index (AI, big data, blockchain, cloud, IoT)	Credit and liquidity risk	Technology adoption lowers both credit and liquidity risk; stronger in larger banks and in countries with deeper financial systems and stronger banking regulation; ownership, Islamic vs conventional status and GCC membership do not moderate
12	Yudaruddin et al. (2024)	Indonesia	142 commercial banks, 2004-2018; panel regression	FinTech development (peer-to-peer lending and payments)	Credit risk and liquidity	Higher liquidity reduces credit risk; FinTech development increases credit risk, especially in small (BUKU 3-4) and private national banks; the liquidity effect depends on the level of FinTech development
13	Zhang et al. (2026)	China	178 commercial banks, 2010-2023; panel regression with endogeneity checks	Digital transformation	Liquidity hoarding (liquidity risk management)	Digital transformation reduces liquidity hoarding by strengthening risk management capability, which in turn raises the inclusiveness of banking services
Operational, cyber and market risk						
14	Dai & Song (2025)	China	Listed commercial banks, 2013-2021; panel regression	Bank digital transformation and sub-areas	Operational risk	Digital transformation lowers operational risk (management digitalization excepted); stronger in regional banks and banks under less capital regulation pressure; the reduction raises market value
15	Alghadi & Al-Jayousi (2026)	Jordan	13 listed commercial banks, 2019-2025; fixed-effects regression	Internet and mobile banking, ATMs and POS systems	Insolvency risk and operational risk	FinTech is generally risk-reducing but the effect differs by technology and risk dimension (ATMs and internet/mobile banking lower operational risk; POS has no significant effect)
16	Alshari et al. (2026)	Yemen	Survey of 332 managers; PLS-SEM	AI, big data, cloud computing and blockchain	Cyber risk and systemic risk	Digital FinTech techniques significantly influence cyber risk, with blockchain having the strongest effect followed by big data; only blockchain affects systemic risk
17	Iuga & Jafri (2026)	Europe (EU-27 and Norway)	Country-level cross-section; hierarchical clustering and Bayesian model averaging	AI adoption and cloud computing	Return on equity and ICT-related cyber risk	AI adoption is negatively associated with ROE; cloud computing is positively associated with cyber risk and strengthens the AI-cyber risk link

18	Dai & Song (2026)	China	32 A-share listed banks, 2013-2021; panel regression	Bank digitalization level	Market risk economic capital	Higher digitalization lowers market-risk economic capital through financial innovation and risk management channels; effect is weaker in large, national and thinly capitalized banks
Systemic risk and contagion						
19	Huo & Li (2026)	China	Listed commercial banks, 2010-2021; extended moral-hazard model and panel tests	Digital transformation (strategic, business, management)	Systemic financial risk	Digital transformation raises systemic risk via expanded interbank business and earnings-management incentives; business and management digitalization drive the effect; external regulation and internal control quality mitigate it
20	Huang et al. (2026)	China	36 listed banks, 2011-2020; quarterly panel, fixed effects	Digital transformation	Systemic risk (tail risk and linkage to market shocks)	Digital transformation lowers systemic risk, more so for national banks through lower management costs; the relationship is asymmetric and excessive transformation may raise systemic risk
21	Zhao et al. (2024)	China	183 listed and unlisted banks, 2010-2021; machine-learning-based systemic risk measure	Digital transformation	Systemic risk	Inverted U-shaped effect; risk-taking and non-interest income mediate; regional digitalization weakens and market concentration strengthens the effect
22	Zhao et al. (2026)	China	Listed banks, 2008-2024; textual FinTech index; DeltaCoVaR and Exposure-DeltaCoVaR; DID	FinTech adoption (market-driven vs regulator-led)	Systemic importance and systemic vulnerability	Market-driven FinTech raises systemic risk through interconnectedness, faster risk transmission and complexity; macro-prudential policy mitigates the effect; regulator-led FinTech is linked to lower vulnerability
23	Liu & Liang (2026)	China	184 commercial banks, 2014-2023; machine-learning text-mined FinTech index	FinTech development	Idiosyncratic risk and contagion risk (systemic risk contribution)	FinTech lowers idiosyncratic risk through lower credit risk and better management efficiency, but raises contagion risk through interbank linkages; macroprudential tools are only partly effective
Enterprise risk management and governance						
24	Sang & Anh (2026)	Vietnam	Survey of 448 senior managers in 26 banks; PLS-SEM	Big data capability and AI application, with five internal control components	Bank-wide risk management and institutional transparency	All five internal control components improve risk management, with monitoring the strongest; AI application improves risk management while big data capability has little effect on AI application
25	Tanbour et al. (2025)	Palestine	Explanatory sequential mixed methods: survey of 80 internal auditors and 23 interviews	AI applications in risk management	Credit, market and operational risk management	AI improves credit and operational risk management (accuracy, automation, anomaly detection); its contribution to market risk is constrained by infrastructure, expertise and strategic priorities
26	Al Hammadi et al. (2024)	United Arab Emirates	Survey of nine Islamic banks; PLS-SEM	FinTech adoption, capabilities, digital maturity and IT security	Risk management effectiveness	FinTech adoption and capabilities improve risk management effectiveness, while digital transformation alone does not; regulatory environment did not moderate the relationships

27	Afgani et al. (2024)	Indonesia and Malaysia	Islamic banks, 2009-2020; two-step GMM; contingency theory	Digitalization proxies (mobile, big data, IoT, cloud, social media)	Risk management practices index and firm performance (Tobin's Q)	Risk management practices and digitalization both raise performance; digitalization mediates the link between risk management practices and performance; practices relate significantly to mobile and social media proxies only
28	Abdo et al. (2026)	Iraq	Central Bank secondary data, 2023-2024; descriptive indicators and hypothesis tests	AI-enabled smart governance (standards, policies, practices, information, technology, skills)	Market, credit, operational and portfolio risk	Smart governance dimensions are associated with better financial risk management in an AI environment, with falling non-performing loans; the observation window is short

Source: Author's analysis. Entries summarise information reported by the studies. Studies are grouped by the primary risk outcome.