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Harmonising GRI, SASB and TCFD: An Integrated ESG Scoring Framework for Transition Economies[1]

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Abstract. The coexistence of the Global Reporting Initiative (GRI) Standards, Sustainability Accounting Standards Board (SASB) Standards, and recommendations of the Task Force on Climate-related Financial Disclosures (TCFD) has contributed to persistent fragmentation in the measurement of environmental, social, and governance (ESG) performance. This fragmentation limits the comparability of sustainability disclosures required by investors. This study develops a three-layer Integrated ESG Assessment Model (IEAM) that combines the GRI, SASB, and TCFD frameworks into a single composite index and examines its relationship with firm financial performance, the mediating role of corporate governance, and portfolio returns. Layer weights are estimated by combining the Analytic Hierarchy Process (AHP), based on a survey of 42 senior experts, with Shannon entropy adjustment. The model is applied to a hand-coded, balanced eight-year panel covering 2018–2025 and comprising 120 non-financial listed firms from five transition economies (Uzbekistan, Kazakhstan, Azerbaijan, Georgia, and Vietnam), yielding 960 firm-year observations. Data were coded using a structured content-analysis protocol, with strong inter-coder agreement between two independent coders. Higher integrated ESG scores are associated with higher return on assets and higher market valuations, as well as a lower weighted average cost of capital. Each layer of the model is associated with a distinct financial channel: financially material disclosure under SASB is most closely associated with profitability, stakeholder-oriented disclosure under GRI with market valuation, and climate scenario disclosure under TCFD with the cost of capital. Board-level governance quality mediates more than half of the association between environmental disclosure and firm valuation. In addition, portfolios comprising firms with the highest IEAM scores outperform portfolios comprising firms with the lowest scores and experience substantially smaller losses during market downturns. The findings suggest that the three frameworks are complementary rather than substitutive and that their combined use can provide investors with more comprehensive information than any single framework alone. The IEAM offers a transparent and reproducible alternative to commercial ESG ratings, particularly in markets characterized by limited disclosure data. It may also serve as a technical reference for regulators in Central Asia developing national sustainability disclosure requirements, provided that enhanced disclosure requirements are accompanied by measures to strengthen corporate governance.

Keywords: ESG measurement, GRI standards, SASB framework, TCFD disclosure, integrated sustainability model, AHP-entropy weighting, transition economies, corporate governance, IFRS S1 and S2

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ИССЛЕДОВАТЕЛЬСКАЯ СТАТЬЯ

Гармонизация стандартов устойчивого развития: единая система оценки для переходных экономик

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Аннотация. Одновременное применение стандартов Глобальной инициативы по отчётности (GRI), стандартов Совета по стандартам учёта в области устойчивого развития (SASB) и рекомендаций Рабочей группы по раскрытию финансовой информации, связанной с климатом (TCFD), приводит к устойчивой фрагментации оценки экологических, социальных и управленческих факторов (ESG). Это снижает сопоставимость данных нефинансовой отчётности, необходимую инвесторам. Цель исследования — разработка трёхуровневой интегрированной модели ESG-оценки (IEAM), объединяющей GRI, SASB и TCFD в едином композитном индексе, а также оценка связи интегрированного индекса с финансовыми результатами компаний, посреднической роли корпоративного управления и доходности инвестиционных портфелей. Новизна исследования состоит в интеграции указанных стандартов в воспроизводимый композитный индекс и в эмпирической проверке его связи с финансовыми показателями на рынках с ограниченной доступностью данных. Веса уровней модели определены путём сочетания метода анализа иерархий, основанного на опросе 42 экспертов, с энтропийной корректировкой по Шеннону. Модель применена к вручную закодированной сбалансированной панели данных за восемь лет (2018–2025), охватывающей 120 нефинансовых публичных компаний пяти стран с переходной экономикой: Узбекистана, Казахстана, Азербайджана, Грузии и Вьетнама. Совокупность включает в себя 960 наблюдений типа «компания–год», закодированных по структурированному протоколу контент-анализа при высокой степени согласованности оценок двух независимых кодировщиков. Более высокое значение интегрированного индекса связано с более высокой рентабельностью активов и рыночной оценкой компаний, а также с более низкой средневзвешенной стоимостью капитала. Каждый уровень модели влияет на финансовые показатели через собственный канал: раскрытие финансово существенной информации по стандартам SASB в наибольшей степени связано с рентабельностью; раскрытие информации для заинтересованных сторон по стандартам GRI — с рыночной оценкой компании; раскрытие климатических сценариев по рекомендациям TCFD — со стоимостью капитала. Качество корпоративного управления на уровне совета директоров опосредует более половины связи между раскрытием экологической информации и рыночной оценкой компании. Портфели компаний с наиболее высокими значениями индекса превосходят по доходности портфели компаний с наиболее низкими значениями и несут значительно меньшие потери в периоды рыночных спадов. Основные выводы касаются того, что рассмотренные в статье экологические стандарты предприятий дополняют, а не заменяют друг друга, поэтому их совместное использование даёт инвесторам более полезную информацию, чем применение любого из них по отдельности.

Ключевые слова: оценка экологических факторов, стандарты отчётности об устойчивом развитии, интегрированная модель оценки, метод анализа иерархий, энтропийное взвешивание, корпоративное управление, переходные экономики

1. Introduction

Over the past fifteen years, the view that non-financial performance can affect a firm's financial value has gained widespread acceptance. What was once a relatively marginal idea, associated mainly with socially conscious investors, is now recognised by central banks, securities regulators, and the world's largest asset managers. Several forces have driven this shift. Advances in climate science have made it increasingly difficult to treat

physical and transition risks as externalities irrelevant to financial analysis. High-profile governance failures at Enron, Volkswagen, and Wirecard have demonstrated the potentially material financial costs of inadequate oversight. At the same time, a growing empirical literature has examined the relationship between sustainability performance and financial outcomes. For example, Atz et al. (2022) synthesise evidence from more than one thousand primary studies and find a broadly positive association, although the size of the effect varies considerably across studies.

Against this backdrop, three disclosure frameworks have become particularly important. The Global Reporting Initiative (GRI), whose first guidelines were published in 2000 and whose 2021 Universal Standards were used by 73 % of the world's 250 largest corporations by 2022 (KPMG, 2022)[1], provides the broadest scope. It asks companies to report on their material impacts on the environment, employees, communities, and governance systems. The Sustainability Accounting Standards Board (SASB), whose industry-specific standards were consolidated in 2018 and later incorporated into the International Financial Reporting Standards (IFRS) Sustainability Disclosure Standards, takes a narrower approach. It focuses on sustainability issues that are relevant to enterprise value from an investor's perspective. The Task Force on Climate-Related Financial Disclosures (TCFD) adds a stronger forward-looking dimension. By 2023, its recommendations had been endorsed by institutions representing more than 194 trillion US dollars in assets. Unlike GRI and SASB, TCFD places particular emphasis on assessing corporate strategy under different climate scenarios and reporting future risk exposures rather than only past performance.

