INTEGRATING ESG INTO CREDIT RISK: Recommendations

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Integrating ESG into Credit Risk: Recommendations

Compilation Contents

1. INTEGRATING ESG RISKS INTO CREDIT ASSESSMENT: A Practical Perspective for Banks – A Protiviti analysis (2024)
2. ESG and Credit Risk: An overlay of ESG for credit appraisal – Deloitte (2022)
3. Impact of ESG on Corporate Credit Risk: Rupali Vashisht
4. Measuring the relationship between ESG factors and firm's credit risk in Europe – by Monica Billio, Michele Costola, Serge Darolles, Loriana Pelizzon
5. HOW IS CREDIT RISK AFFECTED BY ESG FACTORS? - CRIF
6. DOES BETTER ESG PERFORMANCE LOWER CREDIT RISK? ASOVEREIGN CREDIT PERSPECTIVE by Hong Kong Monetary Authority - 2022
7. ESG Relevance in Credit Risk of Development Banks by Jan Porenta and Vasha Rant
8. Draft Guidelines on the management of ESG risks - EBA´s consultative document highlights – Management Solutions (2024)
9. ESG Factors and Credit Risk Analysis
10. Pricing ESG Risk in Sovereign Credit – Hermes Investment Management (2019)
11. An ESG-Modified Credit Risk Assessment Model based on Decision Tree Model (2022)
12. First Abu Dhabi Bank (FAB): Group ESG Risk Policy (2023)
13. ESG Risks and their impact on the Creditworthiness of Companies
14. Responsible financing and investment: identification, development and assessment of ESG metrics

