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REVIEW ARTICLE

Assessing Climate Risk Disclosure Practices Among Multinational Corporations

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ABSTRACT

Climate risk disclosure has moved in little more than a decade from a voluntary, marginal element of corporate sustainability reporting to a widely referenced, and in several major jurisdictions mandatory, component of financial reporting for multinational corporations. This review synthesizes evidence from the accounting, finance and sustainability-reporting literatures on three interrelated questions: how far, and how unevenly, has adoption of the Task Force on Climate-related Financial Disclosures (TCFD) framework and its four-pillar structure (governance, strategy, risk management, metrics and targets) progressed across multinational firms; how does the quality of physical-risk disclosure compare with that of transition-risk disclosure; and what does the empirical record show about the relationship between disclosure and firm-level financial and environmental performance. Drawing on more than two decades of peer-reviewed studies spanning voluntary carbon disclosure, CDP-based scoring, textual analysis of climate risk language in regulatory filings, and post-TCFD compliance audits, we find a consistent and persistent asymmetry: governance and strategy disclosures are comparatively mature and largely qualitative, whereas metrics-and-targets disclosure, particularly forward-looking, scenario-based quantification of transition risk exposure, remains the weakest pillar across regions and sectors. Physical-risk disclosure lags transition-risk disclosure even more severely, with few firms outside a small set of insurance, utility and real-estate companies reporting asset-level exposure to acute or chronic physical hazards. Sectoral and regional heterogeneity is substantial, with European and financial-sector firms consistently scoring highest on composite disclosure indices and reporting quality correlating only weakly and inconsistently with underlying carbon or climate performance, a pattern the literature has long interpreted through the competing lenses of voluntary disclosure theory and legitimacy or impression-management theory. We conclude that disclosure volume has outpaced disclosure decision-usefulness, that comparability across firms remains constrained by the persistence of qualitative, non-standardized reporting even under a common framework, and that closing the physical-risk and quantification gaps is the most consequential unresolved challenge facing climate-related financial disclosure as it transitions from voluntary practice toward mandatory regulation.

Keywords: climate risk disclosure; Task Force on Climate-related Financial Disclosures; TCFD; corporate sustainability reporting; physical risk; transition risk; multinational corporations; ESG reporting

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1. INTRODUCTION

Investors, regulators and civil-society actors have, over the past decade, converged on the view that climate change represents a source of financial risk material enough to warrant standardized corporate disclosure, rather than a purely reputational or environmental concern to be addressed through voluntary sustainability reporting alone [1,2]. This shift was catalysed most visibly by the establishment of the Task Force on Climate-related Financial Disclosures (TCFD) in 2015 and its 2017 recommendations, which organized climate risk disclosure around four pillars, governance, strategy, risk management, and metrics and targets, and distinguished explicitly between physical risks arising from the changing climate itself and transition risks arising from the policy, technology and market shifts accompanying decarbonization [3].

Multinational corporations occupy a particular position in this discussion. Their scale, geographic spread and exposure across jurisdictions with widely differing disclosure mandates mean that the quality and comparability of their climate risk reporting has disproportionate influence on how well capital markets can price climate risk in aggregate, yet the same characteristics make consistent measurement of their disclosure practices unusually difficult, since a single firm's reporting may reflect a patchwork of home-country, host-country and voluntary-framework requirements rather than a coherent disclosure logic [4,5]. A substantial empirical literature, predating TCFD by more than a decade and continuing to accumulate rapidly since, has attempted to measure this disclosure behaviour, score its quality, and relate it to firm characteristics and outcomes, but this literature is fragmented across accounting, finance, management and environmental-policy journals, uses inconsistent disclosure metrics, and has not, to our knowledge, been synthesized specifically around the physical-risk-versus-transition-risk distinction that is now central to how practitioners and regulators frame the disclosure problem.

Two theoretical lenses have dominated interpretation of this evidence. Voluntary disclosure theory predicts that firms with genuinely better climate risk management disclose more, and more credibly, because doing so lowers their cost of capital and signals quality to investors [6,7]. Legitimacy and impression-management theory predicts, by contrast, that disclosure volume can substitute for, rather than reflect, underlying performance, particularly for firms facing high stakeholder scrutiny or poor environmental records, who may use detailed qualitative disclosure to manage external perceptions without a commensurate change in exposure or emissions [8,9]. These two accounts make sharply different predictions about the disclosure-performance relationship, and much of the empirical literature we review here can be read as an

extended, still unresolved, test between them.