These three frameworks are often presented as complementary. In practice, however, they have developed largely independently, creating problems for both companies and investors. Companies may need to maintain separate reporting inventories, which increases the risk of duplication or omission and adds to reporting costs. Investors face a related problem when they rely on commercial environmental, social and governance (ESG) ratings that do not follow a single transparent framework. Berg et al. (2022), for example, document substantial disagreement between ESG rating providers. Their average cross-provider correlation of 0.54 suggests that ratings from different providers cannot be treated as fully interchangeable. Standard-setters have begun to address this fragmentation. The publication of IFRS S1 and IFRS S2 by the International Sustainability Standards Board (ISSB) in 2023 represents a major effort to create a more integrated reporting architecture, drawing explicitly on SASB industry metrics and TCFD recommendations. However, GRI's impact-materiality disclosures remain structurally distinct from this system. Full integration of the three frameworks therefore still requires a measurement approach that can connect their different perspectives.

To address this gap, this paper develops an integrated approach to ESG measurement. It introduces the Integrated ESG Assessment Model (IEAM), a three-layer composite scoring system that translates GRI, SASB, and TCFD disclosure requirements into a single theoretically grounded index. The model is designed to preserve the distinct informational contribution of each framework while making their information comparable. The weights are determined by using a two-stage procedure that combines the Analytic Hierarchy Process (AHP) with entropy weighting. This approach combines

[1] KPMG. (2022). *Big shifts, small steps: Survey of sustainability reporting 2022*. KPMG International. https://assets.kpmg.com/content/dam/kpmg/xx/pdf/2022/10/ssr-small-steps-big-shifts.pdf (Date of access: 11.05.2026).

expert judgment about the relative importance of different indicators with empirical evidence about their ability to distinguish between firms. In doing so, it addresses a key methodological concern surrounding commercial ESG ratings: the lack of transparency in how scores are constructed.

The IEAM is validated using a balanced eight-year panel of 120 listed firms, covering the period from 2018 to 2025, from Uzbekistan, Kazakhstan, Azerbaijan, Georgia, and Vietnam. These five transition economies provide a useful setting for examining ESG measurement in markets where data availability and institutional infrastructure remain more limited than in developed economies. The empirical analysis combines panel regression, structural equation modelling, and portfolio back-testing to examine the relationship between IEAM scores and accounting performance, market-based outcomes, and investment performance.

The geographic focus requires some further explanation. Existing ESG research has concentrated heavily on developed-market firms, whose disclosure practices and institutional environments differ from those found in transition economies. The corporate-governance literature shows that firms in transition economies continue to display different forms of state involvement, although these patterns vary substantially across countries and have changed considerably since the 1990s (Grosman et al., 2016). Ownership structures and capital-market infrastructure also differ across our five countries. Kazakhstan's inclusion in the FTSE Russell (Financial Times Stock Exchange) Emerging Markets index and Vietnam's progression from frontier toward emerging-market status indicate more developed market infrastructure than that found in Georgia or Azerbaijan. We therefore do not assume that a common institutional mechanism operates across the sample. Instead, this variation provides an opportunity to examine country-level differences empirically, which we account for through the panel's fixed-effects structure.

Uzbekistan provides a particularly useful institutional setting as its 2017 economic-reform programme marked an important shift in the country's development trajectory. The subsequent integration of the UN Sustainable Development Goals into the national development strategy, Uzbekistan-2030, provides a further institutional reference point. Our panel, which covers the years from 2018 to 2025, therefore captures both the early period in which these reforms began to influence corporate ESG practices and the subsequent years following the adoption of the Uzbekistan-2030 strategy in 2023. Kazakhstan provides a useful point of comparison, given its earlier development of capital-market institutions, inclusion in the FTSE Emerging Markets index, and commitment to achieving net-zero emissions by 2060.

The remainder of the paper is structured as follows. Section 2 reviews the theoretical and empirical literature underpinning the IEAM design, while Section 3 presents its conceptual architecture and weighting methodology. Section 4 describes the sample, data sources, and estimation strategy, and Section 5 reports and interprets the empirical results. Section 6 discusses the implications for theory, practice, and policy, followed by the conclusion in Section 7.

2. Theoretical Background and Literature Review

2.1. The Institutional Genealogy of GRI, SASB, and TCFD

The three frameworks examined in this study were developed in different institutional contexts and in response to different reporting needs. To explain the distinct role

of each framework and the basis for their integration into a single model, we need to look at their origins.

The GRI emerged from the environmental and social accountability movements of the 1990s. Founded in Boston in 1997 by Ceres (Coalition for Environmentally Responsible Economies) and the United Nations Environment Programme, the organisation initially sought to develop sustainability reporting guidelines comparable to the transparency standards established through decades of financial reporting practice and regulation. Brown et al. (2009) show how GRI's multi-stakeholder governance model shaped a framework centred on impact accountability. Under this approach, companies report not only on risks and opportunities that affect the firm but also on the impacts of their activities on workers, communities, and ecosystems. This impact-oriented approach was further developed in the 2021 Universal Standards, which formalised the concept of double materiality by requiring companies to consider both the impacts of their activities and the financial effects of sustainability-related issues. By 2022, GRI content indices were referenced by firms in more than 100 countries, making GRI one of the most widely used frameworks for sustainability reporting worldwide.

SASB followed a different path. Established in San Francisco in 2011, it was explicitly grounded in the U.S. Securities and Exchange Commission's (SEC) long-established concept of materiality. SASB started from the premise that sustainability information would have limited value for investors unless it could demonstrate financial relevance, that is, unless a reasonable investor could consider the information important when making an investment or voting decision. This principle led SASB to develop industry-specific standards, recognising that the sustainability issues most relevant to financial performance vary considerably across industries. The resulting 77 industry standards, completed in 2018 and subsequently incorporated into the IFRS Sustainability Disclosure Standards, provide a detailed framework for identifying financially material sustainability issues at the sector level. The financial-materiality approach underlying SASB received influential empirical support from Khan et al. (2016), who found that firms performing well on SASB-identified material sustainability issues generated statistically and economically significant positive abnormal returns over multi-year periods. By contrast, performance on issues classified as immaterial was not associated with a detectable return benefit.

The TCFD originated not in voluntary corporate accountability movements but in the post-2008 regulatory reckoning with systemic financial risk. Established by the Financial Stability Board in 2015 under the chairmanship of Michael Bloomberg, the Task Force was charged with designing a disclosure architecture that would help financial supervisors and market participants identify climate-related concentrations of risk before they became systemic events. The four-pillar structure published in the 2017 final recommendations, covering Governance, Strategy, Risk Management, and Metrics and Targets, was deliberately designed for integration into mainstream financial reporting rather than as a standalone sustainability appendix. Its emphasis on scenario analysis is particularly important because it introduces a distinctly forward-looking dimension to disclosure. Rather than focusing primarily on past impacts or currently material sustainability issues, TCFD asks companies to assess how climate change could affect their strategies and operations under different future scenarios. In this way, it connects corporate planning and risk management with alternative climate trajectories and the scientific evidence underlying them.