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INTEGRATING **ESG RISKS** INTO CREDIT ASSESSMENT

A Practical Perspective for Banks

A Protiviti Analysis

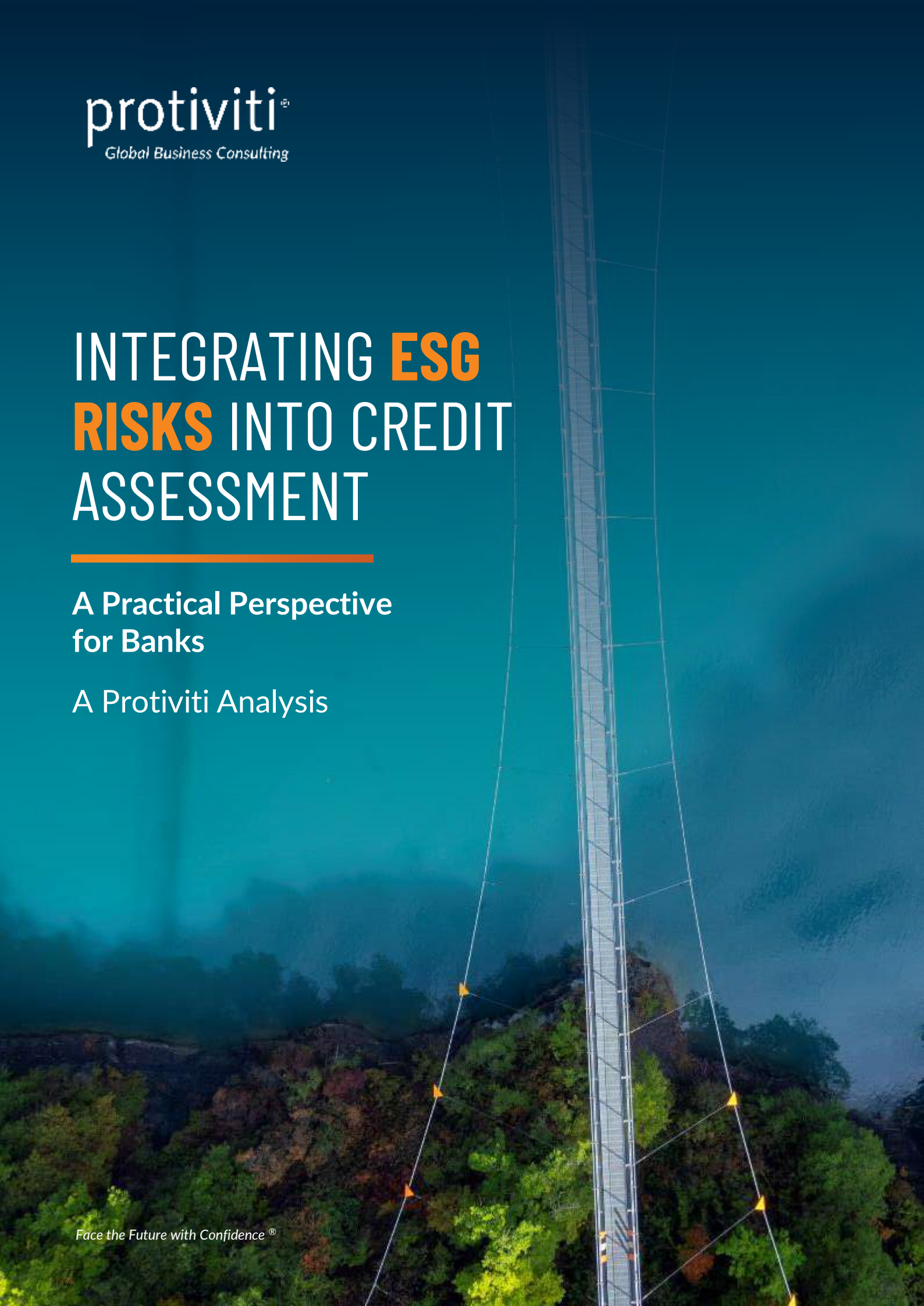

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Table of Contents

01. Executive Summary

Banks and financial institutions have long established the practice of using rating models and scorecards for assessing the creditworthiness of their borrowers. These models are tuned to evaluate the borrowers' ability to repay their debt obligations by focusing on traditional drivers of credit performance, such as industry risk, business risk, financial risk, and management risk.

Banks also periodically validate and update these models to ensure their relevance based on both systemic and idiosyncratic changes. One of the principal recent shifts impacting the banking sector is the increasing focus on ESG (environmental, social, and governance-related factors) and sustainable financing. This focus has been driven by a push from investors, lenders, customers, regulators, and the larger social community. Simultaneously, there is also an internal drive originating from employees, suppliers, and management. Stakeholders across-the-board are increasingly calling for consideration of ESG ramifications of business decisions. Such an ESG focus implies that banks must now finetune their methodology for assessing potential borrowers and monitoring existing borrowers to include parameters related to ESG performance and disclosures.

The paper focuses on the banks' wholesale banking portfolios and explores how banks can meaningfully integrate the borrowing organization's ESG performance into the assessment of the creditworthiness of the borrowers. We have made this exploration in the context of the practical challenges associated with these integrations:

- Absence of historical ESG-related data of borrowers for any meaningful statistical analysis
- Presence of multiple reporting frameworks, and the lack of comparability across disclosures by different companies and sectors
- Data integrity issues of reported disclosures
- Need to integrate new ESG parameters without affecting the stability of currently approved and accepted credit models

02. Understanding ESG: An Organization's Perspective

ESG, represents a set of factors that measure an organization's impact on the environment and society, and how transparent and accountable the organization is regarding the same. As per the World Bank's ESG Investing Report, 'the term ESG, is often used interchangeably with sustainable investing, denotes an investment approach in which analysis goes beyond purely financial factors.

Figure 1 highlights examples of ESG parameters relevant to a typical organization.

Figure 1: ESG Parameters

Examples of ESG parameters relevant to a typical organization.

