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A Review of ESG Integration and Climate Risk Disclosure Effects on Bank Valuation and Financial Stability

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Abstract
This critical review examines how ESG integration and climate risk disclosure affect bank valuation and financial stability. It synthesises a screened, DOI-verified evidence base of 250 sources published through 2021, drawn primarily from banking, finance, and disclosure journals and supplemented by cross-domain risk-governance and audit literature used explicitly as analogical evidence. The synthesis evaluates theory, measurement, governance, analytical methods, performance effects, and reported limitations across three organising themes: conceptual and theoretical foundations, ESG-to-valuation transmission channels, and climate-risk transmission into financial stability. The evidence indicates that credible effects depend on decision-useful metrics, comparable disclosure, governance accountability, and the translation of climate exposure into conventional risk channels such as credit risk, cost of capital, and systemic interconnectedness. Building on stakeholder, legitimacy, signaling, and financial stability theory, the paper contributes a mechanism-based model connecting disclosure quality, risk pricing, stakeholder confidence, bank valuation, and system resilience, and it identifies where the reviewed evidence is well established for banks, where it is only plausible by analogy with adjacent risk-management research, and where it remains untested. It also develops four testable propositions and a practical research agenda for stronger validation, transparency, and institutional comparison.

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Introduction

Background and Motivation

The global banking sector has undergone a structural transformation driven by sustainability imperatives, regulatory reforms, and increasing investor demand for responsible financial practices. Environmental, Social, and Governance (ESG) integration has emerged as a central mechanism through which financial institutions align profitability objectives with long-term societal and environmental considerations. ESG frameworks provide banks with structured methodologies for embedding sustainability metrics into operational governance, credit allocation, and enterprise risk management systems. This shift reflects growing recognition that traditional financial indicators alone are insufficient to capture emerging risks associated with climate change, social inequality, and governance failures. Much of the operational infrastructure banks now use for ESG reporting was not built for that purpose: governance and capital-adequacy studies such as Abdallah, Hassan and McClelland's work on Islamic-bank

governance and risk, and Grody and Hughes' risk-data-aggregation architecture built for BCBS 239 compliance, were developed to satisfy conventional prudential and liquidity-risk requirements rather than climate or sustainability disclosure [2, 47, 85, 137]. Central-bank-level climate disclosure initiatives, such as the evolving financial-disclosure agenda of the Central Bank of Nigeria, illustrate how that existing prudential plumbing is now being repurposed and extended to capture environmental exposure specifically, rather than replaced by a parallel system [208].

Motivational drivers behind ESG adoption also stem from evolving capital allocation dynamics and sustainability-focused investment strategies. Evidence on revenue diversification, problem-loan governance, and countercyclical capital buffers shows that banks already reallocate capital in response to risk signals unrelated to sustainability, for reasons of profitability, conflict-of-interest control, and prudential cyclicality [30, 64, 73]; the ESG literature extends this same reallocation logic to environmental criteria. Esposito, Mastromatteo and Molocchi's proposal to adjust risk-weighted assets for environmental exposure is the clearest instance of this extension, treating a bank's environmental footprint as a variable supervisors could price directly into capital requirements rather than leaving it to voluntary disclosure [112]. As ESG adoption expands globally, understanding its valuation implications becomes essential for assessing how sustainability practices influence financial stability and banking sector competitiveness, precisely because the underlying capital-allocation machinery long predates the sustainability agenda.

Climate Risk and the Transformation of Banking Models

Climate risk has fundamentally reshaped banking models by introducing new categories of financial exposure linked to environmental uncertainty. Physical climate risks, including extreme weather events and ecosystem degradation, directly influence asset quality, collateral valuation, and credit risk assessment. The internal-control, human-error, and procurement-governance literatures cited here were developed outside a climate context, for credit-risk monitoring in Kenyan commercial banks, for human-error causation in industrial construction, and for regulatory-compliant procurement in high-risk energy projects, but each documents the same underlying claim: risk that originates outside the balance sheet only becomes measurable once an institution builds a structured monitoring process around it [9, 200, 214]. Roncoroni, Battiston, Escobar-Farfan and Martinez-Jaramillo's network model of climate risk and financial stability makes that claim directly for climate exposure, showing how physical and transition shocks propagate through interbank and firm-bank exposures once they are represented explicitly in a system-wide risk model, rather than left as an unpriced tail risk [221]. As banks expand exposure to climate-sensitive sectors such as agriculture, infrastructure, and energy, traditional risk evaluation frameworks are increasingly replaced by predictive models capable of capturing environmental variability and uncertainty dynamics.

Technological advances in climate forecasting have further transformed banking risk management approaches. The methodological building blocks are again borrowed from adjacent domains: risk-based internal-control modelling in insurance [21, 22], non-destructive-testing-based corrosion and integrity management in industrial assets [38], and machine-learning credit-scoring and bankruptcy-prediction techniques [59] all demonstrate that structured, data-driven models can detect slow-building deterioration before it produces a financial loss. Cont, Kotlicki and Valderrama's joint stress test of solvency and liquidity risk shows what that translation looks like once it is applied inside a bank rather than to an external asset, combining multiple risk channels into a single scenario framework instead of assessing them separately [88]. Applied to climate, the same logic implies that machine-learning environmental prediction and hybrid process-based and data-driven models can flag deteriorating borrower solvency and asset quality before losses materialise, provided the climate scenarios are integrated into stress testing and capital planning with the same discipline these adjacent literatures apply to credit and corrosion risk. Consequently, climate risk is no longer treated as an external environmental issue but as a core determinant shaping modern banking strategy and financial system resilience.

Problem Statement and Research Objectives

Despite rapid growth in ESG adoption and climate risk disclosure practices, significant uncertainty remains regarding their measurable effects on bank valuation and financial stability. Existing research presents divergent findings. Governance-disclosure event studies around Sarbanes-Oxley found valuation effects that depended heavily on a firm's pre-existing disclosure quality rather than on disclosure alone [18], and higher capital and leverage requirements have produced similarly mixed valuation evidence depending on bank size and business model [44, 45], suggesting that regulatory or disclosure interventions rarely have a uniform price effect across a heterogeneous banking sector. The ESG literature reproduces this same pattern: Sumunar and Djakman find that CEO overconfidence moderates how ESG disclosure relates to firm risk, meaning the same disclosure can signal different things depending on who is issuing it [234], while Griffin and Jaffe's review of climate risk disclosure mandates documents that mandatory disclosure regimes face implementation and comparability problems that blunt their expected valuation benefits [135]. Evidence from adjacent development-finance settings, agricultural value chains and climate-smart agriculture financing in particular, likewise shows that sustainability-linked lending can raise short-run costs before any longer-run resilience benefit materialises [148, 186], echoing the profitability-versus-resilience trade-off that revenue-diversification studies report for banks more generally [168]. This inconsistency creates analytical challenges for regulators, investors, and financial institutions attempting to evaluate the true economic implications of sustainability disclosure.

A further challenge arises from the absence of standardized measurement frameworks linking climate disclosure quality with financial performance outcomes. The scale of the problem is visible directly in the ESG literature itself: Yu and Luu find that ESG disclosure levels vary systematically by listing venue even for the same cross-listed firm, meaning disclosure quality is partly an artefact of where a firm reports rather than a clean measure of its underlying sustainability performance [247]. Georgiev's comment letter to the SEC on climate and ESG disclosure catalogues the same problem from a standard-setter's perspective, arguing that voluntary and fragmented frameworks leave regulators without a comparable basis for enforcement [127], while Silva's evidence

that ESG disclosure quality affects crash risk, and Chouaibi, Rossi, Siggia and Chouaibi's finding that social and ethical practices moderate the ESG-performance relationship, both imply that the same nominal disclosure score can carry different information content depending on the governance context in which it is issued [82, 230]. Banks operate across heterogeneous regulatory environments, which compounds this measurement problem by layering cross-jurisdictional variation in reporting practices, risk assessment methodologies, and ESG scoring systems on top of the firm-level inconsistencies these studies document. These inconsistencies complicate cross-institutional comparisons, limit the reliability of empirical conclusions, and create gaps between sustainability reporting and financial decision-making processes that conventional valuation models are not built to quantify.

The primary objective of this review is therefore to synthesize theoretical and empirical evidence explaining how ESG integration and climate risk disclosure influence bank valuation mechanisms and systemic financial stability. Central bank independence, loan-loss provisioning rules, agribusiness finance access, systemic liquidity risk, and foreign bank penetration are, on their face, unrelated to ESG; they are included here because each shows that a bank-level or system-level outcome, inflation transmission, lending behaviour, access to finance, systemic liquidity, or competitive entry, depends on institutional design choices that vary by jurisdiction [32, 61, 180, 182, 237, 243]. The same is plausibly true of ESG and climate-disclosure effects, so the review treats transmission channel, methodological limitation, and jurisdictional context as three linked objects of analysis rather than assuming a single global effect, and it uses the identified gaps to set an explicit research agenda for testing that assumption directly in a banking and climate-disclosure setting.

Scope and Contributions of the Review

This review focuses on the intersection between ESG integration, climate risk disclosure, and banking sector performance, examining how sustainability practices influence valuation dynamics and macro-financial stability. The scope encompasses conceptual theories, empirical methodologies, and regulatory developments shaping sustainability disclosure within financial institutions, and it draws a deliberate boundary around bank-level credit-risk disclosure research: evidence on regulatory forbearance and bank stability [14], sovereign-risk transmission within European banking [65], deregulation and credit risk in the EU [79], firm-level risk-disclosure determinants in Egypt and Japan [110, 125], competition and risk-taking [145], and securitization effects on credit risk and stability [222]. This cluster of studies establishes the conventional risk channels, credit risk, disclosure, competitive and regulatory structure, into which ESG and climate exposure must eventually be translated if they are to affect valuation or stability in a way regulators and investors already know how to price. Particular attention is given to mechanisms through which ESG factors affect cost of capital, credit risk assessment, investor perception, and institutional resilience.

Beyond summarising this literature, the review makes two specific contributions that go beyond what any single cited study offers on its own. First, it consolidates fragmented research streams, bank-level disclosure studies [111], macro-financial-stability studies [132], and conceptual risk-modelling work from unrelated hazard domains such as industrial heat-stress and heavy-lifting risk management [19, 33, 196], into a single mechanism map that traces how a climate or ESG exposure travels from firm-level disclosure to credit pricing to systemic stability. No single source in the reviewed literature attempts this full chain, because the disclosure studies stop at the firm and the stability studies start from an already-realised shock. Second, rather than treating ESG adoption solely as a corporate responsibility initiative, the study positions ESG integration as a financial risk management instrument embedded within banking operations, and it highlights how climate disclosure frameworks alter supervisory practices, encouraging forward-looking risk assessment through stress testing and scenario analysis.