2.2. Comparative Analysis: Materiality, Industry Scope, and Time Horizon

Scholarly comparison of the three frameworks has clarified their complementarity along three structural axes. The materiality axis is perhaps the most contested. GRI's double-materiality standard requires companies to report both on how sustainability issues affect their financial performance and on how their activities affect the broader world, including impacts that may never be reflected in financial statements. SASB, by contrast, applies a strictly investor-centric single-materiality filter, discarding topics that cannot plausibly affect enterprise value regardless of their broader social significance. TCFD occupies an intermediate position: its primary audience is financial supervisors and investors, but climate-related physical risks can generate losses at the ecosystem level before they manifest in corporate balance sheets, giving the framework an indirect double-materiality character. The European Sustainability Reporting Standards (ESRS), mandatory across the European Union under the Corporate Sustainability Reporting Directive (CSRD) from 2024, have adopted GRI's double-materiality logic, creating a significant divergence from the ISSB's single-materiality architecture that the international standard-setting community has not yet resolved.

The industry-scope axis reflects the tension between universality and precision. GRI's universal approach ensures broad cross-country and cross-sector applicability but sacrifices granularity within sectors. Grewal et al. (2021) show that SASB-identified material disclosures are significantly associated with analyst forecast accuracy and the magnitude of earnings surprises, whereas undifferentiated GRI disclosures are not. This finding supports the importance of industry-specificity in sustainability reporting. At the same time, broad coverage remains important when comparing firms across transition economies, where some ESG issues are not confined to a single industry. For example, informal labour and biodiversity loss can affect firms across different sectors and may therefore be missed by standards focused primarily on industry-specific risks.

A key distinction between TCFD and the other frameworks lies in its temporal dimension: TCFD places greater emphasis on how climate-related risks may affect firms in the future. Christensen et al. (2021) find that firms adopting TCFD-aligned governance and strategy disclosures experience reductions in their cost of equity and debt of around 10 to 15 basis points. Their evidence suggests that the value of TCFD disclosure lies not in its description of past carbon emissions but in its credible communication of a board's understanding of future risk, a temporal premium that prospective investors are willing to pay for.

The literature reviewed above is drawn primarily from Anglo-American accounting and finance journals. However, a substantial body of Russian-language research examines the same question of framework harmonisation from a perspective closer to the transition-economy context of this study. Abdalova and Karelskaia (2022), for example, trace the gradual reduction in institutional fragmentation following the 2015 joint statement by CDP (formerly the Carbon Disclosure Project), the Climate Disclosure Standards Board (CDSB), GRI, the International Integrated Reporting Council (IIRC), and SASB and the IFRS Foundation's establishment of the International Sustainability Standards Board (ISSB) in 2021. They argue, however, that important institutional differences remain. In particular, TCFD originated as a voluntary initiative of the Financial Stability Board and does not have the same independent standard-setting role as GRI and SASB.

Malinovskaya (2022) provides a systematic comparison of GRI, SASB, and the emerging IFRS Sustainability Disclosure Standards across scope, materiality, and assurance requirements. The study finds that convergence under the ISSB has not

eliminated the underlying difference between GRI's double-materiality approach and SASB's investor-focused materiality framework. This distinction is central to the comparison developed in this paper because the two frameworks capture different types of sustainability information.

Safonova (2023) further shows that companies reporting against multiple frameworks often maintain separate and parallel disclosure processes rather than a genuinely integrated system. This finding reinforces the need for a measurement approach that combines the information provided by different frameworks rather than simply placing their indicator sets side by side. The IEAM is designed to address this integration problem.

2.3. ESG Ratings: Methodological Critiques and the Case for Transparency

The rapid growth of ESG measurement has created a fragmented rating industry that has attracted increasing scrutiny from academic researchers and financial regulators. One of the most influential studies of rating disagreement is Berg et al. (2022), who identify three main sources of differences between ESG ratings. Scope divergence occurs when providers differ in which activities or issues they include in their assessments. For example, providers may differ in whether a company's supply-chain emissions are included in its environmental score. Measurement divergence occurs when providers consider the same issue but use different methods to measure or code it, such as reported emissions data versus estimated values. Weight divergence arises when providers assign different levels of importance to environmental, social, and governance indicators. Berg et al. find that measurement divergence is the largest source of disagreement, accounting for more of the variation between providers than scope and weight divergence combined.

This finding has an important implication for the design of ESG measurement models. Making measurement rules explicit and reproducible, as the IEAM does, can reduce ambiguity in how firms are assessed and make the resulting scores easier to compare and replicate than ratings based on opaque methodologies.

Concerns also extend to the stability of commercial ESG scores over time. Kotsantonis and Serafeim (2019) document that rating providers may revise historical scores without explaining the reasons for those revisions. Using the latest available score for earlier periods can therefore introduce look-ahead bias into empirical research. Drempetic et al. (2020) further show that firm size is associated with ESG score levels even after accounting for sustainability performance. One possible explanation is that larger firms have greater resources to invest in sustainability reporting and disclosure. These concerns are particularly relevant when studying emerging and transition economies, where firms tend to have more limited reporting resources and commercial ESG databases often provide less extensive coverage. This provides further motivation for an assessment model based on publicly available disclosure documents rather than proprietary ESG ratings.

2.4. ESG in Transition Economies: Evidence and Gaps

The empirical literature on ESG in transition and post-Soviet economies remains limited relative to the importance of these markets. Nevertheless, several findings are well established. Governance quality, measured through indicators such as board independence, ownership concentration, and national governance indices, appears to have a stronger association with financial performance in transition economies than in developed markets. Miralles-Quiros et al. (2017) attribute this pattern to higher agency costs and weaker rule-of-law protections in these settings. This literature provides a basis

for examining the role of governance in the relationship between ESG disclosure and firm value. The structural equation modelling analysis therefore tests whether board-level governance quality mediates the relationship between environmental disclosure and firm valuation, and whether this relationship is stronger when financial-materiality information aligned with SASB is also disclosed.

The Central Asian context presents additional features that are relevant to ESG measurement. State ownership remains significant among major enterprises in Uzbekistan and Kazakhstan, creating principal-principal conflicts between controlling state shareholders and minority investors. This differs from the principal-agent conflicts that have traditionally received greater attention in Western corporate governance research. Both economies are also relatively energy-intensive, reflecting their Soviet-era industrial legacies. As a result, exposure to climate transition risks varies substantially across sectors, making the TCFD dimension of the IEAM particularly relevant.

Uzbekistan also provides an important institutional context for the analysis. Since 2017, the country has moved from a relatively closed, state-led economic system towards greater market orientation and has attracted increasing foreign investment. The institutional environment in which ESG reporting developed therefore changed over the period covered by the panel. This within-country variation provides additional context for the panel analysis and can be accounted for through the country fixed-effects specification.

3. Theoretical Framework and Model Design

3.1. Multi-Theoretical Foundations

No single theory of the firm fully explains why ESG disclosure might affect financial performance across all three dimensions covered by the IEAM. The model therefore draws on three complementary theoretical perspectives, with each layer linked to the theory that best explains its underlying informational mechanism.

Stakeholder theory, developed by Freeman (1984) and further elaborated in the corporate governance literature by Donaldson and Preston (1995), provides the theoretical foundation for the GRI-based Stakeholder Materiality (SM) layer. The theory holds that firms depend on relationships with a broad range of stakeholders, including employees, local communities, regulators, and other groups affected by their activities. Effective management of these relationships can generate relational and reputational benefits and reduce risks associated with operational disruption, regulatory intervention, and stakeholder conflict. GRI's materiality process is consistent with this perspective because it places stakeholder engagement at the centre of determining which sustainability topics should be reported. The resulting disclosures therefore capture information about the relationships and impacts that may influence a firm's ability to create value over the long term.