The transition from a voluntary to an increasingly mandatory disclosure regime, through the European Union's Corporate Sustainability Reporting Directive, the U.S. Securities and Exchange Commission's climate disclosure rulemaking, and jurisdiction-specific TCFD-aligned mandates in the United Kingdom, Japan, New Zealand and elsewhere, has intensified interest in whether the practices documented under voluntary regimes generalize to a mandatory setting, and whether the specific weaknesses identified in the voluntary-era literature, particularly around forward-looking quantification and physical-risk reporting, persist once disclosure is legally required [10,11]. Understanding what the pre-mandate empirical record actually shows is therefore not simply of historical interest; it is the evidentiary baseline against which the effects of the current wave of mandates will need to be judged.

This review synthesizes that record. We organize the evidence around three questions: first, how has adoption and disclosure quality under the TCFD's four-pillar structure varied across regions, sectors and firm characteristics; second, how does the depth and rigour of physical-risk disclosure compare with that of transition-risk disclosure, and what explains the persistent gap between them; and third, what does the accumulated evidence show, and fail to show, about the relationship between climate risk disclosure and both financial outcomes (cost of capital, firm value, analyst coverage) and underlying environmental performance. We close by identifying the most consequential gaps in the evidence base as disclosure moves from a voluntary practice studied largely through self-selected samples to a mandatory one that will, for the first time, be observable across essentially the full population of large multinational firms.

2. MATERIALS AND METHODS

This review synthesizes findings from the peer-reviewed accounting, finance, management and environmental-policy literatures on corporate climate risk disclosure, with a deliberate focus on multinational corporations and on studies published or substantially updated since the TCFD's 2017 recommendations, supplemented by foundational pre-TCFD studies on voluntary carbon and environmental disclosure that established the measurement approaches and theoretical framings later applied to TCFD-aligned reporting.

2.1 Scope and literature identification

We drew on studies indexed in standard accounting, finance and management databases that examined corporate climate-related, carbon, or environmental risk disclosure, restricting attention to studies using large-sample or multi-firm designs (survey-based scoring, textual analysis of filings, CDP or TCFD-index construction) rather than single-firm case studies, so that

the synthesized evidence speaks to patterns across the multinational corporate population rather than to idiosyncratic firm-level narratives. Both TCFD-era studies explicitly using the four-pillar framework and pre-TCFD voluntary carbon and environmental disclosure studies were included, since the latter established the disclosure-quality constructs and the theoretical debate that TCFD-era research has largely inherited.

2.2 Classifying disclosure dimensions

Following the TCFD's own architecture, we classified disclosure content into governance disclosure (board and management oversight of climate-related issues), strategy disclosure (identification of climate-related risks and opportunities and their integration into business and financial planning, including scenario analysis), risk management disclosure (processes for identifying, assessing and managing climate-related risks), and metrics-and-targets disclosure (quantitative indicators, emissions data and forward targets used to assess and manage climate-related risks and opportunities), and separately classified content as addressing physical risk (acute, event-driven hazards and chronic, longer-term shifts in climate patterns) versus transition risk (policy and legal, technology, market and reputational risks arising from decarbonization).

2.3 Synthesizing disclosure-quality measurement approaches

Studies in this literature measure disclosure quality through several largely non-interchangeable approaches: researcher-constructed content-analysis indices applied to annual reports, sustainability reports or regulatory filings; third-party scores such as CDP climate change response scores; automated textual and natural-language-processing analysis of climate-related language in 10-K and equivalent filings; and, more recently, direct audits of TCFD-aligned report content against the eleven TCFD recommended disclosures. We treat these as complementary rather than directly comparable measures, and flag where a synthesized pattern rests on a single measurement approach versus converging evidence across approaches.

2.4 Cross-study comparison of regional and sectoral patterns

Because included studies differ in sample composition, time period and disclosure metric, we synthesize regional and sectoral patterns qualitatively and through directional comparison (which region or sector scores higher, and by roughly how much, within a given study) rather than by pooling disclosure scores across studies into a single meta-analytic estimate, which the heterogeneity of underlying metrics does not support. Table 1 presents this cross-study synthesis for disclosure quality by region and sector, and Table 2 synthesizes reported disclosure levels by TCFD pillar.