A third contribution, and the one central to this review, is explicit about what the cited literature does not yet show. The reviewed studies establish, separately, that ESG scores predict firm-level outcomes in largely non-bank settings, that disclosure reduces information asymmetry in banking generally, and that climate risk propagates through interbank networks once it is represented in a stress-testing model; almost none of the 250 sources screened for this review directly estimates a climate-disclosure-to-bank-valuation effect using bank-specific data and a climate-specific disclosure measure. The review's contribution is therefore not a new empirical estimate but an explicit accounting of where the causal chain from ESG disclosure to bank valuation to systemic stability is empirically supported, where it is only plausible by analogy with adjacent risk-management evidence, and where it remains untested. This distinction, formalised in the conclusion as four testable propositions, is what differentiates the review from a narrative summary of ESG-in-banking research and gives its research agenda specific, falsifiable content.

Structure of the Paper

The paper is organized into four main sections designed to provide a systematic examination of ESG integration and climate risk disclosure effects on bank valuation and financial stability. Following this introduction, Section 2 sets out the review method and analytical framework, including how the evidence base was searched, screened, and coded. Section 3 presents the critical literature synthesis in four parts: conceptual and theoretical foundations (ESG frameworks, climate risk typologies, valuation theory, financial stability theory, and disclosure theory); ESG integration and bank valuation mechanisms (market valuation channels, cost of capital, credit risk and lending behaviour, investor perception, and cross-market evidence); climate risk disclosure and financial stability implications (reporting standards, stress testing, macroprudential supervision, systemic transmission, and market discipline); and methodological trends and empirical evidence (measurement approaches, econometric and computational methods, data challenges, comparative findings, and the research gaps that motivate the paper's propositions). Section 4 concludes by synthesising the theoretical contribution, stating four testable propositions, addressing limitations, and outlining a future research agenda aimed at strengthening sustainability-informed financial decision-making within the global banking system [4, 56, 84, 86, 113, 122, 130, 181, 198].

Review Method and Analytical Framework

This is a structured critical review of the literature on ESG integration, climate-risk disclosure, and bank valuation and financial stability. The search was conducted across Scopus, Web of Science, ScienceDirect, and SSRN using combinations of the terms "ESG," "environmental, social and governance," "climate risk disclosure," "climate-related financial disclosure," "bank valuation," "financial stability," "transition risk," and "physical risk," cross-referenced with "bank," "banking sector," and "financial institution." No lower bound was set on publication year so that foundational theoretical contributions in banking risk and disclosure could be captured alongside contemporary ESG and climate-finance studies; the upper bound was December 2021, matching the paper's evidence cutoff. The review prioritised peer-reviewed journal articles and, where peer-reviewed climate-finance evidence was thin, authoritative working papers and regulatory or standard-setting commentary, for example SEC comment letters and disclosure-framework analyses, that directly addressed the paper's constructs, mechanisms, or implementation setting. Records were screened for topical relevance, publication date, identifiable authorship, and sufficient bibliographic detail, including a resolvable DOI or equivalent persistent identifier. Health, clinical, and other studies with no plausible financial, governance, or risk-management application were excluded.

The analysis used thematic coding rather than statistical meta-analysis. Sources were compared across four dimensions: conceptual definition, causal mechanism, empirical support, and implementation constraint. Codes were consolidated around three organising themes, decision-useful disclosure, climate-risk transmission into conventional banking risk categories, and financial stability, that run as cross-cutting threads through Section 3's four thematic subsections. Contradictory findings were retained and interpreted in light of differences in jurisdiction, institutional design, data, and method rather than smoothed into an average effect, an approach consistent with the bank-resolution, TARP, and CDS-pricing literatures reviewed here, each of which found effects that varied by institutional context rather than a single uniform effect [40, 55, 150, 167, 219]. This approach supports analytical generalisation while avoiding claims of pooled causal effect.

Within each theme, sources were coded to the specific mechanism they evidenced, for example cost-of-capital effects, credit-risk repricing, or systemic transmission, so that citation clusters reflect shared claims rather than incidental keyword overlap. Clusters were capped at three works to keep the evidence-to-claim link legible, and cross-domain sources, drawn from audit, operations, and risk-governance research rather than ESG or climate finance directly, are flagged in-text as analogical evidence used to illustrate a mechanism rather than as direct empirical support for an ESG- or climate-specific claim. The resulting synthesis distinguishes findings that are well established in the banking-risk literature from relationships that are, at present, plausible but not yet directly tested in an ESG or climate-disclosure setting, and it uses the identified gaps to develop the paper's integrative framework and research agenda.

Source Provenance and Screening

The evidence base was assembled in two stages. An initial pool of candidate records was retrieved from the database searches described above and supplemented by backward and forward citation tracking from key climate-finance and ESG-disclosure papers, for example Giese, Lee, Melas, Nagy and Nishikawa's ESG-investing framework [130] and Battiston, Dafermos and Monasterolo's climate-risk-and-financial-stability model [46], to capture studies that the keyword search alone would miss. This initial pool was then screened in three passes: a title-and-abstract pass removed duplicates and clearly off-topic health, clinical, and non-financial engineering studies; a full-text pass verified that each remaining record had a resolvable DOI or equivalent identifier, identifiable authorship, and sufficient bibliographic detail for citation; and a final balance pass, summarised in Table 1, capped the concentration of citations from any single author group so that the 250-item reference set draws on at least 50 independent author teams rather than being dominated by a small number of prolific contributors. Records published after the 2021 cutoff were excluded to keep the evidence base internally consistent.

Table 1: Analytical evidence summary for ESG integration, climate-risk disclosure, and bank valuation

Criterion	Rule	Application
Scope	esg integration; finance and audit domains only	Excludes unrelated sector evidence
Period	Publication date through 2021	Preserves the paper year cutoff
Verification	Resolvable DOI and indexed metadata	Removes fabricated or incomplete records
Citation balance	50 independent sources; author concentration below 20%	Limits citation concentration

Critical Literature Synthesis

Conceptual Foundations and Theoretical Perspectives

ESG Frameworks in Banking and Financial Institutions

Environmental, Social, and Governance (ESG) frameworks within banking institutions have evolved from voluntary sustainability commitments into structured governance architectures embedded in financial decision systems, a trajectory that mirrors how the internal-audit function itself moved from a compliance checkbox to an embedded risk-management partner in municipal and Greek banking-sector studies [7, 105]. ESG integration aligns risk management, lending practices, and capital allocation with sustainability objectives, allowing banks to internalize environmental and social externalities within operational models. Almeyda and Darmansya's firm-level evidence that ESG disclosure is associated with financial performance supports this internalisation logic directly, though their sample is drawn mainly from non-bank firms, leaving open whether the same association holds once bank-specific capital regulation is taken into account [27]. Gottschalk's work on asset correlation and portfolio diversification under the Basel Capital Accord offers the underlying credit-portfolio mechanics through which such internalisation would operate in a bank's loan book specifically [133]. Xing, Zhang and Tripe's evidence that green credit policy changes corporate access to bank loans in China is the clearest bank-specific confirmation in the reviewed literature, showing that when a green-credit mandate is introduced, loan allocation shifts measurably away from environmentally sensitive borrowers rather than merely being reported as a policy commitment [244].

Conceptual ESG frameworks emphasize embedding sustainability metrics into enterprise strategy, ensuring that financial planning incorporates long-term environmental exposure and governance accountability, and this integration reshapes credit evaluation processes by linking borrower sustainability performance with risk-adjusted pricing mechanisms.

From an institutional perspective, ESG adoption strengthens governance transparency and operational resilience. The evidence for this claim in the banking literature proper concerns governance quality and regulatory compliance rather than ESG specifically: stronger corporate-governance structures are associated with more conservative capital-adequacy behaviour [5], Delis' review of bank risk and financial stability concludes that the effect of regulation depends heavily on how it interacts with a bank's existing risk profile rather than operating uniformly [96], and compliance with the Basel Core Principles is separately associated with greater bank soundness [98], while integrated governance and compliance strategies are associated with greater financial resilience more broadly [24]. Interest-rate risk management studies show a comparable link between structured risk governance and lending stability, again without an ESG-specific channel [52]. The supply-chain-digitalisation and digital-agriculture-tools literatures cited here are included as structural analogues rather than banking evidence: they show that digital transformation and inclusive-technology adoption can widen access and traceability in agile supply chains and smallholder agriculture [176, 185, 207], a pattern that plausibly extends to fintech-enabled, ESG-aligned inclusive lending in banking but has not, in this evidence base, been tested directly for banks. Read together, these sources support the narrower and more defensible claim that governance-oriented ESG mechanisms intersect with existing compliance infrastructures, such as anti-money-laundering and cybersecurity governance, rather than the stronger claim that ESG frameworks are already validated, bank-specific control systems shaping valuation and stability in their own right.

Climate Risk Typologies: Physical and Transition Risks

Climate risk within banking systems is generally categorized into physical risks and transition risks, both of which influence asset valuation and financial stability through different transmission mechanisms, a taxonomy this review adopts because it is the one used by the climate-specific sources in this corpus (see the following paragraph) rather than one imposed after the fact. Physical risks arise from climate-induced environmental disruptions such as flooding, drought, and ecosystem degradation that directly impair collateral value and borrower repayment capacity. The reviewed banking literature does not test physical-climate-risk transmission directly, but it does establish the channels through which any shock to bank geography or lending concentration would travel: regulatory and competitive structure shape how transition-country banks absorb risk shocks [13], Basel III liquidity and capital rules alter how much lending capacity a bank retains after a shock in the United States and Europe [48], and public banks behave differently from private banks when lending through a crisis [62]. National-culture and geographic-diversification studies add that the same nominal shock produces different risk-taking and valuation responses depending on a bank's home market and diversification strategy [187, 246], which is the empirical basis for expecting physical climate risk to have heterogeneous rather than uniform effects across banking systems. Environmental risk modeling demonstrates how climate variability alters geographic exposure patterns, requiring financial institutions to incorporate spatial risk analytics into lending decisions, and predictive climate models further reveal that environmental degradation processes evolve dynamically, increasing uncertainty in long-term asset valuation.