Agency theory and the economics of information asymmetry, associated with Jensen and Meckling (1976) and Akerlof (1970), provide the foundation for the SASB-based Financial Materiality (FM) layer. From this perspective, ESG disclosure can reduce information asymmetry between managers and investors by providing more credible information about sustainability-related factors that may affect future financial performance. Better information can, in turn, reduce uncertainty in capital markets and improve investors' assessment of firm value. SASB standards operationalise this approach through industry-specific disclosure requirements. Across its 77 industries,

the standards identify sustainability-related metrics that are considered financially material to investors, thereby distinguishing information relevant to enterprise value from information that may be more relevant to other stakeholder groups.

The TCFD-based Climate Scenario (CS) module is informed by systemic risk theory and by the climate-risk literature underpinning integrated assessment models and macroprudential regulation. Climate-related risk differs from conventional firm-specific risks in two respects that are particularly relevant to this layer. First, climate risks can extend beyond individual firms and accumulate across portfolios and financial systems, creating a systemic dimension that may not be fully captured by firm-level risk assessments. Second, many of their financial consequences may materialise over time horizons extending to the period between 2030 and 2050, well beyond the typical planning horizons used in corporate and financial decision-making. This long-term and uncertain nature makes scenario analysis particularly relevant. TCFD's emphasis on forward-looking, scenario-based disclosure addresses these challenges by encouraging firms to assess how different climate trajectories could affect their strategies, operations, and risk exposures.

These three theoretical perspectives are not independent. They overlap in important ways, and the IEAM's layered architecture is designed to reflect these connections while preserving the distinct role of each framework. Stakeholder theory and agency theory, for example, both emphasise the importance of information in managing relationships and reducing uncertainty. Stakeholder theory views disclosure primarily as a means of building trust and reducing the risk of stakeholder conflict, whereas agency theory focuses on how disclosure reduces information asymmetry between managers and investors. The two perspectives therefore point to different consequences of the same underlying function of disclosure: making information about the firm more accessible and credible to external parties.

Legitimacy theory (Suchman, 1995), discussed further in Section 6.2 in relation to the governance-mediation results, provides a useful link between these perspectives. Firms may strengthen their legitimacy among stakeholders by demonstrating that their commitments are credible and supported by verifiable information. Such disclosure can also strengthen investor confidence when it provides evidence about how the firm manages sustainability-related risks. From this perspective, stakeholder legitimacy and investor confidence can reinforce one another rather than represent competing objectives.

Systemic risk theory connects to these perspectives differently. Stakeholder and agency theory focus primarily on relationships between the firm and its immediate stakeholders or investors, whereas systemic risk theory considers risks that extend beyond individual firms and accumulate across the wider economy and financial system. This distinction is particularly relevant to climate risk, whose effects can unfold over much longer time horizons. The CS module therefore incorporates scenario horizons such as 2030 and 2050, extending beyond the shorter horizons typically associated with stakeholder relationships and conventional investor monitoring.

The layered architecture described in Section 3.2 reflects these theoretical differences. The SM and FM layers capture related information and value-creation mechanisms associated with stakeholder relationships and investor information, while the CS module addresses the distinct collective and long-term dimensions of climate risk. The IEAM therefore does not simply add three separate measures together; it combines complementary dimensions of ESG information while preserving the different mechanisms through which each may affect firm value.

3.2. IEAM Architecture: Three Layers

The IEAM organises its composite score across three layers that are hierarchically nested rather than simply additive. The SM layer defines the broadest universe of potentially relevant sustainability topics, encompassing every material issue identified through GRI stakeholder engagement. The FM layer then filters that universe to the subset deemed financially material by SASB for the firm's industry, adding sector-specific precision. The CS module finally introduces a dynamic, scenario-contingent dimension by evaluating the quality and depth of the firm's engagement with forward-looking climate risk, a dimension entirely absent from any static, retrospective measurement of disclosed performance. Table 1 presents the full three-layer architecture alongside its theoretical and framework correspondences.

3.2.1. Layer 1: GRI Stakeholder Materiality (SM)

The SM layer draws on thirty-eight disclosure indicators extracted from GRI 2 (General Disclosures), GRI 3 (Material Topics), and twelve applicable GRI Topic Standards, covering energy, water and effluents, biodiversity, atmospheric emissions, employment practices, occupational health and safety, diversity and inclusion, anti-corruption, and tax transparency. Indicators are grouped into three sub-pillars, Environmental Stewardship (fourteen items), Social Accountability (sixteen items), and Governance Integrity (eight items), scored on a five-point scale that distinguishes absence (0) from partial qualitative (1), full qualitative (2), quantitative (3), and independently assured quantitative (4) disclosure. The inclusion of an assurance level within the scoring scale reflects accumulated evidence that third-party verification significantly increases the decision-usefulness of sustainability disclosures to investors, particularly in markets where accounting enforcement is weak or inconsistent (Christensen et al., 2021). Firms publishing a GRI-referenced content index receive a five-percentage-point process-quality increment on their SM sub-total, rewarding the navigability and completeness signal that formal index publication provides.

3.2.2. Layer 2: SASB Financial Materiality (FM)

Constructing a cross-industry FM layer from seventy-seven sector-specific standards requires a method that preserves industry specificity while allowing firms from different sectors to be compared on a common scale. The study addresses this challenge through a two-step protocol. First, each sample firm is mapped to its primary industry in the

Table 1

IEAM Architecture: Layer Correspondences

Layer	Framework	Materiality Type	Theoretical Anchor
L1: SM	GRI Universal Standards (2021)	Double materiality (impact + financial)	Stakeholder Theory (Freeman, 1984; Donaldson & Preston, 1995)
L2: FM	SASB Industry Standards (77 sectors)	Financial materiality (investor-centric)	Agency Theory (Jensen & Meckling, 1976; Akerlof, 1970)
L3: CS	TCFD Recommendations (2017/2021)	Climate financial risk (transition + physical)	Systemic Risk Theory; Integrated Assessment Modelling
IEAM	**GRI + SASB + TCFD (harmonised)**	**Integrated: double + financial + climate**	**Multi-theoretical synthesis; IFRS S1/S2 convergence logic**

Source: Author's elaboration.

SASB Sustainable Industry Classification System (SICS) using crosswalk tables between the Bloomberg Industry Classification System (BICS) and SICS. The corresponding SASB standard then determines the firm-specific set of relevant metrics. Second, the full SASB library is examined to identify the twenty-two metrics that appear as disclosure topics in at least forty of the seventy-seven sector standards. These metrics form a universal core applicable to all firms, regardless of industry. The five most heavily weighted metrics in each firm's sector-specific standard are then added to this core, producing a firm-level FM indicator set of between twenty-two and twenty-seven items. This approach combines cross-industry comparability with sector-specific precision. Scores are assigned using the same five-point scale as in the SM layer, thereby maintaining ordinal comparability across the two quantitative layers.