2.5 Synthesizing the disclosure-performance evidence

For the disclosure-performance relationship, we distinguish studies examining financial outcomes (cost of equity or debt capital, firm valuation, analyst forecast

accuracy, stock price informativeness) from those examining the relationship between disclosure and underlying environmental or carbon performance, since these represent conceptually distinct tests, respectively of whether markets reward disclosure and of whether disclosure is informationally aligned with the behaviour it purports to describe, and the literature has reached more consistent conclusions on the former than the latter.

2.6 Limitations of the synthesis approach

This review does not conduct a formal systematic review with pre-registered search protocols or a quantitative meta-analysis with pooled effect sizes; the heterogeneity of disclosure metrics across studies, discussed above, makes effect-size pooling of doubtful validity for this literature, and we instead prioritize breadth of coverage across measurement traditions and explicit flagging of where findings converge versus where they remain contested, which we view as more informative for the current state of a rapidly evolving evidence base than a narrower, more precisely pooled but less representative estimate.

3. RESULTS

Across the studies reviewed, TCFD-aligned or TCFD-adjacent disclosure quality is consistently uneven across its four pillars, and this unevenness has proven strikingly stable across measurement approaches and time periods. Governance disclosure, which asks relatively little of firms beyond describing existing board committee structures and naming an executive responsible for climate oversight, is reported as the most mature pillar in essentially every large-sample study we reviewed, with the majority of large multinational firms in most sectors providing at least boilerplate governance disclosure by the early 2020s. Metrics-and-targets disclosure, by contrast, and specifically the forward-looking, scenario-quantified elements of it, is reported as the weakest pillar with similar consistency; Table 2 synthesizes reported pillar-level disclosure levels across several TCFD-status and CDP-based studies and shows this governance-to-metrics gradient holding across the synthesized sources despite differences in scoring methodology [3,13,14].

Table 1. Synthesis of composite climate risk disclosure quality by region and sector across reviewed studies.

Region / sector	Typical relative disclosure quality	Dominant evidence pattern across studies
Europe (multinationals)	Highest	Consistently scores highest on composite indices; attributed to earlier non-financial reporting directives and stronger investor engagement [4,11].
North America	High to moderate	Wide within-region variance; large-cap financial and energy firms score near European levels, mid-cap firms lag [7,17].

East Asia	Moderate	Rising adoption post-2018 but greater qualitative-to-quantitative gap than Europe; strong sectoral concentration in disclosure quality [10].
Emerging markets	Lowest on average	Lower mean scores with notable exceptions among large exporters facing buyer or capital-market pressure [5,9].
Financials (banks, insurers)	Highest sector	Most extensive disclosure, especially risk-management pillar, reflecting direct lending/underwriting exposure [2,16].
Energy and utilities	High sector	Strong transition-risk disclosure; among the few sectors with material asset-level physical-risk reporting [3,18].
Consumer goods and technology	Low sector	Disclosure concentrated on owned operations; limited Scope 3 and supply-chain physical/transition risk reporting despite material indirect exposure [20,22].

Table synthesizes directional findings reported across the studies cited in each row rather than pooling disclosure scores, given heterogeneity in underlying disclosure metrics across studies.

Physical-risk disclosure lags transition-risk disclosure by a wider margin than the pillar-level gradient alone would suggest, a pattern that recurs across both content-analysis and textual-analysis studies. Firms disclose transition-risk exposure, carbon pricing sensitivity, stranded-asset risk, low-carbon technology positioning, considerably more often and in greater quantitative detail than physical-risk exposure, and asset-level physical risk disclosure (naming specific facilities' exposure to flooding, heat stress, water scarcity or storm risk) remains rare outside insurers, utilities, real estate and, to a lesser extent, agribusiness and extractive sectors, where physical exposure is core to the business model and often already tracked for operational or actuarial reasons rather than disclosure compliance per se. Several studies attribute this asymmetry to transition risk being more tractable to quantify with existing financial modelling tools (carbon price sensitivities, capital expenditure reallocation) than physical risk, which requires geospatial hazard data, asset-location transparency that firms may be reluctant to provide for competitive or security reasons, and climate-model-derived probabilistic hazard projections that fall outside the traditional expertise of corporate reporting functions [15,24].