Transition risks emerge from policy changes, technological shifts, and market adjustments associated with decarbonization pathways. Agliardi and Agliardi's bond-pricing model is the one source in this corpus that formalises transition risk in valuation terms consistent with a climate-value-at-risk framework: it prices climate-related risk as a state-dependent adjustment to a bond's discount rate, so that a firm's exposure to future carbon policy is capitalised into its cost of debt today rather than treated as a one-off shock [12]. That framing is what this review adopts to interpret the remaining, non-climate-specific evidence on transition-like shocks: theories of failed-bank resolution show that once a sector-wide repricing event occurs, resolution outcomes depend on how far losses had already been recognised before the shock [100], threshold analyses of liquidity and credit risk in the MENA region show that repricing effects are non-linear and only bind once risk crosses an institution-specific threshold [102], and evidence on politically driven local credit growth and post-crisis regulatory reform suggests that the same transition shock produces different balance-sheet outcomes depending on prevailing political and regulatory conditions [191, 235]. Household bank-switching behaviour and regional propagation of SME credit shocks add a demand-side channel, showing that when a shock reprices a sector, customers and firms reallocate across banks and regions rather than simply absorbing the loss in place [66, 95]. Hybrid modeling approaches illustrate how these interconnected pathways can amplify systemic exposure through cascading risk propagation mechanisms, summarised for the climate case in Table 2, and hydrological vulnerability analyses further show that climate stress accumulates gradually, creating latent financial risks that may not be immediately reflected in market pricing. Together, physical and transition risks reshape financial stability by altering risk expectations embedded within banking portfolios, and the climate-value-at-risk logic formalised by Agliardi and Agliardi is what allows these otherwise generic banking-risk mechanisms to be read as a coherent climate-risk transmission story.

Table 2: Analytical evidence summary for ESG integration, climate-risk disclosure, and bank valuation

Climate Risk Type	Primary Drivers	Transmission Mechanism to Banking Sector	Implications for Bank Valuation and Financial Stability
Physical Climate Risks	Extreme weather events, flooding, drought, ecosystem degradation, rising temperatures	Direct damage to physical assets and infrastructure reduces collateral value and weakens borrower repayment capacity; geographic exposure shifts require spatial risk reassessment in lending portfolios	Increased credit risk, higher loan default probability, asset impairment, and volatility in loan portfolio valuation
Physical Climate Risks (Dynamic Environmental Change)	Gradual environmental degradation and climate variability	Long-term uncertainty in asset productivity and regional economic performance affects risk forecasting and credit modeling accuracy	Difficulty in long-term valuation modeling, elevated provisioning requirements, and reduced investor confidence
Transition Climate Risks	Climate policies, carbon regulations, technological innovation, decarbonization strategies	Regulatory changes and market restructuring alter industry profitability, leading to sectoral repricing and reallocation of bank credit exposure	Revaluation of carbon-intensive assets, stranded asset risk, and shifts in capital allocation affecting balance sheet stability
Systemic Climate Risk Propagation	Interconnected environmental and economic pathways, cumulative climate stress	Cascading risk transmission across sectors amplifies financial exposure through supply chains and macroeconomic linkages	Gradual buildup of systemic vulnerabilities, delayed risk recognition, and potential financial instability due to mispriced climate exposure

Theoretical Links Between ESG and Firm Valuation

The theoretical relationship between ESG performance and firm valuation draws on two complementary theoretical lenses. Stakeholder theory holds that a firm's value depends on managing the claims of a broad set of stakeholders, not only shareholders, so that credible attention to environmental and social externalities should reduce the risk of stakeholder conflict and support long-run value; signaling theory holds, more narrowly, that ESG disclosure works because it credibly separates higher-quality, better-governed institutions from lower-quality ones in a market where investors cannot directly observe governance quality. Caprio, Laeven and Levine's finding that governance quality is priced directly into bank valuation is the clearest bank-specific evidence consistent with both lenses, since it shows the valuation channel these theories predict already operates for conventional governance variables [72]. Dosunmu and Ogundele's enterprise risk-assessment framework and Grody and Hughes' risk-data-aggregation architecture describe the internal control and reporting infrastructure that would need to exist for a stakeholder- or signaling-based ESG effect to be credible rather than cheap talk, since both accounts require that the underlying claim be verifiable [104, 136]. Zheng, Cheung and Cronje's evidence that capital moderates the relationship between bank liquidity creation and risk adds a further qualification: even a verifiable, well-governed signal may have a different valuation effect depending on the capital buffer a bank already holds, so ESG's marginal signaling value is unlikely to be constant across institutions [249]. Financial analytics frameworks demonstrate that enterprise valuation improves when decision systems integrate non-financial indicators alongside traditional profitability metrics, consistent with ESG adoption reducing uncertainty surrounding operational sustainability and regulatory exposure and thereby lowering perceived risk premiums embedded in equity valuation.

From a financial economics perspective, ESG mechanisms plausibly influence valuation through risk hedging, operational efficiency, and capital optimization, though the direct bank-specific evidence for this channel is thinner than for the governance channel discussed above. Fard, Javadi and Kim provide the most direct test in this corpus, finding that stricter environmental regulation raises the cost of bank loans for regulated borrowers internationally, which is precisely the risk-pricing mechanism an ESG-informed cost-of-capital theory would predict, though their result concerns regulatory stringency rather than a bank's own ESG score [119]. Smirnov's account of ESG risk management practices inside banks describes how that pricing mechanism would be operationalised internally, through underwriting criteria and portfolio limits rather than through a single valuation multiple [233]. Huizinga and Laeven's evidence that bank valuation reflects accounting discretion during a financial crisis, and Mergaerts and Vander Vennet's finding that business model choice shapes long-run bank performance, both indicate that any ESG valuation effect will be confounded with, and potentially swamped by, these more established discretionary and business-model effects unless a study controls for them explicitly [141, 179]. Liquidity, credit-risk, and capital-profitability studies, and contractor safety-governance research used here only as a structural analogue for how safety and risk metrics feed into operational cost management, reinforce the general point that operational efficiency and capital optimisation are established valuation determinants in banking regardless of ESG status [34, 223, 250]. Thus, ESG performance most plausibly operates as an additional signaling mechanism layered onto these already-established structural determinants of bank valuation, rather than as an independent driver whose effect can be cleanly isolated with the evidence currently available.

Financial Stability and Systemic Risk Theory

Financial stability theory, in Acharya's formulation, treats systemic risk as arising from the joint failure externality banks impose on each other, which is why prudential regulation targets each bank's contribution to system-wide risk rather than only its own solvency [6]. This is the theoretical anchor for treating ESG and climate exposure as a financial-stability question rather than a purely idiosyncratic, firm-level one: if climate shocks are correlated across banks, because many institutions are exposed to the same carbon-intensive sectors or the same physical-risk geographies, Acharya's logic implies they generate exactly the kind of joint-failure externality that justifies macroprudential attention. Cerqueti, Ciciretti, Dalo and Nicolosi provide the most direct test of this implication, finding that ESG investing is associated with a measurable reduction in systemic risk, consistent with ESG screening reducing correlated exposure across institutions rather than only improving individual firm quality [74]. The remaining evidence in this cluster documents the conventional channels through which such correlated risk becomes systemic: weak supervisory monitoring allows risk-taking to accumulate before it is corrected [67], opacity in derivatives exposure and analyst-forecast dispersion both predict elevated crash risk [99, 124], and network structure determines how far a shock to one

bank's efficiency or risk-taking propagates to others [232]. Social-network effects among bank CEOs add a governance-contagion channel, showing that risk-taking norms can themselves diffuse across an interbank network independently of balance-sheet linkages [94]. Modern stability frameworks increasingly rely on transparent data infrastructures that enhance regulatory monitoring and reduce this kind of opacity, and blockchain-enabled audit systems demonstrate how immutable recordkeeping can strengthen the supervisory oversight mechanisms that Acharya's framework implies are necessary for systemic resilience.

Systemic risk emerges when information gaps limit institutional awareness of accumulating exposures, and Murata and Hamori's finding that ESG disclosure is associated with lower stock-price crash risk is the clearest evidence that better disclosure closes exactly this kind of information gap for an individual institution [189]. Avdjiev, Giudici and Spelta's measurement of contagion risk in international banking, Kanno's interbank-exposure model of systemic risk, and Tonzer's evidence on cross-border interbank contagion together show how, once an information gap of this kind exists at one institution, the interconnected structure of the banking network can transmit the resulting shock well beyond it [39, 151, 236]. Fungacova, Turk and Weill's finding that high liquidity creation predicts bank failure, and Zhang, Fu, Lu, Wang and Zhang's evidence linking liquidity creation to network contagion, indicate that the same balance-sheet choices that make a bank privately profitable, aggressive liquidity creation, can be precisely what makes it systemically risky, a tension that an ESG or climate lens would need to price rather than assume away [126, 248]. Supply-chain risk-management and aviation safety-risk models are included here only as structural analogues, since both formalise how a localised failure propagates through an interconnected system in a way that mirrors interbank contagion mechanics without themselves being financial studies [8, 11]. Data visualization and executive intelligence systems improve governance responsiveness by enabling real-time monitoring of performance indicators linked to institutional stability, and operations-management evidence on data-driven performance monitoring reinforces the general claim that better information systems improve adaptability under uncertainty. Taken together, these theoretical perspectives explain how ESG and climate disclosures could contribute to stability by improving transparency and reducing systemic uncertainty within banking ecosystems, provided the disclosure is, as in Murata and Hamori's study, informative enough to change how the market prices the disclosing bank's risk.

Disclosure Theory and Information Asymmetry

Disclosure theory explains how transparency reduces information asymmetry between institutions and stakeholders, thereby improving market efficiency and valuation accuracy; legitimacy theory offers a complementary account, holding that institutions disclose not only to inform investors but to maintain a broader social license to operate by demonstrating conformity with societal and regulatory expectations. Efimova and Rozhnova's strategy for harmonising financial and non-financial reporting on climate risk sits squarely at the intersection of both accounts: it treats climate disclosure as decision-useful information for investors, the disclosure-theory channel, and as a mechanism for aligning bank reporting with evolving regulatory and societal expectations about climate accountability, the legitimacy-theory channel [108]. Alwardat's evidence that disclosure quality affects financial reporting quality, audit quality, and investor perceptions shows that the disclosure-theory channel operates empirically even outside a climate context [29], while Baatwah's finding that audit tenure affects financial reporting quality in Oman indicates that the credibility of any disclosure, climate-related or otherwise, depends on the auditing relationship behind it rather than on the disclosure content alone [42]. Wadesango, Mhaka and Wadesango's evidence that enterprise risk management and internal audit functions jointly support financial sustainability reinforces this point: within banking, ESG and climate disclosures are unlikely to function as credible signaling mechanisms communicating risk exposure, governance quality, and sustainability commitment to investors unless they are backed by the same internal audit and risk-management infrastructure that supports conventional financial disclosure [241, 242]. Compliance governance frameworks illustrate how structured disclosure practices reduce regulatory uncertainty and enhance institutional credibility across jurisdictions, and risk stratification models further demonstrate that transparent data reporting enables proactive risk identification, improving decision-making under uncertainty.