3.2.3. Layer 3: TCFD Climate Scenario Module (CS)

The CS module translates TCFD's four-pillar disclosure architecture into eighteen indicators assessed using three measurement approaches. Governance and Risk Management indicators are scored on a three-point scale that distinguishes between absence of disclosure, descriptive disclosure, and evidence supported by concrete process documentation. Strategy indicators are assessed on a four-point scenario-quality scale, ranging from no scenario analysis to narrative discussion, qualitative scenario analysis, and full quantitative modelling based on a recognised warming pathway, such as the Net Zero Emissions scenario of the International Energy Agency (IEA NZE), the scenarios of the Network for Greening the Financial System (NGFS), or a Representative Concentration Pathway (RCP) scenario of the Intergovernmental Panel on Climate Change (IPCC). Metrics and Targets indicators include two continuous measures. The first is a carbon-intensity ratio, calculated as Scope 1 plus Scope 2 emissions divided by USD revenue, using emissions data from company disclosures and national greenhouse gas (GHG) registries. The second is a physical-risk exposure index, constructed by overlaying IPCC Sixth Assessment Report hazard projections for the relevant grid cells with the geographic coordinates of the firm's operating assets, as identified from annual-report property disclosures. All CS indicators are assessed against two reference horizons: 2030 as the near-term horizon and 2050 as the long-term horizon. These horizons are consistent with the time frames used in climate-risk assessment and with the net-zero commitments adopted by the jurisdictions in the sample.

3.3. Composite Scoring: AHP-Entropy Weighting

The composite IEAM score for firm i in year t takes the form:

$$IEAM_{it} = w_1 \cdot SM_{it} + w_2 \cdot FM_{it} + w_3 \cdot CS_{it},$$

where *SM*, *FM*, and *CS* are min-max normalised to the unit interval and $w_1 + w_2 + w_3 = 1$. Sub-pillar scores within each layer are aggregated to layer totals using the same weighting procedure applied at the top level, ensuring methodological consistency across the hierarchy.

The primary weights come from AHP expert elicitation conducted with forty-two senior practitioners, comprising ESG portfolio managers, chief sustainability officers, and regulatory officials, recruited through the United Nations Principles for Responsible Investment (UN PRI) signatory network and the GRI Certified Training Partner register. Each respondent completed a structured pairwise-comparison instrument presenting

all twelve binary comparisons across the three layers and their component sub-pillars, using Saaty's one-to-nine intensity scale. Geometric means were computed across respondents to aggregate individual judgement matrices; all resulting matrices satisfied Saaty's (2022) consistency ratio (CR) threshold of CR < 0.10, with the highest observed consistency ratio equal to 0.079.

The entropy correction follows Wang and Lee (2007). For each layer k, the information entropy H_k is computed as $-\Sigma_i\ p_{ik}\ ln(p_{ik})\ /\ ln(n)$, where p_{ik} is firm *i's* normalised score on layer k and n is the number of firms. The entropy-adjusted weight for layer k is then proportional to $(1 - H_k)$, capturing the idea that a layer exhibiting low entropy, meaning all firms score similarly, carries less discriminatory information and should receive proportionally less weight in the composite. Final composite weights are blended as $W_k = 0.60 \cdot w_k(\text{AHP}) + 0.40 \cdot w_k(\text{entropy})$. The 0.60/0.40 split was chosen following a sensitivity analysis confirming that the ranking of firms and the sign and significance of regression coefficients remain stable across blending parameters α ranging from 0.40 to 0.80. This range accommodates different preferences in weighting, from greater reliance on expert judgment to greater reliance on data-driven approaches.

4. Data and Methodology

4.1. Sample Construction

The primary sample consists of 120 non-financial firms that maintained a primary listing on a national stock exchange in one of five countries throughout the full observation period from 2018 to 2025: Uzbekistan (n = 28), Kazakhstan (n = 32), Azerbaijan (n = 18), Georgia (n = 14), and Vietnam (n = 28). The country selection reflects different stages of transition and capital-market development. Kazakhstan and Vietnam have relatively more developed capital-market and sustainability-reporting infrastructure, while Azerbaijan and Georgia represent intermediate cases. Uzbekistan provides an early-stage reform environment.

Vietnam's inclusion alongside the four post-Soviet economies requires explicit justification because it is not a post-Soviet state and its inclusion does not imply institutional equivalence with Uzbekistan, Kazakhstan, Azerbaijan, or Georgia. The selection instead rests on three measurement-relevant structural characteristics shared across the five countries: (i) a legacy of centrally planned economic administration followed by market-oriented reforms; (ii) continuing state ownership in strategic sectors; and (iii) relatively thin capital markets and limited coverage by commercial ESG rating providers. These characteristics correspond to the data-sparse environment that motivates the study and is discussed in Section 1.

The historical trajectories of the five countries are nevertheless substantially different. Vietnam's Doi Moi (renovation) reforms, initiated in 1986, differ in political and historical origin from the post-Soviet transitions that began from 1991 onward. The purpose of including both settings is therefore not to treat them as institutionally equivalent, but to examine whether the IEAM can be applied across different transition pathways that share relevant structural characteristics. In this sense, the term "cross-civilisational institutional variation" refers to variation in the political and historical origins of the sampled economies rather than to institutional similarity across countries. The empirical models account for time-invariant firm characteristics and common year effects

through firm and year fixed effects, allowing the analysis to examine whether the estimated relationships remain consistent across this heterogeneous set of transition economies.

Three eligibility conditions were applied during sample construction. First, firms were required to have reported annual financial results throughout the entire eight-year panel without gaps, ensuring a fully balanced dataset. Second, sufficient publicly available text, including annual reports, standalone sustainability reports, GRI content indices, and CDP climate questionnaire responses, had to exist to permit coding of at least seventy percent of the indicators in each IEAM layer; firms below this threshold were excluded to prevent excessive imputation. Third, firms classified in SASB's Financial sector were excluded on grounds of structural incomparability with the non-financial majority of the sample. The resulting 960 firm-year observations span 23 SASB industry classifications and twelve primary GRI sector programmes, providing reasonable industry diversification within the size constraints of a hand-coded dataset.

4.2. IEAM Coding Procedure

Scoring of the thirty-eight SM indicators, the twenty-two to twenty-seven FM indicators, and the eighteen CS indicators was conducted through a structured content-analysis protocol developed specifically for this study. The protocol assigns each of the eighty to eighty-three possible indicators a decision tree with explicit coding rules distinguishing each point on the five-point or four-point scale, minimising the role of coder judgment in ambiguous cases. Two research assistants with postgraduate training in accounting and sustainability reporting independently coded every firm-year observation. Inter-coder agreement was assessed using Cohen's kappa; the mean statistic across all indicators was 0.84 (range 0.77 to 0.91), a level conventionally classified as strong agreement. Discrepancies were resolved in adjudication sessions with a senior researcher. Approximately eight percent of indicator values across the full dataset required imputation, using industry-year median scores conditional on SASB sector, to address residual data gaps.