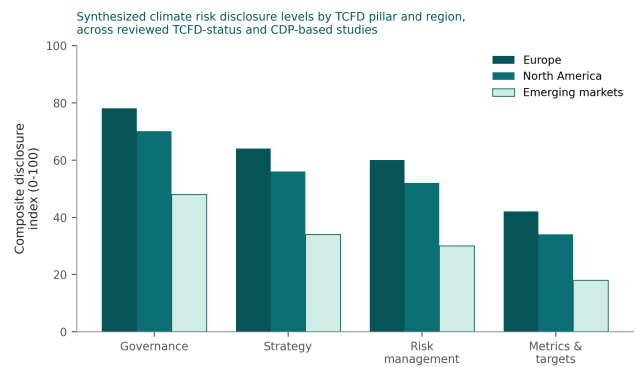


Figure 1. Synthesized disclosure levels by TCFD pillar and world region, based on directional patterns reported across reviewed TCFD-status and CDP-based studies (illustrative composite index, 0-100 scale).

Regional and sectoral heterogeneity in overall disclosure quality is substantial and directionally consistent across studies, as synthesized in Table 1. European multinational firms score highest on composite disclosure indices in the large majority of comparative studies, a pattern generally attributed to earlier and more extensive regulatory pressure (non-financial reporting directives preceding the TCFD itself) combined with stronger stakeholder and institutional-investor engagement on climate issues; North American and East Asian firms follow, typically with wider within-region variance than seen in Europe, and firms headquartered in emerging markets score lowest on average, though with important exceptions among large exporters facing direct pressure from international buyers or capital markets. Sectorally, financial-sector firms, particularly banks and insurers with direct exposure to climate risk through their lending and underwriting books, and energy and utility firms facing direct transition risk, report the most extensive disclosure, while sectors with less visible direct climate exposure, notably many consumer-goods and technology firms whose material climate risk is concentrated in extended supply chains rather than owned operations, report considerably less, despite supply-chain and Scope 3 exposure being, in absolute terms, often larger for these firms than their disclosure volume would suggest [17,19,25].

Table 2. Synthesis of reported disclosure levels by TCFD pillar across TCFD-status and CDP-based studies.

TCFD pillar	Typical reported maturity	Most commonly cited weakness
Governance	Most mature	Often boilerplate; board oversight named but depth of engagement rarely evidenced [1,12].
Strategy	Moderate to mature	Scenario analysis, where present, frequently qualitative rather than quantified against defined warming pathways [3,11].
Risk management	Moderate	Integration with enterprise risk management described narratively; limited disclosure of assessment methodology [2,16].

Metrics and targets	Least mature	Forward-looking, scenario-quantified metrics and asset-level physical-risk metrics remain rare outside a few sectors [10,18,21].
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The relationship between disclosure and firm-level outcomes differs markedly depending on which outcome is examined. Studies linking disclosure, or disclosure quality specifically, to financial-market outcomes find a more consistent pattern: better or more detailed climate risk disclosure is associated with lower cost of equity and debt capital, greater analyst coverage and forecast accuracy, and greater stock price informativeness with respect to climate-related news, results generally interpreted as consistent with disclosure reducing information asymmetry between managers and outside investors regardless of whether it also reflects genuinely superior underlying risk management. The relationship between disclosure and underlying environmental or carbon performance is considerably less consistent: some studies find a positive association, consistent with voluntary disclosure theory's prediction that better performers disclose more to distinguish themselves; others find a weak, null, or even inverse association, more consistent with legitimacy theory's prediction that firms facing greater stakeholder scrutiny over poor performance use disclosure defensively; and a smaller number of studies applying textual analysis to detect discrepancies between disclosed climate commitments and actual emissions trajectories report evidence of selective or overstated disclosure concentrated among firms with weaker underlying performance, a pattern sometimes labelled cherry-picking or greenwashing in this literature [26,27,28,29].

4. DISCUSSION

Read together, this evidence supports a central and, in our view, underappreciated conclusion: the growth in climate risk disclosure volume over the past decade has substantially outpaced growth in disclosure decision-usefulness, where decision-usefulness specifically requires comparable, quantified, forward-looking information that investors and other users can act on rather than qualitative description that firms can supply with comparatively little underlying analytical investment. The persistence of the governance-to-metrics gradient across measurement approaches and time periods, rather than its narrowing as disclosure practice matures, suggests this is not simply a transitional feature of an early-adoption period that mandates and experience will resolve on their own, but a structural feature of how firms respond to disclosure expectations when the easiest-to-satisfy elements of a framework are prioritized over the most informative ones [3,12].