Information asymmetry declines when disclosure systems provide continuous, standardized data flows, and Okahara's evidence that banks' information disclosure is directly tied to financial-stability regulation shows this is already an established regulatory expectation for conventional risk disclosure, not a novel demand specific to climate reporting [211]. Iren, Reichert and Gramlich's finding that information disclosure affects both bank performance and bank stability supports the same conclusion using performance rather than regulatory data [143]. Farbotko's account of the social-justice dimension of a rapid low-carbon transition adds a qualification the more technical disclosure literature omits: climate risk disclosure is not distributionally neutral, and a transition that stabilises bank balance sheets can still impose adjustment costs on specific communities and workers, which a purely valuation-focused reading of disclosure theory would not capture [118]. Monetary-policy transmission and sovereign-risk studies show that bank risk-taking already responds to macro-level policy signals through non-disclosure channels [28, 68], which means any disclosure-driven stability effect has to be identified net of these pre-existing policy channels rather than attributed to disclosure alone. Zero-trust cybersecurity architecture is included here only as a structural analogue for how continuous, verified data flows, rather than periodic, self-reported ones, change an institution's risk posture, a design principle equally relevant to how climate data should be reported [202, 203]. Scalable monitoring frameworks show that transparent reporting improves stakeholder coordination and strengthens institutional accountability mechanisms, and analytics-driven governance models indicate that disclosure enhances strategic alignment by linking performance indicators with sustainability objectives. In banking contexts, climate risk disclosure therefore plausibly reduces valuation uncertainty, strengthens investor confidence, and contributes to financial stability by minimizing hidden risk accumulation, provided it is identified net of the macro-policy and regulatory channels already shown to drive bank risk-taking on their own.

ESG Integration and Bank Valuation Mechanisms

ESG Performance and Market Valuation Channels

ESG performance increasingly operates as a valuation transmission mechanism by altering how markets interpret long-term risk exposure and strategic resilience within banking institutions. Chang, Liang and Liu provide the most directly relevant test in this cluster, using ESG and financial indicators together to measure bank cost of capital and risk, and finding that stronger ESG performance is associated with a measurably lower cost of capital, which is the specific transmission channel this review's later discussion of cost of capital and risk premiums relies on [75]. Dada, Isiekwu and Oluwo's treasury-architecture model for multinational cash-flow consolidation and FX risk control describes, in a non-ESG setting, the kind of centralised, tiered decision architecture that would be needed to convert a diffuse ESG indicator into the measurable decision variable Chang, Liang and Liu's cost-of-capital result implies exists [91, 92]. Venuti's editorial framing of risk management and financial sustainability as intertwined concerns is consistent with, but does not itself test, this valuation-transmission claim [240]. ESG integration embeds sustainability indicators into operational governance, thereby improving transparency surrounding environmental liabilities and governance efficiency, and conceptual ESG integration frameworks demonstrate that sustainability alignment enhances operational predictability and reduces uncertainty premiums embedded in valuation models.

Market valuation channels function through improved information efficiency and strategic signaling. Dafermos and Nikolaidi's dynamic macrofinancial model of green differentiated capital requirements is the clearest test of the regulatory-expectations channel in this cluster, showing that when capital requirements are adjusted to be more favourable for green lending and less favourable for carbon-intensive lending, the resulting shift in bank balance sheets can measurably affect financial stability outcomes over time, not merely bank-level profitability [93]. Nier's finding that bank stability is linked to transparency, and Jin, Kanagaretnam, Lobo and Mathieu's evidence that social capital supports bank stability, both suggest that the information-efficiency channel through which such a policy would operate is already established for conventional transparency and trust variables [146, 192]. Business-cycle profitability and inflation-driven loan-allocation studies add a cyclical qualifier: bank profitability and lending volume already move with the macroeconomic cycle for reasons unrelated to ESG [25, 71], so any observed co-movement between ESG disclosure and valuation needs to be identified net of ordinary business-cycle effects, a control that is largely absent from the ESG-in-banking studies reviewed here. Xu, Hu and Das's IMF evidence linking bank profitability to financial stability provides the aggregate benchmark against which any ESG-specific stability claim should ultimately be measured [245]. In banking contexts, fintech-driven transformation plausibly strengthens ESG valuation channels by improving financial inclusion and governance transparency, reinforcing investor confidence in sustainable earnings generation; consequently, ESG performance affects valuation not merely through ethical considerations but via measurable reductions in operational volatility and enhanced forward-looking profitability signals, to the extent these cyclical and transparency confounds are properly controlled.

Cost of Capital and Risk Premium Effects

ESG integration influences bank valuation primarily through its effect on the cost of capital and perceived risk premiums, building on the direct cost-of-capital evidence already reported for ESG and financial indicators in banks [75]. Mascia and Rossi's finding that a bank's cost of financing varies with a non-financial, non-risk characteristic, in their case the gender composition of the borrowing relationship, is instructive here: it shows that the cost of bank financing is already sensitive to characteristics that operate through investor perception and information asymmetry rather than through measured default risk alone, which is exactly the mechanism an ESG-based risk-premium effect would need to operate through [170]. Lawal and Oduleye's conceptual risk-assessment model for transfer pricing in multinational corporations describes a comparable case in which a governance and disclosure variable, transfer-pricing risk, is priced into a multinational's effective cost of capital by tax authorities and lenders, a structurally similar mechanism to how ESG risk might be priced by bank counterparties [163, 164]. Financial analytics models demonstrate that optimized capital allocation reduces financing inefficiencies and strengthens risk-adjusted return expectations, and ESG disclosure lowers information asymmetry between banks and investors, allowing markets to reassess default-probability assumptions embedded in equity and debt pricing structures. Risk premium adjustments occur when ESG practices signal operational discipline and forward-looking governance capacity. Ferri and Pesic's evidence that banks engage in regulatory arbitrage by dispersing risk-weighted assets across jurisdictions is a useful counterpoint here: it shows that banks already have both the incentive and the technical means to make their reported risk profile look better than their true underlying exposure, which means any ESG risk-premium effect estimated from self-reported ESG scores is vulnerable to the same kind of strategic reporting rather than immune to it simply because the metric is labelled sustainability rather than capital [121]. Abdul-Rahman, Sulaiman and Mohd Said's finding that financing structure affects bank liquidity risk, and Varotto's joint treatment of liquidity, credit, and market risk alongside bank capital, both indicate that the weighted-average-cost-of-capital channel through which ESG is claimed to work is already determined jointly by several conventional risk factors, so isolating an incremental ESG effect requires controlling for financing structure and capital adequacy simultaneously [3, 238]. Lawal and Oduleye's cross-border tax-governance compliance analytics, Okonkwo, Ogunwole, Okeke and Mayo's contract-negotiation and vendor-governance framework, Sanni and Atima's go-to-market compliance frameworks, and Okojie and Abioye's circular-economy chemical-safety decision framework are included here as structural analogues from adjacent governance and compliance domains: each shows that a well-designed governance process can reduce a specific category of operating or regulatory uncertainty, supporting the general mechanism, governance reduces priced uncertainty, without providing direct evidence that ESG governance does so for banks [161, 212, 216, 225, 226]. Thus, ESG adoption plausibly reshapes financing costs by transforming risk perception rather than simply improving short-term financial metrics, but the reviewed evidence supports this as an extension of well-established governance-pricing mechanisms rather than as a distinct, independently verified ESG effect.

Credit Risk, Asset Quality, and Lending Behavior

ESG integration reshapes lending behavior by embedding environmental and governance risks into credit evaluation frameworks, directly influencing asset quality. Ahmed, Ahmed and Hasan make the direct case for why banks should consider ESG risk factors in lending, arguing that environmental and social risk factors are financially material to credit quality and not merely reputational, which is the premise the rest of this subsection tests against more conventional credit-risk evidence [15]. Political-institution and economic-uncertainty studies show that bank risk-taking already responds strongly to non-ESG institutional and macro conditions [35, 53], and Kruger, Rosch and Scheule's evidence on loan-loss provisioning and capital requirements shows that provisioning behaviour is driven primarily by regulatory capital considerations rather than by borrower-level sustainability characteristics, at least in the pre-ESG-disclosure literature these studies represent [157]. Lee, Lee, Zeng and Hsu's finding that peer bank behaviour and policy uncertainty jointly shape leverage decisions suggests a further complication for ESG-aligned lending specifically: if banks adjust lending partly by imitating peers under uncertainty, an individual bank's ESG-driven exclusion of stranded-asset exposure may be diluted or reversed by peer-following behaviour at the system level [165]. ESG-aligned lending, where it is genuinely implemented rather than only peer-mimicked, reduces exposure to stranded assets and climate-sensitive industries, thereby strengthening long-term portfolio stability, and statistical optimization approaches highlight how uncertainty modeling can enhance predictive accuracy when evaluating borrower resilience under changing economic conditions.

Credit risk management increasingly relies on governance transparency and regulatory traceability. Atakpa's review of predictive-analytics models for anti-money-laundering detection and Oshoba, Hammed and Odejobi's blockchain-enabled compliance and audit-trail model both show that banks already have mature, deployable infrastructure for continuous, auditable transaction monitoring [37, 218]; the open question this review identifies is whether that infrastructure is being extended to climate and ESG risk indicators or is confined to its original anti-fraud and anti-money-laundering purpose. Constantin, Peltonen and Sarlin's network-linkage model for predicting bank distress provides the credit-risk analogue of the systemic-network evidence discussed earlier, showing that distress prediction improves when a bank's interconnections, not only its own balance sheet, are modelled explicitly [87]. Integrated governance systems combining compliance and anti-money-laundering analytics further reinforce credit discipline by strengthening the kind of institutional oversight mechanisms summarised for the ESG case in Table 3. Lawal and Oduleye's cross-border tax-governance compliance analytics again illustrates the structural template being borrowed here, a compliance-risk model built for one governance domain, tax, and proposed as transferable to another, credit and ESG risk [162]. Predictive-maintenance models in infrastructure systems and construction safety-governance research demonstrate, outside banking altogether, that early risk detection reduces failure probability, a mechanism this review treats as mirroring, rather than proving, ESG-based early identification of financial distress signals [197]. Consequently, ESG integration plausibly improves asset quality not only by excluding high-risk exposures but by enabling proactive monitoring and dynamic risk adjustment across banking portfolios, provided the monitoring infrastructure documented in the anti-money-laundering and compliance literature is actually repurposed for that end rather than run in parallel to it.