4.3. Financial Variables and Controls

Three financial outcomes form the dependent variables in the main regression analysis. Return on assets (ROA), calculated as net income divided by the average of beginning- and end-of-year total assets, captures current-period operating efficiency. Tobin's Q, measured as the market value of equity plus book value of total debt divided by total assets, captures long-run market valuation incorporating intangible capital. The weighted-average cost of capital (WACC) captures the risk discount applied by providers of both debt and equity: the equity component is estimated using the Capital Asset Pricing Model (CAPM) with a trailing sixty-month beta, and the debt component uses the yield on the firm's most recently issued bond or bank debt where available, with a synthetic spread assigned otherwise. All financial data are drawn from Refinitiv Eikon, supplemented by national stock exchange filings for firms with incomplete international database coverage. Control variables include the natural logarithm of total assets (firm size), total debt to total assets (leverage), net property, plant and equipment to total assets (asset tangibility), the natural logarithm of years since incorporation (firm age), and a count of the years since the firm first published any form of ESG disclosure (reporting experience). All continuous variables are winsorised at the first and ninety-

ninth percentiles within each country-year cell to limit the influence of extreme observations attributable to thin trading or accounting restatements.

4.4. Estimation Strategy

The principal regression specification is a two-way fixed-effects panel model of the form: $Y_{it} = \alpha_i + \delta_t + \beta \cdot IEAM_{it} + \gamma \cdot X_{it} + \varepsilon_{it}$, where α_i and δ_t denote firm and year fixed effects respectively, X_{it} is the vector of time-varying controls, and ε_{it} is an idiosyncratic error term. Standard errors are clustered at the firm level throughout. The Hausman test rejects the random-effects specification for all three outcome variables, validating the fixed-effects choice. Because fixed effects absorb all time-invariant unobserved heterogeneity, the identifying variation comes entirely from within-firm changes in IEAM scores over time, a clean source of variation that guards against simple omitted-variable explanations rooted in stable firm characteristics.

The structural equation model (SEM) tests a mediation-moderation structure in which board-level governance quality (the Governance Integrity sub-pillar of the SM layer, G-SM) mediates the path from environmental disclosure quality (the Environmental Stewardship sub-pillar, E-SM) to Tobin's Q, with the FM score as a moderator of both the direct and indirect paths. Estimation uses maximum likelihood with bootstrapped standard errors (5,000 draws), and the moderated-mediation index of Hayes (2018) is used to test the statistical significance of the conditional indirect effect. Portfolio back-testing constructs annually rebalanced quintile portfolios ranked on the end-of-prior-year IEAM score, computing compound annual returns, Sharpe ratios, maximum drawdown, and the long-short spread between the highest (Q5) and the lowest (Q1) quintiles over the period from 2019 to 2025. All estimation is carried out in R version 4.3.2 using the plm, lavaan, PerformanceAnalytics, and sandwich packages.

5. Empirical Results

5.1. Sample Characteristics and IEAM Score Distribution

Table 2 reports summary statistics for the full 960-observation panel. The mean composite IEAM score of 0.487 (standard deviation 0.163) indicates that the average firm in the sample discloses at roughly the midpoint of the maximum achievable quality standard, with scores spanning nearly the full unit interval from a minimum of 0.112 to a maximum of 0.881. The Financial Materiality layer has the highest mean score of the three layers (0.531), reflecting the relatively structured nature of SASB's quantitative disclosure metrics. These metrics are generally easier to extract from financial statements and management commentary than the broader impact-oriented disclosures required by GRI. The Climate Scenario module has the lowest mean score (0.318) and the highest dispersion (standard deviation = 0.198), consistent with the relatively limited development of scenario-analysis practices across the five countries, particularly in the earlier years of the panel. Uzbekistani firms have a mean CS score of 0.241, compared with 0.389 for Vietnamese firms and 0.376 for Kazakhstani firms. These differences may partly reflect differences in the regulatory and reporting environments across the three countries, including the more recent introduction of mandatory climate-disclosure requirements in Kazakhstan and the reporting incentives faced by Vietnamese firms with greater exposure to European markets.

Table 2

Descriptive Statistics: IEAM Scores and Financial Outcome Variables (n = 960)

Variable	Mean	SD	Min	P25	P75	Max
IEAM Composite Score	0.487	0.163	0.112	0.372	0.614	0.881
SM Layer Score (GRI)	0.512	0.158	0.125	0.401	0.634	0.902
FM Layer Score (SASB)	0.531	0.142	0.148	0.430	0.640	0.896
CS Module Score (TCFD)	0.318	0.198	0.000	0.148	0.482	0.854
Return on Assets (%)	6.810	4.290	−8.470	4.120	9.680	22.310
Tobin's Q	1.430	0.680	0.510	0.960	1.820	4.210
WACC (%)	9.720	2.840	4.180	7.680	11.420	18.930
Firm Size (ln assets)	19.840	1.620	16.210	18.720	21.040	24.180
Leverage	0.380	0.190	0.010	0.220	0.520	0.840

Note: IEAM and sub-layer scores normalised to [0, 1] via min-max scaling. Financial variables from Refinitiv Eikon and national exchange filings. Source: Author's computations.

5.2. AHP-Entropy Weight Estimates

Expert elicitation produced AHP primary weights of $w_1 = 0.380$ for the SM layer, $w_2 = 0.350$ for the FM layer, and $w_3 = 0.270$ for the CS module. The weights place slightly greater emphasis on stakeholder and financial materiality than on the climate scenario dimension, while still assigning substantial weight to TCFD-related climate considerations. The entropy correction raises the CS weight by approximately 1.4 percentage points, as its higher cross-firm variance makes it more discriminatory than the AHP scores alone would imply, yielding final composite weights of $W_1 = 0.372$, $W_2 = 0.344$, and $W_3 = 0.284$. Table 3 presents the full weight breakdown alongside consistency ratios.

5.3. Panel Regression Results

Table 4 presents the main regression results. Columns (1) through (3) use the composite IEAM score as the explanatory variable; Columns (4) through (6) disaggregate by layer. The composite score is positively and significantly associated with ROA ($\beta = 3.47$, $p < 0.001$) and Tobin's Q ($\beta = 0.68$, $p < 0.001$), and negatively associated with WACC ($\beta = -1.24$, $p < 0.01$). In economic terms, a one-standard-deviation improvement in the IEAM score is associated with a 0.57 percentage-point increase in ROA, a 0.11 unit increase in Tobin's Q, and a 20-basis-point decrease in WACC, each of which represents a meaningful magnitude within the range of observed outcomes in our panel.

The disaggregated specifications in Columns (4) to (6) reveal that the three layers exert their primary influence through different financial channels. The FM layer drives

Table 3

AHP-Entropy Layer Weight Estimates

Layer	AHP Weight	Entropy Weight	Composite Weight	CR (AHP)
Layer 1: SM (GRI)	0.380	0.360	0.372	0.063
Layer 2: FM (SASB)	0.350	0.330	0.344	0.071
Layer 3: CS (TCFD)	0.270	0.310	0.284	0.058
Sum	**1.000**	**1.000**	**1.000**	—

Note: Composite weight = 0.60 × AHP + 0.40 × Entropy. CR = Saaty Consistency Ratio; acceptable threshold < 0.10. Source: Author's computations.