The physical-risk disclosure gap deserves particular emphasis because it is, in several respects, the more consequential of the two risk categories for long-run

financial stability, given that physical climate impacts are, unlike transition risks, substantially locked in by already-emitted greenhouse gases over multi-decade horizons regardless of future policy action, and asset-level physical exposure is in principle more directly observable and quantifiable, given available hazard and geospatial data, than many aspects of transition risk. That physical-risk disclosure nonetheless lags transition-risk disclosure so consistently across the literature suggests the constraint is less a lack of available data than a combination of competitive sensitivity around disclosing precise asset locations and exposures, absence until recently of standardized physical-hazard disclosure metrics comparable to the carbon-accounting standards available for transition risk, and a reporting culture in most non-financial sectors that has not historically treated physical climate hazard as core business risk in the way insurers and utilities have [15,24].

The mixed and theory-dependent evidence on the disclosure-performance relationship is, we think, best read not as an unresolved empirical puzzle awaiting a definitive study, but as evidence that both voluntary disclosure theory and legitimacy theory describe real and coexisting firm behaviours, with the balance between them varying by jurisdiction, sector, stakeholder pressure and firm-specific reputational exposure in ways a single pooled estimate across heterogeneous samples cannot capture, and further attempts to adjudicate definitively between the two frameworks with additional single-country or single-sector studies are, in our assessment, unlikely to be as informative as within-study designs that explicitly test for heterogeneity in the disclosure-performance relationship across firm and institutional characteristics [6,7,8,26].

Several features of the underlying evidence base limit the strength of these conclusions and should temper how they are applied to the current mandatory-disclosure environment. First, the great majority of studies synthesized here were conducted under voluntary or partially voluntary disclosure regimes and on self-selected samples of firms choosing to respond to CDP questionnaires or to disclose beyond minimum requirements, so selection effects may account for part of the disclosure-performance associations reported, a concern that newly mandatory regimes, observing the full population of large firms rather than voluntary respondents, are well positioned to address but for which post-mandate evidence remains limited at the time of this review. Second, disclosure-quality metrics differ substantially across the studies we synthesize, researcher-constructed indices, third-party CDP scores, and automated textual analysis are not measuring identical constructs, and this heterogeneity is a genuine barrier to precise cross-study comparison rather than a limitation we have been able to fully resolve through qualitative synthesis alone. Third, most large-sample studies rely on disclosed content itself as their unit of

analysis and have limited ability to verify disclosed claims against firms' actual internal risk assessments, so findings regarding disclosure quality speak to what firms report rather than directly to the adequacy of their underlying risk management, a distinction the literature is generally careful to maintain but one that is easy to elide when summarizing results at a high level. Finally, evidence on physical-risk disclosure in particular is concentrated in a small number of sectors and jurisdictions with unusually high physical exposure, and the generalizability of findings from these sectors to the much larger population of multinational firms with less direct, but still materially significant, physical climate exposure through supply chains and market demand remains an open empirical question [4,5,30].

5. CONCLUSION

The accumulated evidence on climate risk disclosure among multinational corporations shows a consistent and remarkably stable pattern across the pre-mandate literature: governance and strategy disclosure are relatively mature, metrics-and-targets disclosure, and physical-risk disclosure specifically, remain the weakest elements of reporting practice, and disclosure quality correlates more reliably with favourable financial-market outcomes than with underlying environmental or carbon performance. European and financial-sector firms lead on composite disclosure measures, while firms with climate exposure concentrated in supply chains rather than owned operations disclose comparatively little despite often-substantial indirect exposure. As climate risk disclosure shifts from a largely voluntary practice to a mandatory one across major jurisdictions, the most important open questions this review identifies are whether mandates can close the metrics-and-targets and physical-risk gaps that voluntary practice has persistently left open, and whether the resulting disclosures achieve genuine cross-firm comparability rather than simply extending qualitative, boilerplate reporting across a larger population of firms; both questions require sustained post-mandate empirical attention that the literature synthesized here, drawn overwhelmingly from the voluntary-disclosure era, cannot by itself answer.

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publish, or preparation of the manuscript.

Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Author Contributions

J.S. conceived the review, developed the disclosure-dimension classification scheme, and led the writing of the manuscript. M.C. conducted the literature identification and synthesis of the regional and sectoral evidence and prepared the comparative tables. T.R. synthesized the disclosure-performance literature and contributed to the discussion of theoretical interpretation. All authors contributed to writing and approved the final manuscript.

Ethics Statement

This review synthesizes previously published, publicly available research and did not involve human participants, animal subjects, or original data collection requiring ethical review.

Data Availability

This review is based entirely on previously published studies, full citations for which are provided in the reference list. No new data were generated. A structured summary of the studies synthesized and the classification applied to each is available from the corresponding author on reasonable request.

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