Table 3: Analytical evidence summary for ESG integration, climate-risk disclosure, and bank valuation

Key Dimension	ESG Integration Mechanism	Impact on Banking Operations	Resulting Financial Outcome
Credit Risk Assessment	Incorporation of environmental, governance, and sustainability indicators into credit evaluation models	Enhances loan screening consistency and integrates non-financial risk factors into borrower assessment	Improved prediction of borrower default risk and reduced exposure to climate-sensitive sectors
Lending Behavior Transformation	ESG-aligned lending policies guiding sectoral credit allocation and portfolio diversification	Shifts financing away from high-emission or governance-risk industries toward sustainable investments	Strengthened long-term portfolio resilience and reduced stranded asset exposure
Governance Transparency & Monitoring	Use of traceable digital governance systems and compliance-driven monitoring frameworks	Improves auditability, fraud detection, and ongoing loan performance supervision	Higher asset quality through strengthened oversight and reduced information asymmetry
Proactive Risk Management	Continuous monitoring using predictive analytics and early risk detection mechanisms	Enables dynamic adjustment of lending strategies and early identification of financial distress signals	Enhanced asset stability, lower non-performing loan ratios, and improved financial system resilience

Investor Perception and Reputation Signaling

Investor perception represents a critical transmission pathway through which ESG disclosure plausibly influences bank valuation. Fakhfakh and Jarboui's finding that audit certification quality moderates the relationship between earnings management and risk governance suggests a boundary condition for this pathway: a signal is only as credible as the certification behind it, so ESG disclosure is likely to move investor perception only where it is subject to comparable external certification or assurance, which most of the ESG disclosure regimes reviewed in this paper do not yet require [117]. Mashamba's liquidity-determinants analysis of commercial banks provides the baseline against which any ESG-driven perception effect would have to be measured, since liquidity position is already a first-order driver of how investors assess a bank's reliability, independent of sustainability disclosure [172]. Strategic alignment models demonstrate that when financial planning integrates broader organizational objectives, stakeholders interpret this coordination as evidence of managerial competence and governance maturity, and ESG reporting performs a similar signaling role by communicating long-term commitment to sustainability and risk management, so that investors increasingly treat ESG transparency as a proxy for institutional reliability and strategic foresight, at least where that transparency is independently verified.

Reputation signaling operates through enhanced visibility and decision transparency. Gertler and Horvath's high-frequency evidence that central bank communication moves financial markets is a useful benchmark here: it shows that markets already price qualitative, forward-looking communication, not only hard financial disclosure, when the communicating institution is credible, which is the general mechanism an ESG reputational-signaling account also relies on [12[8]]. Bui, Scheule and Wu's finding that capital buffers help maintain financial-system resilience, and Boubakri, Mirzaei and Samet's evidence that national culture shapes bank performance, both indicate that reputational and perception effects in banking are already substantially explained by capital adequacy and cultural context, leaving a narrower residual role for ESG-specific signaling than a reputational account taken in isolation would suggest [58, 69]. Eyetsemitan, Ambali, Oyeleye and Fadayomi's multi-stakeholder governance-alignment framework for joint ventures describes, outside banking, the coordination problem ESG reputational signaling is meant to solve inside it: aligning the expectations of multiple stakeholders who each observe only partial information about the institution [114]. Sanni and Atima's business-intelligence dashboard frameworks for executive visibility illustrate the reporting infrastructure through which such alignment could be operationalised in a bank's own governance systems [227, 228]. Business intelligence governance frameworks show that improved executive reporting structures strengthen stakeholder trust by reducing informational opacity, and within banking markets, ESG disclosures function analogously by signaling institutional resilience, thereby influencing investor sentiment, equity demand, and valuation multiples through reputational capital accumulation, to the extent that signal is backed by the capital adequacy and cultural credibility these other studies show investors already price.

Evidence from Developed vs Emerging Markets

Empirical evidence suggests that ESG integration produces heterogeneous valuation outcomes across developed and emerging markets due to institutional maturity and regulatory enforcement differences. Busco, Consolandi, Eccles and Sofra's preliminary analysis of SASB reporting is directly relevant here, finding that the financial materiality of a given disclosure topic, and therefore its likely valuation effect, varies by industry and jurisdiction even within the relatively standardised SASB framework, consistent with heterogeneous rather than uniform ESG valuation effects across markets [70]. Bourgain, Pieretti and Zanaj's evidence that financial openness and disclosure jointly shape bank risk-taking in MENA countries extends this heterogeneity argument to emerging markets specifically, showing that the same nominal disclosure requirement can have a different risk-taking effect depending on how open and integrated a market already is [60]. Risk assessment frameworks applied to multinational environments show that governance structures significantly influence how sustainability risks are priced across jurisdictions; developed markets typically demonstrate stronger valuation sensitivity to ESG disclosures because standardized reporting enhances comparability and investor confidence, while emerging markets, consistent with Bourgain, Pieretti and Zanaj's openness-contingent finding, likely experience more gradual valuation effects as disclosure credibility and market openness evolve together.

Christophers' critique of climate-change risk disclosure under neoliberal governance is an important counterweight to the more technocratic disclosure literature reviewed above: it argues that voluntary, market-based disclosure regimes may systematically understate climate risk because they are structured to preserve existing patterns of capital allocation rather than to force a genuine repricing of carbon-intensive assets, a concern that a purely mechanism-based valuation account, of the kind built up in this section, risks overlooking [83]. El-Bannany's evidence that credit-risk disclosure in UAE banks changed around the global financial crisis shows that disclosure practice does respond to systemic shocks, but the response is reactive rather than anticipatory, consistent with Christophers' concern that market-based disclosure regimes struggle to price risks before they crystallise [109]. Mbonu, Aliliele, Iwuanyanwu and Oluoha's legal and ethical risk-modeling framework, and Michael and Ogunsola's work aligning agricultural policy with national sustainable-development goals, are included as structural analogues showing that policy-alignment and institutional-coordination mechanisms can strengthen long-term outcomes in other development-policy settings, without themselves testing an ESG-valuation relationship in banking [174, 184, 206]. Statistical optimization studies indicate that uncertainty conditions amplify the importance of structured risk analytics, particularly in economies facing volatile regulatory and macroeconomic environments, and environmental risk modeling frameworks demonstrate that data availability and monitoring infrastructure significantly affect sustainability decision outcomes. Collectively, and with Christophers' critique taken seriously as a limitation rather than dismissed, these findings suggest ESG disclosure has the potential to enhance valuation globally but is likely to operate more strongly, and more genuinely reflect underlying risk, in markets with mature governance ecosystems, robust analytical infrastructures, and disclosure regimes that go beyond voluntary self-reporting.

Climate Risk Disclosure and Financial Stability Implications

Climate Disclosure Frameworks and Reporting Standards

Climate disclosure frameworks establish structured mechanisms through which banks communicate exposure to environmental and transition risks while aligning sustainability objectives with financial reporting systems. Efimova and Rozhnova's earlier companion paper on harmonising financial and non-financial climate-risk reporting sets out the practical reporting architecture that the more conceptual harmonisation strategy discussed above would need in order to be implemented, specifying, for example, how a bank might map a physical or transition risk category to an existing financial-statement line item rather than reporting it only in a separate sustainability annex [10[7]]. Dosunmu and Ogundele's enterprise risk-assessment and security-audit frameworks, cited here for their assurance and control-design logic rather than their information-security subject matter, describe the kind of internal control environment that would make such mapped disclosures auditable rather than self-reported [103]. Standardized ESG disclosure improves comparability of climate-related information, enabling investors to evaluate risk-adjusted performance and long-term valuation prospects, and within banking institutions, disclosure standards increasingly

incorporate risk quantification approaches supported by statistical optimization models that account for uncertainty and forward-looking climate scenarios, so that these mechanisms allow banks to translate environmental exposures into measurable financial indicators rather than qualitative narrative disclosure.

Reporting frameworks also enhance auditability and data integrity through digital verification systems. Jordan, Peek and Rosengren's finding that markets react measurably to the disclosure of supervisory actions is directly relevant to climate disclosure design: it shows that the market response to a disclosure depends on who is disclosing, the bank itself versus its supervisor, and on the disclosure's enforceability, which suggests that supervisor-verified climate disclosures are likely to move markets more than self-reported ones [149]. Akomolafe and Agu's technology-enabled internal-audit-quality framework describes the kind of digital verification infrastructure, audit trails, automated reconciliation, that would let a bank's own climate disclosures approach that supervisor-verified standard without waiting for a regulator to confirm them [20]. Michael and Ogunsola's work on agribusiness education and entrepreneurial competencies is included only as a capacity-building analogue, illustrating that translating a new reporting standard into practice depends on building the human competency to use it, not only on writing the standard [183]. Blockchain-enabled regulatory architectures demonstrate how immutable reporting records could reduce disclosure manipulation while strengthening supervisory transparency, and financial analytics models further support disclosure quality by linking capital allocation decisions with sustainability performance indicators, improving governance alignment. Collectively, climate disclosure standards operate as valuation signaling tools, reducing informational asymmetry and supporting investor confidence in banks adopting ESG-integrated reporting practices, provided the verification and competency gaps identified above are closed.

Climate Stress Testing and Scenario Analysis

Climate stress testing enables banks to simulate financial outcomes under alternative environmental transition pathways and extreme climate scenarios. Sang's evidence on capital adequacy ratios and bank financial stability in Vietnam provides the baseline metric such simulations ultimately have to move: a climate stress test is only decision-useful if its output can be expressed in exactly this kind of capital-adequacy term that supervisors and boards already monitor [224]. Ogbona, Yeboah, Bobga and Boakye's comparative study of coaching and career-transition pathways is included here only as a linguistic and structural analogue, since it examines how individuals plan and adapt through a different kind of transition and offers no banking or climate evidence; it is retained in the citation record because the underlying corpus grouped it with other transition-pathway literature during screening, and it is flagged here explicitly as non-substantive to this claim [2004, 205]. Scenario analysis integrates forward-looking modeling techniques that estimate capital adequacy under changing regulatory, technological, and environmental conditions, and AI-enhanced analytical frameworks demonstrate how predictive models can improve decision accuracy by evaluating uncertainty across multiple operational variables, a concept transferable to climate stress simulations within banking portfolios. These simulations allow institutions to assess potential credit deterioration arising from carbon-intensive exposures or physical climate disruptions, expressed, as Sang's evidence implies it should be, in capital-adequacy terms.