Table 4

Two-Way Fixed-Effects Panel Regressions: IEAM Scores and Financial Performance

	(1) ROA	(2) Tobin's Q	(3) WACC	(4) ROA	(5) Tobin's Q	(6) WACC
IEAM composite	3.47***	0.68***	−1.24**	—	—	—
SM Layer (GRI)	—	—	—	2.94***	0.82***	−0.98*
FM Layer (SASB)	—	—	—	4.12***	0.71***	−1.12**
CS Module (TCFD)	—	—	—	1.89*	0.54**	−1.68***
Firm Size	0.84**	0.12*	−0.43**	0.81**	0.11*	−0.41**
Leverage	−2.18***	−0.31***	1.62***	−2.14***	−0.29***	1.59***
Observations	960.00	960.00	960.00	960.00	960.00	960.00
Adj. R^2	0.74	0.68	0.61	0.77	0.71	0.65

Note: ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$. Firm and year fixed effects included. Standard errors clustered at firm level. Country and industry fixed effects omitted from display. Source: Author's computations.

the strongest ROA effect ($\beta = 4.12$, $p < 0.001$), consistent with agency theory's prediction that investor-relevant financial-materiality disclosure improves the efficiency of resource allocation at the firm level. The SM layer is the most powerful predictor of Tobin's Q ($\beta = 0.82$, $p < 0.001$), consistent with stakeholder theory's account of how relational capital with broad constituencies accumulates into intangible firm value visible to equity markets over multi-year horizons. The CS module produces the largest WACC reduction ($\beta = -1.68$, $p < 0.001$), consistent with systemic-risk theory's prediction that credible climate-risk disclosure reduces the uncertainty premium demanded by both equity and debt investors.

5.4. Structural Equation Modelling: Mediation and Moderation

The mediation analysis confirms that board-level governance quality (G-SM sub-pillar score) carries a significant fraction of the total effect of environmental disclosure quality (E-SM sub-pillar) on Tobin's Q. The estimated indirect effect via governance is $\beta = 0.41$ (95 % bootstrapped confidence interval [0.28, 0.54], $p < 0.001$), while the residual direct effect remains significant at $\beta = 0.29$ ($p < 0.01$), indicating partial rather than complete mediation. The partial mediation finding is substantively important: it implies that environmental disclosure has independent informational value to equity investors beyond its role as a signal of governance quality, though the governance channel accounts for approximately 59 % of the total effect. This proportion follows the standard mediation-analysis convention of dividing the indirect effect by the total effect (Hayes, 2018): with an indirect, governance-mediated effect of $\beta = 0.41$ and a residual direct effect of $\beta = 0.29$, the total effect on Tobin's Q is 0.70, of which the indirect path accounts for $0.41/0.70 \approx 58.6$ %, rounded here to 59 %.

The moderated mediation test reveals that the indirect effect via governance strengthens significantly as the FM score increases. The index of moderated mediation is 0.18 (95 % CI [0.07, 0.31]), statistically significant under both frequentist and Bayesian assessment. Interpreted substantively, the results indicate that the governance-mediated association between environmental disclosure and firm valuation is stronger among firms that also provide higher-quality disclosure on SASB-identified financially material issues. This finding provides empirical support for the multi-framework integration underlying the IEAM: environmental disclosure appears to be more strongly associated with firm valuation when accompanied by information that addresses investor-relevant

financial materiality. The result therefore suggests that the GRI and SASB dimensions capture complementary aspects of ESG information rather than fully substitutable ones.

5.5. Portfolio Back-Testing

Quintile portfolios constructed on lagged IEAM scores exhibit a monotone performance gradient from Q1 (lowest) to Q5 (highest) in terms of both return and risk-adjusted return over the back-test window from 2019 to 2025. The Q5 portfolio generates an annualised compound return of 4.82 percentage points above Q1, with a Sharpe ratio of 0.74 for Q5 versus 0.31 for Q1. The Q5 maximum drawdown of 12.4 % compares favourably with the Q1 drawdown of 31.8 %, suggesting that high IEAM scores are associated not merely with elevated average returns but with meaningfully lower loss concentration during adverse market conditions. This asymmetric drawdown result is consistent with the crisis-resilience hypothesis advanced by Broadstock et al. (2021), under which stronger governance and environmental performance are associated with lower sensitivity of firm value to systemic shocks. This property is particularly valuable in periods of market stress, when diversification benefits across conventional risk factors may weaken or disappear.

6. Discussion

6.1. Interpreting the Layer-Differentiated Effects

The finding that each IEAM layer exerts its strongest effect on a different financial outcome variable is not merely a statistical curiosity; it provides direct empirical content to the multi-theoretical architecture on which the model is built. Agency theory predicts that reducing investor information asymmetry about financially material, operationally relevant factors should be reflected most quickly in current-period accounting performance, as better-informed capital allocation improves the marginal efficiency of investment. The fact that the FM layer is the dominant driver of ROA, which captures exactly this dimension of short-run value creation, constitutes a specific and falsifiable validation of that prediction rather than a generic ESG-performance association.

The SM layer's dominant role in predicting Tobin's Q, a forward-looking measure that capitalises the present value of expected future cash flows including intangible assets, aligns with stakeholder theory's emphasis on relational capital as a driver of long-run competitive advantage. Firms that engage more deeply with employees, communities, and regulators, as GRI's broad stakeholder-materiality lens requires, accumulate trust-based assets that reduce the probability of costly disruptions, whether regulatory sanctions, labour disputes, or community opposition, over multi-year horizons. Those assets do not appear in financial statements prepared under generally accepted accounting principles (GAAP) but are priced by equity markets, explaining why the SM layer's valuation effect operates through Q rather than ROA.

The CS module's dominance in explaining WACC variation directly corroborates the risk-theoretic account of TCFD's value. Debt and equity investors in transition economies face uncertainty about how physical climate risks may affect corporate cash flows over relevant investment horizons. This concern is particularly relevant in Central Asia, where drought, extreme heat, and glacial melt pose documented risks to water availability and irrigation-dependent agriculture. Firms that disclose credible, scenario-tested assessments of those risks communicate not only risk awareness but risk preparedness, reducing the information-asymmetry component of the required risk premium. The

stronger effect observed in the five-country sample provides additional context to the finding reported by Christensen et al. (2021) for developed markets. In these transition economies, where firms may face significant physical climate risks and environmental regulatory frameworks remain at different stages of development, the results suggest that the value associated with forward-looking climate disclosure may also be relevant beyond developed-market settings.

6.2. The Governance Mediation Result and Its Implications

The structural equation modelling results indicate that governance quality mediates approximately 59 % of the association between environmental disclosure and firm valuation. This finding provides evidence on the mechanism through which environmental disclosure may be linked to valuation, going beyond the direct associations typically estimated in conventional regression models. Legitimacy theory, as developed by Suchman (1995), would predict exactly this mechanism: firms that make credible environmental commitments do so most convincingly when they are embedded in governance structures capable of monitoring, reporting, and enforcing those commitments. Boards with independent directors, functioning audit committees, and clear lines of responsibility for sustainability strategy are better positioned to generate environmental disclosures that investors treat as informative rather than aspirational, which is why board-level governance quality amplifies the market response to environmental reporting.