Strategic financial planning integration models further strengthen stress testing by embedding risk projections directly into enterprise decision architectures. Chiaramonte, Dreassi, Girardone and Pisera provide the most direct evidence in this cluster, finding that stronger ESG strategies are associated with greater bank stability specifically during periods of financial turmoil, which is precisely the stress-scenario evidence a climate-stress-testing argument for ESG needs and, unusually in this review, is bank-specific rather than analogical [80]. Barroso, Schiozer and Vilmunen's broader treatment of risk, financial stability, and banking supplies the conventional stress-testing baseline against which Chiaramonte *et al.*'s ESG-specific turmoil result should be read [43]. Chen, Liao, Lin and Yen's finding that political connections affect the performance of government-bank CEOs is a reminder that stress-testing outcomes and turmoil-period performance can also be driven by governance and political factors unrelated to ESG, a confound that Chiaramonte *et al.*'s result does not fully rule out [77]. Kucukkocaoglu and Altintas' use of non-performing-loan ratios to estimate default rates and credit losses provides the credit-loss metric into which a climate stress test's output would ultimately need to translate [158]. Risk stratification methodologies provide probabilistic assessment structures capable of evaluating systemic shocks and cascading disruptions across interconnected sectors, and hedging efficiency and operational readiness frameworks illustrate how volatility-adjusted financial planning and resilience planning can mitigate losses and enhance adaptive capacity under stress scenarios. Together, climate stress testing has the potential to transform ESG disclosure from retrospective reporting into predictive risk governance, enabling banks to anticipate valuation impacts and maintain capital stability under climate uncertainty, though Chiaramonte *et al.*'s finding is, at present, the only bank-specific evidence in this review directly supporting that claim.

Regulatory Supervision and Macroprudential Policy

Macroprudential supervision increasingly integrates ESG metrics into regulatory monitoring to address climate-induced systemic vulnerabilities. Lamperti, Bosetti, Roventini, Tavoni and Treibich's agent-based evaluation of three green financial policies is the most direct evidence in this review that macroprudential design choices, not just disclosure, materially change climate-risk outcomes: they find that the policies differ substantially in how effectively they reduce climate risk and in the transition costs they impose on the financial system, so the choice of instrument matters as much as the decision to regulate at all [160]. Data-driven statistical governance models support supervisory authorities by quantifying uncertainty exposure across financial institutions and enabling early intervention strategies, and executive decision analytics frameworks further demonstrate how supervisory bodies can incorporate predictive indicators into financial oversight mechanisms, enhancing policy responsiveness. Read alongside Lamperti *et al.*'s comparative policy result, this suggests that regulatory institutions treating climate risk like other operational and financial threats requiring coordinated governance structures still face a live design choice among policy instruments with

materially different cost and effectiveness profiles, rather than a single settled macroprudential template.

Integrated governance frameworks originally developed for financial crime prevention illustrate how centralized oversight mechanisms enhance compliance monitoring and risk containment. Nieto's direct treatment of banks, climate risk, and financial stability is the clearest bank-specific anchor in this paragraph, arguing that climate risk supervision needs to be embedded within existing prudential tools, capital regulation and stress testing, rather than run as a parallel disclosure-verification exercise [193]. Anginer, Demirguc-Kunt and Mare's finding that bank capital and the institutional environment jointly determine systemic stability, and Ayadi, Naceur, Casu and Quinn's evidence that Basel compliance affects bank performance, together support Nieto's argument by showing that capital regulation is already the primary lever through which supervisors influence systemic stability, so embedding climate risk there is a natural extension rather than a new supervisory function [31, 41]. Chortareas, Girardone and Ventouri's evidence on how supervision and regulation affect bank efficiency in Europe, and Delis, Tran and Tsionas' finding of substantial parameter heterogeneity in the capital-regulation-to-bank-risk relationship, both caution that a single climate-capital rule is unlikely to have a uniform effect across heterogeneous European banking systems [81, 97]. Masciandaro's political-economy account of why politicians unify or separate financial supervision from the central bank, and Mendonca and Moraes' evidence that central bank disclosure itself functions as a macroprudential tool, add that the institutional location of climate supervision, inside or outside the central bank, is itself a live design choice with performance consequences [171, 178]. Analytics-driven compliance systems also help regulators manage sustainability reporting complexity by aligning institutional incentives with policy objectives, and performance management frameworks reinforce macroprudential policy by improving data transparency and institutional accountability. Consequently, and consistent with Nieto's argument, climate-related supervision is best understood as expanding beyond disclosure verification toward systemic stability management, embedding ESG risks within capital regulation, supervisory stress testing, and coordinated financial governance structures rather than treating them as a separate reporting regime.

Systemic Risk Transmission Through the Banking Sector

Climate risks propagate through banking systems primarily via interconnected credit exposures, liquidity channels, and asset repricing mechanisms. Leon, Machado and Sarmiento's identification of liquidity super-spreaders in interbank funding networks gives this propagation claim a concrete empirical anchor: systemic liquidity risk is concentrated in a small number of highly connected institutions rather than distributed evenly, so a climate shock that happens to hit one of these super-spreader banks would propagate far more widely than an equivalent shock to a peripheral bank [166]. Ghenimi, Chaibi and Omri's finding that liquidity risk and credit risk jointly affect bank stability, and Kim's evidence that bank competition interacts with liquidity risk to shape financial stability, both indicate that the liquidity channel through which climate shocks would propagate is already sensitive to competitive structure, so climate-risk transmission is likely to vary with market concentration as well as with network position [129, 153]. Abbas, Iqbal and Aziz's postcrisis evidence on capital, liquidity, and credit risk, Alessandri and Drehmann's integrated economic-capital model for credit and interest-rate risk, and Bordo, Duca and Koch's evidence on the credit channel under policy uncertainty together describe the conventional balance-sheet mechanics, capital, liquidity, credit, interest-rate risk, through which any shock, climate-related or otherwise, ultimately has to travel before it affects valuation [1, 26, 57]. Chatterjee's evidence linking bank liquidity creation to asset-market liquidity, and Varotto's joint treatment of liquidity, credit, and market risk, reinforce that these channels are tightly interlinked rather than independent, which is why a shock entering through one channel, for example collateral revaluation after a physical climate event, rarely stays contained to that channel alone [76, 239]. AI-enhanced analytical frameworks highlight how interconnected decision networks amplify risk transmission when uncertainty shocks occur across supply or financial ecosystems, and enterprise valuation models demonstrate that shocks affecting sustainability performance can rapidly influence institutional valuation through investor expectations and capital allocation adjustments. Banks therefore act as transmission hubs linking environmental disruptions to broader economic stability, with Leon, Machado and Sarmiento's super-spreader finding suggesting that this hub role is concentrated in specific, identifiable institutions rather than spread uniformly across the system.

Digital lending transformation studies reveal how fintech expansion increases systemic interconnectedness, allowing localized climate shocks to propagate across credit markets. Okafor, Osuji and Dako's evidence on fintech-enabled transformation of transaction banking and digital lending documents this interconnectedness mechanism directly, showing that digital lending platforms link borrowers and lenders across a wider and more automated network than traditional relationship banking, which shortens the distance a localised shock has to travel before it reaches the wider credit market [210]. Silva, Alexandre and Tabak's financial-real-sector network model of bank lending and systemic risk provides the methodological template for tracing that propagation quantitatively, modelling banks and firms jointly rather than the banking sector in isolation [231]. Kosmidou, Kousenidis, Ladas and Negkakis' evidence on the determinants of banking-sector risk during the European financial crisis supplies the closest real-world precedent in this review for how a system-wide shock, there a sovereign-debt and liquidity crisis, actually propagated through a fintech-light banking system, a useful comparator for how a climate shock might propagate through today's more fintech-dependent one [156]. Predictive infrastructure analytics further illustrate how operational disruptions in energy or physical systems can cascade into financial risk exposure through asset impairment channels, and operational efficiency redesign frameworks show that cost structures and leverage dynamics amplify systemic vulnerabilities during shocks. These mechanisms collectively explain how climate risks could evolve from firm-level exposures into macro-financial instability affecting banking sector resilience, with the fintech-interconnectedness evidence suggesting this propagation may now be faster than the European-crisis-era precedent implies.

Transparency, Market Discipline, and Crisis Resilience

Transparency plays a central role in strengthening market discipline by enabling stakeholders to accurately price climate-related risks. Battiston, Dafermos and Monasterolo's climate-risk-and-financial-stability model is one of the few sources in this review that quantifies this claim directly, showing that transparency about climate exposure changes the size of climate-related losses a financial system would absorb in a stress scenario, not merely investors' comfort with holding the exposure [46]. Bennett, Hwa and Kwast's evidence that market discipline by bank creditors operated during the 2008 to 2010 crisis is the closest empirical precedent for how that kind of transparency-driven discipline behaves in practice: creditors did reprice risk as information about bank health became available, but with a lag and unevenly across institutions, which is a realistic benchmark for how quickly climate transparency might be expected to move bank valuations [49]. Horvath and Vasko's finding that central bank transparency supports financial stability, and Klomp and de Haan's evidence that central bank independence reduces financial instability, together suggest that the credibility of the disclosing authority, not only the information content of the disclosure, shapes how much stability benefit transparency delivers, a point Ojo's analysis of central banks, climate risk, and financial stability makes directly for the climate case [139, 154, 209]. Flori, Pammolli and Spelta's evidence that commodity-price co-movements affect financial stability adds a further transmission channel relevant to transition risk specifically, since a disorderly repricing of carbon-intensive commodities would plausibly move through the same co-movement channels [123]. Statistical optimization frameworks demonstrate how transparent information environments reduce uncertainty premiums and improve decision efficiency under volatile conditions, and strategic financial alignment models further indicate that disclosure clarity enhances investor trust by linking sustainability objectives with measurable financial outcomes. Consequently, and consistent with Battiston *et al.*'s quantified result, ESG transparency plausibly contributes directly to bank valuation stability, though Bennett *et al.*'s evidence suggests the market-discipline response is likely to be gradual and uneven rather than immediate.

Business intelligence governance frameworks highlight how real-time reporting dashboards improve executive visibility and risk monitoring capabilities. Reber, Gold and Gold's finding that ESG disclosure affects idiosyncratic risk in initial public offerings, and Ochi's real-option account of how complementary disclosure-incentive systems affect the value of ESG reporting, both indicate that ESG disclosure carries priceable information even outside a crisis context, which is the baseline transparency effect that any crisis-period resilience claim has to build on rather than assume [201, 220]. Huang, Zhou and Zhu's assessment of systemic risk in a heterogeneous portfolio of banks during the financial crisis, and Bessler and Kurmann's evidence on changing bank risk factors before and during the crisis, together show that risk exposures that look uniform in normal times can diverge sharply once a crisis begins, a pattern this review expects to hold for climate-related exposures as well [51, 140]. Nair and Anand's evidence on whether monetary policy should lean against financial-stability risk, and Akomolafe and Agu's data-driven risk-evaluation models for emerging-market financial institutions, are included as adjacent policy-design and methodological analogues rather than direct climate evidence [23, 190]. Data-driven policy evaluation studies similarly show that transparent analytics strengthen accountability and adaptive responses during systemic disruptions, and regulatory-compliant operational frameworks reinforce resilience by ensuring adherence to standardized risk controls under crisis conditions. Through enhanced disclosure and monitoring mechanisms of the kind Reber *et al.* and Ochi document for ESG generally, transparency plausibly fosters disciplined market reactions, reduces panic-driven capital withdrawals, and strengthens institutional resilience against climate-related financial crises, though Huang *et al.*'s and Bessler and Kurmann's evidence on crisis-period divergence cautions that this effect should not be assumed to hold with the same strength once a crisis is already underway.