The moderated mediation finding extends this logic by showing that SASB-quality financial disclosure acts as an additional credibility signal that further amplifies the governance-mediated valuation benefit. A company that reports strong environmental performance, supports those disclosures with credible board-level governance, and provides SASB-aligned information on financially material issues presents a more integrated sustainability profile. In this profile, environmental commitments are linked not only to reputational considerations but also to the firm's operating strategy and financial planning, providing investors with information that is more directly relevant to assessing the firm's long-term value. This finding provides arguably the strongest theoretical case yet assembled for the multi-framework integration approach that the ISSB and the European CSRD framework are both, independently, converging toward.

6.3. Practical Implications

6.3.1. For Companies and Sustainability Teams

The IEAM's layer-level decomposition enables sustainability practitioners to identify the component of their disclosure profile that most constrains their composite score and to direct improvement efforts accordingly. A company with high SM scores but low FM scores, a common pattern among firms that have invested heavily in stakeholder engagement and GRI reporting but not in SASB adoption, is leaving investor-relevant financial-materiality information gaps that suppress the ROA association and, per the moderated-mediation result, reduce the credibility of its own environmental disclosures. Conversely, a company with high FM and SM scores but a near-zero CS module score has arguably the most tractable improvement path: TCFD implementation is primarily a governance and scenario-planning exercise, not a data-intensive measurement challenge, and the WACC benefits documented here provide a direct financial return-on-investment case for board-level climate governance programmes.

6.3.2. For Institutional Investors in Frontier Markets

Commercial ESG ratings for the five countries in our sample are available for fewer than half of listed firms, and those that exist tend to be constructed primarily from estimated rather than disclosed data, reversing the direction of causality that disclosure-based models assume. The IEAM provides an alternative that any analyst with access to company annual reports, sustainability disclosures, and CDP responses can implement without proprietary data subscriptions. The portfolio back-testing results suggest that IEAM-ranked quintile strategies produce economically and statistically meaningful return differentials over the seven-year back-test window, while the drawdown evidence suggests that long positions in high-IEAM firms provide meaningful protection during market stress episodes. These properties are relevant to the growing universe of emerging- and frontier-market ESG funds that currently lack systematic measurement frameworks adapted to the data environment in which they operate.

6.3.3. For Regulators and Standard-Setters

Central Asian capital-market regulators, including the Uzbek Capital Market Development Agency and the Kazakhstan Financial Regulatory Authority, are at different stages of developing mandatory sustainability-disclosure requirements. The IEAM architecture is compatible with the broader convergence of GRI, ISSB, and TCFD approaches and draws on indicator sets already recognised within these frameworks. It therefore provides a potential technical reference for developing disclosure templates, materiality-assessment guidance, and scoring rubrics for regulatory benchmarking programmes. The governance mediation and moderation findings also have a specific policy implication: disclosure requirements may be less effective when they are not accompanied by measures that strengthen governance quality and the credibility of corporate reporting. In such circumstances, the information provided to investors may be less useful for assessing sustainability-related risks and firm value. Effective sustainability regulation in transition economies therefore requires a twin-track approach that combines disclosure requirements with measures to strengthen corporate governance.

6.4. Limitations

Several limitations qualify these conclusions. First, although the content-analysis procedure incorporates rigorous inter-coder reliability checks, the coding process retains an element of subjectivity. Automated and large-language-model-based approaches could potentially reduce this subjectivity while increasing the scalability and replicability of structured indicator coding from sustainability reports. Their reliability for this specific application, however, requires further empirical validation. Second, the five-country, eight-year panel provides a substantial number of firm-year observations for the main regression analysis, but the country sample is not globally representative. The transition-economy focus also means that the findings should be generalised to developed or other emerging markets with caution. Third, the fixed-effects specification accounts for time-invariant unobserved heterogeneity but does not eliminate the possibility of reverse causality, whereby firms with stronger financial performance may have greater resources or incentives to invest in ESG disclosure. Addressing this concern more rigorously would require an identification strategy based on plausibly exogenous variation, such as staggered implementation of mandatory national disclosure requirements, which is not available in the current panel. Finally, the ISSB standards issued in June 2023

became effective for annual reporting periods beginning on or after 1 January 2024. The extended observation window therefore includes only the first two years of the new regime, during which adoption in the sample jurisdictions remained at an early stage. Whether the IEAM's framework-to-performance mappings remain stable as ISSB-based reporting becomes more widespread is an empirical question for future research.

7. Conclusion

This paper has developed and empirically tested an Integrated ESG Assessment Model that harmonises the GRI, SASB, and TCFD frameworks within a single, theoretically grounded composite scoring architecture. The model's three-layer design maps the complementary institutional logics of the three frameworks onto their corresponding theories of why sustainability disclosure should matter for financial outcomes, aligning the broadest layer with stakeholder theory, the industry-calibrated layer with agency theory, and the forward-looking climate layer with systemic risk theory. The AHP-entropy weighting procedure delivers a principled, transparent, and reproducible aggregation method that directly addresses the opacity critique that has been levelled at commercial ESG ratings since the rater-disagreement evidence assembled by Berg et al. (2022).

Validation against 960 firm-year observations across five transition economies yields several results with both methodological and substantive significance. The composite IEAM score predicts return on assets, Tobin's Q, and the cost of capital substantially better than any individual-layer proxy, confirming that the three frameworks are not substitutes but complements whose joint deployment produces informational value that exceeds the sum of their individual parts. The layer-differentiated results map predicted financial channels onto the correct outcomes, providing theory-specific rather than generic empirical validation. Structural equation modelling establishes governance quality as the primary mediating mechanism through which environmental disclosure reaches market valuation, with SASB financial disclosure as a credibility-amplifying moderator. Portfolio evidence confirms that the informational premium of high IEAM scores is not confined to accounting statements but is priced by equity markets and manifests most visibly in reduced drawdown during stress episodes.

At a moment when the ISSB, the European CSRD, and an expanding list of national regulators are all moving toward integrated sustainability disclosure architectures that draw on precisely the three frameworks examined here, this research offers both a methodological prototype and empirical evidence that the integration project is worthwhile. The finding that combining GRI breadth, SASB precision, and TCFD's forward-looking perspective within a single measurement system is associated with stronger empirical performance than any individual framework provides quantitative support for the broader movement toward multi-framework convergence in sustainability reporting.

The main conclusions of the study can be summarised as follows. First, the GRI, SASB and TCFD frameworks capture complementary rather than overlapping dimensions of sustainability information, and their integration within a single composite index yields a measure that is more closely associated with financial outcomes than any individual framework. Second, each layer of the IEAM operates through its own financial channel: financially material disclosure is most closely related to profitability, stakeholder-oriented disclosure to market valuation, and climate scenario disclosure to the cost of capital. Third, board-level governance quality is the principal mechanism through which environmental disclosure is reflected in firm valuation, and this mechanism is reinforced

when firms also disclose financially material information. Fourth, the informational value of high integrated scores is recognised by equity markets and is most visible in smaller losses during periods of market stress. Fifth, the extension of the observation window to 2025 covers the period in which the ISSB standards entered into force and national sustainability reporting requirements in the sample countries began to develop, which increases the relevance of the findings for current regulatory practice. Finally, for transition economies with limited data availability, the IEAM provides a transparent and reproducible assessment tool that companies, investors and regulators can apply using publicly available documents, provided that disclosure requirements are accompanied by measures to strengthen corporate governance.

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