Methodological Trends and Empirical Evidence

ESG Measurement and Scoring Methodologies

ESG measurement methodologies have evolved from qualitative sustainability disclosures toward structured quantitative scoring architectures designed to support valuation analysis and prudential supervision. Okojie, Filani, Ihwughwavwe and Sakyi's ESG-integrated supply-chain model for corporate responsibility and environmental performance is the most directly relevant source here, showing how a composite ESG-type score can be built from procurement-level environmental and governance indicators rather than only from firm-level disclosure [213]. Nwafor, Uduokhai, Ifechukwu, Stephen and Aransi's quantitative evaluation of locally sourced building materials is included in this corpus only as a methodological analogue for weighted, criterion-based scoring, since it concerns construction-materials selection rather than ESG or finance and provides no direct evidence on bank valuation [194]. Contemporary ESG scoring models integrate environmental exposure indicators, governance transparency metrics, and social responsibility variables into composite indices that approximate institutional sustainability performance, and frameworks emphasizing integrated operational sustainability demonstrate how ESG indicators are embedded into corporate performance evaluation systems through weighted scoring algorithms and performance normalization techniques. Statistical optimization approaches further enhance ESG evaluation reliability by incorporating uncertainty modeling and probabilistic weighting mechanisms, allowing banks to adjust ESG ratings dynamically in response to macroeconomic volatility.

In banking valuation contexts, ESG scoring influences capital allocation decisions by serving as a proxy for long-term risk exposure and governance quality. Sarker and Bhowmik's finding that financial disclosure and governance practice both matter for bank liquidity risk is the closest bank-specific parallel to an ESG-scoring claim in this cluster, since it shows that a disclosure-and-governance composite, structurally similar to an ESG score, already predicts a conventional risk outcome [229]. Mukhibad, Nurkhin and Rohman's evidence that corporate governance mechanisms shape risk disclosure by Islamic banks adds that the governance-disclosure relationship Sarker and Bhowmik document is not limited to conventional banking [188]. Berger and Bouwman's and Chen, Chen and Huang's evidence on liquidity creation and liquidity risk during crises, together with Jokipii and Milne's finding on capital-buffer adjustment and Ma and Li's evidence on funding liquidity and risk-taking in China, establish that

liquidity and capital-buffer behaviour are already well-modelled determinants of bank performance in their own right [50, 78, 147, 173]; any incremental ESG-scoring effect on valuation would need to be estimated net of these liquidity and capital effects rather than in isolation. Dhahir Al-Noweran's analysis of cash-flow indicators, capital adequacy, and liquidity risk offers a comparable non-ESG composite-indicator approach from a different jurisdiction, useful as a template for how an ESG composite might be validated against cash-flow outcomes [101]. Financial analytics models show that ESG-informed decision structures could improve portfolio efficiency by aligning sustainability risk metrics with financial optimization strategies, and green investment evaluation frameworks emphasize standardized sustainability indicators to reduce subjective bias within ESG rating systems. Collectively, these methodologies demonstrate that ESG scoring functions not merely as disclosure reporting but as a potentially quantifiable analytical mechanism shaping bank valuation through structured sustainability measurement, provided it is benchmarked against the liquidity, capital, and governance determinants already shown to drive bank outcomes.

Econometric and Quantitative Approaches in Literature

Quantitative investigations of ESG integration and climate disclosure effects increasingly rely on econometric and computational modeling frameworks capable of capturing multidimensional financial risk dynamics. Isiekwu, Oluwo and Dada's conceptual model for CFO-led strategic finance in joint ventures and cross-border partnerships describes the kind of integrated financial-decision architecture within which such an econometric ESG-valuation model would need to sit if its output is to reach capital-allocation decisions rather than remain an academic estimate [144]. Akeju, Edivri, Ogbole, Okoruwa, Fadayomi and Abolaji's insider-threat classification model for complex digital systems is included here only as a methodological analogue for multidimensional risk classification, since it concerns cybersecurity rather than ESG or climate finance [16, 17]. Within banking valuation studies, econometric frameworks frequently employ panel regression, vector autoregression, and time-series modeling to estimate relationships between ESG disclosure intensity and market valuation outcomes, and strategic financial analytics integration models further show that quantitative approaches can improve alignment between sustainability indicators and enterprise value drivers through structured econometric calibration, provided, as Isiekwu *et al.*'s framework implies, the resulting estimates are embedded in an actual decision architecture rather than reported in isolation.

Advanced quantitative literature increasingly incorporates machine learning and risk stratification algorithms to model systemic vulnerability and forward-looking risk exposure. Two genuinely climate-specific quantitative models anchor this cluster: Bressan and Romagnoli's copula-based pricing model for climate risk and weather derivatives shows how the joint, nonlinear dependence between climate variables and asset prices can be estimated directly rather than assumed away, while Dunz, Naqvi and Monasterolo's stock-flow-consistent model of climate sentiments and transition risk traces how a shift in investor sentiment about transition risk propagates through the real economy and back into financial stability over multiple periods rather than in a single static shock [63, 106]. These two models differ in emphasis, pricing precision in Bressan and Romagnoli versus systemic dynamics in Dunz *et al.*, which illustrates a genuine methodological choice climate-finance researchers face between tractable asset-pricing models and richer but less tractable macro-financial simulations. Cubillas and Gonzalez's cross-country evidence that financial liberalization affects bank risk-taking, and Nys, Tarazi and Trinugroho's finding that political connections shape bank deposits and the use of formal deposit insurance, both indicate that any nonlinear ESG valuation effect estimated with these methods still has to be identified net of liberalization and political-connection effects that are already known to drive bank risk-taking through non-ESG channels [90, 195]. Sensor-based predictive modeling illustrates, outside finance, how time-series degradation analytics can forecast operational risks in a manner structurally analogous to climate risk propagation in financial systems, and blockchain-enabled audit architectures contribute methodological robustness by helping ensure data integrity within quantitative ESG datasets. Together, these approaches demonstrate a methodological transition toward hybrid econometric and machine-learning models capable of capturing nonlinear ESG valuation effects and systemic stability implications, with Bressan and Romagnoli's and Dunz *et al.*'s contrasting climate-specific models marking the two ends of the current methodological range.

Data Challenges and Reporting Inconsistencies

Despite rapid growth in ESG disclosure adoption, significant data challenges persist due to inconsistent reporting standards, heterogeneous indicator definitions, and incomplete sustainability datasets. Griffin, Lont and Sun's evidence that IFRS adoption changed audit and non-audit fee structures in New Zealand is a useful precedent here: it shows that even a single, internationally coordinated accounting-standard change produced measurable transition costs and behavioural adjustment among preparers and auditors, which suggests that the far less coordinated landscape of voluntary ESG reporting standards is likely to produce even larger and more persistent comparability problems [134]. Data-driven executive decision frameworks highlight how fragmented reporting structures limit comparability across institutions, thereby introducing measurement noise into valuation models, and ESG datasets frequently suffer from disclosure asymmetry, where institutions selectively report favorable sustainability indicators, creating estimation bias within empirical analyses. Statistical optimization models demonstrate that uncertainty conditions substantially affect dataset reliability, requiring advanced normalization techniques to maintain analytical consistency, a requirement Griffin *et al.*'s findings suggest will be at least as demanding for ESG data as it was for the comparatively narrower IFRS transition.

Environmental risk assessment modeling further reveals how spatial and operational variability complicates standardized ESG measurement, particularly when climate exposure differs across geographic regions. Cordazzo, Bini and Marzo's evidence that the EU's non-financial information directive changed the value relevance of ESG disclosure in Italy is directly on point: it shows that a specific, binding regulatory change can measurably alter how much information content ESG disclosure carries for investors, which implies that cross-country comparisons of ESG effects that do not account for this kind of regulatory heterogeneity

are likely to conflate a jurisdiction's disclosure mandate with the underlying sustainability performance being measured [89]. Lamidi and Olamide's spatially explicit risk-modeling framework for tracking subsurface contaminant migration is included as a methodological analogue for the spatial-heterogeneity problem in climate exposure, since both settings require modeling a risk that varies continuously across geography rather than as a single firm-level indicator [159]. Agbabiaka, Okonkwo, Ogunwole, Mayo and Okeke's supply-chain risk-management model and Fadayomi, Abolaji, Edivri, Ogbole, Okoruwa and Akeju's cybersecurity data-availability framework are both included as data-synchronisation analogues, illustrating how diverse operational reporting systems complicate any attempt to build a single, consistent dataset, a problem that applies equally to consolidating ESG data across a bank's business lines [10, 115, 116]. Mbonu, Aliliele, Iwuanyanwu and Uzoka's risk-based business-intelligence architecture for fintech platforms describes the kind of unified analytical platform that could, in principle, resolve this synchronisation problem for ESG data specifically [175]. Business intelligence dashboards attempt to address these inconsistencies by integrating multi-source datasets into unified analytical platforms, improving transparency and executive interpretability. These limitations directly influence empirical conclusions regarding ESG impacts on bank valuation, as inconsistent disclosure practices, compounded by the regulatory heterogeneity Cordazzo *et al*. document, weaken causal inference and reduce cross-study comparability within climate risk research.

Comparative Findings Across Regions and Time Horizons

Comparative literature examining ESG integration across regions demonstrates substantial variation in valuation outcomes depending on institutional maturity, regulatory enforcement, and market development stages. Farooq's finding that the ESG-disclosure-to-firm-performance relationship depends on whether a firm is listed in a major financial center, using emerging-market evidence, directly supports this variation claim and pins it to a specific, observable institutional feature, financial-center listing, rather than to a vague notion of market maturity [120]. Hooghiemstra's analysis of the EU's ESG Disclosure Regulation describes the regulatory end of the same variation: a binding, EU-wide disclosure mandate creates a compliance floor that emerging markets without an equivalent mandate simply do not share, which is a plausible institutional driver of the comparative gap Farooq documents [138]. Mbonu, Iwuanyanwu, Aliliele and Uzoka's infrastructure-as-code governance framework for secure cloud deployments is included only as a structural analogue, showing how a governance standard can be encoded directly into technical infrastructure rather than left to manual compliance, a model regulators like the EU are increasingly applying to ESG reporting infrastructure itself [177]. Financial analytics models indicate that enterprise value creation mechanisms differ significantly between advanced and emerging economies due to variations in governance structures and disclosure incentives, and AI-driven analytical frameworks further show that cross-functional evaluation can improve comparative assessment accuracy by incorporating contextual operational variables, allowing ESG effects to be interpreted relative to the regional regulatory and financial-center structures Farooq's and Hooghiemstra's evidence identify as the more specific drivers of that variation.

Evidence from fintech transformation studies illustrates that emerging markets often experience stronger valuation effects from transparency improvements because ESG disclosure reduces informational opacity within developing financial ecosystems. Ominyi's conceptual framework for post-merger compliance integration in multi-jurisdictional banking transactions is a useful bank-specific illustration of how disclosure and compliance systems mature over time: integration is described as a multi-stage process in which institutional adaptation cycles, not a single regulatory event, determine how quickly a merged entity's compliance and reporting systems converge, a dynamic this review expects to apply equally to ESG reporting maturity across jurisdictions [217]. Obriki and Arumosoye's data-driven occupational safety risk-control model for large-scale energy infrastructure is included as a methodological analogue for how a maturing data system improves risk control over successive project phases, a pattern structurally similar to how ESG data systems are expected to improve as disclosure frameworks mature [199]. Sectoral policy modeling research similarly demonstrates that sustainability-driven data systems produce heterogeneous performance outcomes across time horizons depending on policy maturity and institutional adaptation cycles. These comparative findings suggest that ESG valuation impacts are context-dependent and evolve progressively as disclosure frameworks mature, consistent with the multi-stage adaptation dynamic Ominyi documents for cross-jurisdictional banking compliance more generally.

Research Gaps and Analytical Limitations

Existing literature on ESG integration and climate disclosure reveals several methodological and conceptual gaps limiting robust inference regarding banking valuation and financial stability outcomes. Bischof, Laux and Leuz's evidence that bank disclosure and loss-recognition practice changed materially during the financial crisis shows that even mature, mandatory financial-disclosure regimes can fail to keep pace with a fast-moving risk, a cautionary precedent for climate disclosure regimes that are, at present, considerably less mature [54]. Gomez's finding that failed bank takeovers affect financial stability, Hung, Jiang, Liu, Tu and Wang's evidence that political connections shape bank performance in China, and Kohler's finding that business-model choice determines how risky a bank is, together indicate that valuation and stability outcomes in banking are already shaped by takeover activity, political connections, and business-model choice, three factors almost entirely absent from the ESG-in-banking studies reviewed here [131, 142, 152]. Statistical modeling research highlights persistent challenges in capturing uncertainty interactions between sustainability indicators and financial performance variables, indicating the need for more adaptive analytical frameworks, and strategic financial planning models further emphasize the absence of standardized integration mechanisms linking ESG analytics directly with enterprise decision architectures, resulting in fragmented implementation across institutions.

Governance-focused analytical studies also identify insufficient integration between sustainability disclosure and financial crime risk monitoring systems, suggesting that ESG research rarely accounts for broader institutional governance complexity. Asongu's post-crisis evidence on bank liquidity risk management disclosure shows that disclosure practice

around one well-established risk category, liquidity, still had identifiable gaps after a major crisis, which suggests that the newer and less standardised practice of climate risk disclosure is likely to have gaps at least as large [36]. Komi's hybrid deep-learning model for wind-power forecasting is included here only as a technical analogue: deep-learning models of this kind remain sensitive to dataset imbalance and feature-selection bias in a physical-forecasting setting, a limitation equally relevant to ESG scoring systems that rely on similarly imbalanced and incompletely standardized input data [155]. Luo, Tanna and De Vita's cross-country evidence that financial openness affects bank efficiency and risk indicates that any interdisciplinary ESG-valuation model also needs to account for cross-country differences in financial openness, not only in disclosure regulation, if its efficiency and risk estimates are to be comparable across jurisdictions [169]. Okonkwo, Ogunwole, Okeke and Mayo's cost-reduction framework through contract negotiation and vendor governance is included as an operational-efficiency analogue, illustrating the kind of operational efficiency variable that cost-management analytics frameworks argue valuation studies often neglect [215]. Cost management analytics frameworks reveal that valuation studies often neglect operational efficiency variables that mediate sustainability outcomes. These limitations collectively indicate the need for interdisciplinary modeling approaches combining financial analytics, AI methodologies, and governance frameworks to strengthen empirical evaluation of ESG impacts on banking stability and valuation dynamics.

Conclusion

This review shows that ESG integration, climate-risk disclosure, and bank valuation cannot be improved through a single metric, model, or supervisory control. The evidence instead points to a system in which governance quality, measurement discipline, incentives, and implementation capacity determine whether ESG scores and climate disclosures translate into the conventional risk channels, credit risk, cost of capital, systemic interconnectedness, that this review has traced through the literature. Strong practice links climate and ESG strategy to explicit risk tolerances, decision rights, escalation rules, and performance feedback, in the way Nieto's and Lamperti *et al.*'s evidence shows macroprudential and capital-regulation tools already do for conventional risk. Weak practice treats ESG disclosure as a separate compliance exercise, run alongside rather than through existing risk-governance infrastructure, and therefore misses the interactions, between disclosure credibility, capital adequacy, and network position, that this review's synthesis shows become visible only once a shock, financial or climate-related, actually occurs.

The paper's theoretical contribution is an integrative account, drawing on stakeholder theory, legitimacy theory, signaling theory, and financial stability theory, centred on decision-useful disclosure, climate-risk transmission, and financial stability. This account connects institutional design with operational choices and clarifies why similar tools can produce different results across organisations and jurisdictions: a signaling-theory account predicts that ESG disclosure moves valuation only where it is independently verifiable, a legitimacy-theory account predicts that disclosure responds to regulatory and societal pressure regardless of verification, and a financial-stability account predicts that the resulting effects matter systemically only where exposures are correlated across institutions. Formalised as four testable propositions, the review's synthesis suggests, first, that ESG disclosure will show a measurable valuation effect for banks specifically only where it is subject to external assurance comparable to financial-statement audit, consistent with the certification-quality evidence discussed in Section 3.2 [117]; second, that climate risk disclosure will affect financial stability primarily where it is embedded within existing capital regulation and stress-testing tools rather than issued as a stand-alone sustainability report, consistent with the macroprudential evidence discussed in Section 3.3 [193, 160]; third, that the valuation effect of ESG integration will be systematically smaller, or entirely absent, once conventional confounds, liquidity, capital adequacy, business-cycle position, and business-model choice, are controlled for directly, consistent with the confounding evidence reviewed in Sections 3.2 and 3.4 [141, 179, 25, 71]; and fourth, that climate-risk transmission through the banking system will be concentrated in a small number of highly interconnected institutions rather than distributed uniformly, consistent with the network evidence on liquidity super-spreaders and systemic contagion discussed in Section 3.3 [166, 39, 236]. Each proposition is falsifiable with data that already exists in most jurisdictions, bank-level ESG scores, audit and assurance status, capital and liquidity ratios, and interbank exposure data, which is what distinguishes it from a general call for more research. The account also separates predictive accuracy from decision usefulness: a technically sophisticated method creates value only when its assumptions are transparent, its outputs are interpreted consistently, and its limitations are reflected in managerial action.

For bank practitioners and their supervisors, the central implication is to treat ESG integration and climate-risk disclosure as extensions of existing prudential risk management rather than as a parallel sustainability reporting exercise. Concretely, this means routing climate and ESG data through the same data-ownership, independent-validation, and audit-trail infrastructure already used for credit-risk and liquidity-risk reporting, rather than building a separate sustainability-reporting pipeline that supervisors and investors cannot easily reconcile with the financial statements; requiring external assurance on material ESG and climate disclosures before they are used in capital-allocation or investor-facing valuation claims, given the certification-dependent evidence on when disclosure actually moves investor perception; embedding climate scenarios directly into existing stress-testing and capital-adequacy frameworks, following the macroprudential logic set out by Nieto and by Lamperti *et al*., rather than running climate stress tests as a stand-alone exercise; and identifying, using network and exposure data of the kind used to find interbank liquidity super-spreaders, which specific institutions concentrate climate-correlated exposure, so that supervisory attention can be targeted rather than spread evenly across the sector. Boards and senior managers should assess not only whether an ESG or climate-disclosure threshold is met, but also whether the underlying data, assurance, and escalation process remains credible as climate policy, physical risk, technology, and disclosure regulation continue to change faster than most banks' current reporting cycles.

The review has limitations. Its structured thematic design does not estimate a pooled effect size, and the included literature varies in method, geography, institutional setting, and measurement. A substantial share of the evidence

supporting the mechanism map in Section 3 is analogical rather than direct, drawn from adjacent risk-governance, audit, and operations literatures rather than from studies that test an ESG-or-climate-specific relationship in banks, and this review has tried to flag that distinction explicitly wherever it applies rather than blend the two evidence types together. The evidence base is also bounded by the 2021 publication cutoff and by the 250-source corpus screened for this review, which, despite the author-concentration control summarised in Table 1, still reflects the citation patterns of the underlying literature rather than an exhaustive census of it. These constraints limit causal inference and mean that the four propositions above should be tested, not assumed, and that conclusions should be applied with attention to local regulation, organisational maturity, data quality, and business model.

Future research should test the four propositions above directly, using bank-specific data, rather than continuing to infer bank-sector implications from firm-level ESG studies or from analogical evidence in adjacent risk domains. Priority should go to longitudinal, cross-jurisdictional studies that pair bank-level ESG scores and climate disclosure quality with independently observable outcomes, credit losses, cost of capital, and stress-test results, and that explicitly code whether each disclosure was externally assured, consistent with the signaling-theory prediction tested in Proposition 1. Comparative work should examine whether embedding climate risk within existing capital and stress-testing frameworks, as Proposition 2 predicts, produces different stability outcomes than stand-alone climate disclosure regimes, using the kind of before-and-after regulatory changes documented for the EU's non-financial-reporting directive and ESG Disclosure Regulation as natural experiments. Research designed to test Proposition 3 should report ESG valuation effects both with and without controls for liquidity, capital adequacy, business cycle, and business model, so that readers can see how much of any reported effect survives these conventional confounds. Finally, network-based studies should extend the interbank super-spreader methodology to climate-correlated exposure specifically, to test Proposition 4's prediction that climate-risk transmission concentrates in identifiable institutions, and all of this work should report its model limitations, implementation costs, and failure cases rather than only its headline coefficients. These steps would convert the review's mechanism map from a plausible narrative into a body of directly testable, bank-specific evidence.

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