ESG Parameters

ENVIRONMENTAL	SOCIAL	GOVERNANCE
• GHG Emissions • Waste Generation • Water Consumption • Hazardous Material Disposal • Energy Costs • Ongoing Environmental Litigations	• Workplace Injuries • Labour Rights Violations • Procurement Practice • % of Temporary Workers • CEO Pay Ratios • Diversity in Staff • Non-discrimination Policies	• Levels of Disclosures • Trade Records • Adverse History (Fraud/Corruption) • Code of Conduct • Corporate Governance Policies • Board Independence • Auditor Qualification

Sources: Global Reporting Initiative (GRI)
Protiviti Analysis

(Illustration)

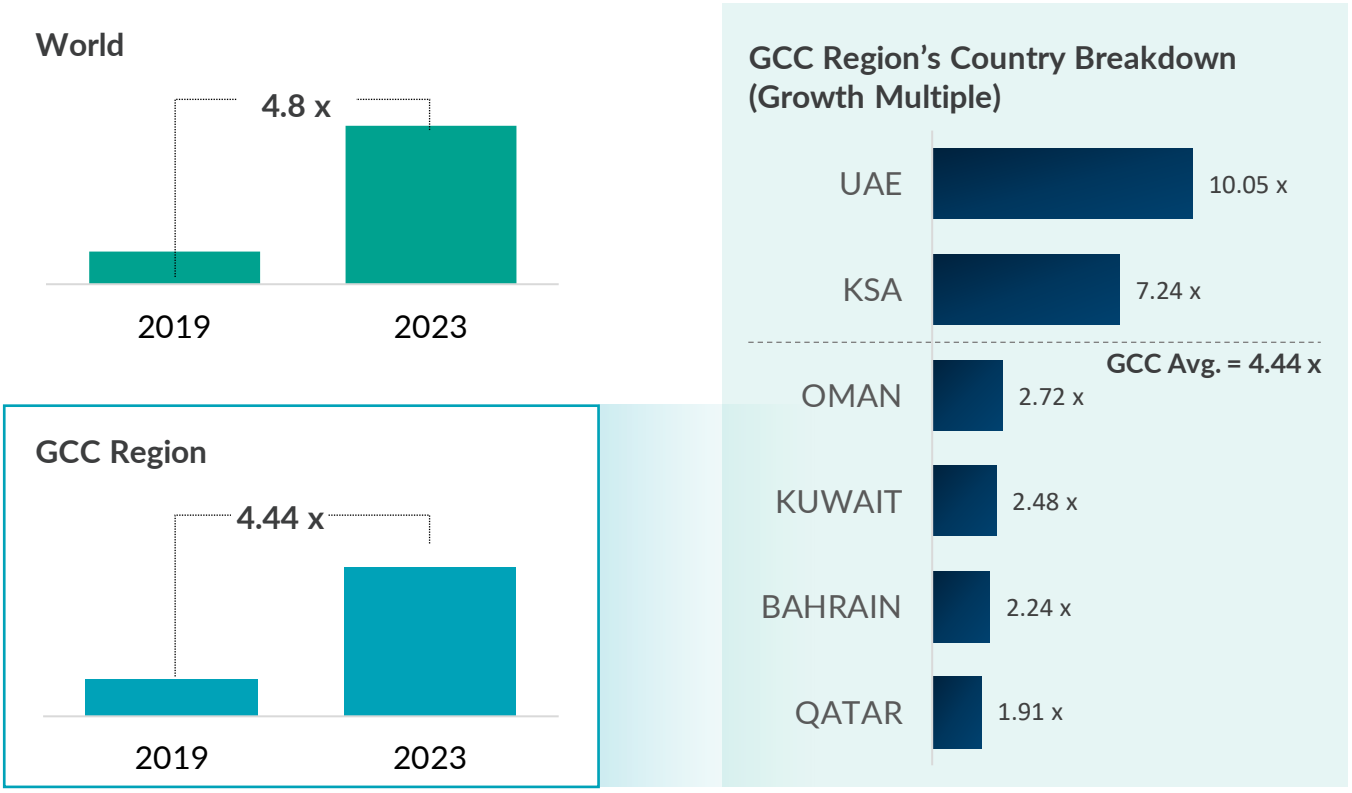
There is an increasing focus by stakeholders towards consideration of ESG factors while evaluating an organization's long-term sustainability and performance. This has been driven by a push from investors, lenders, customers, regulators, and the larger social community as well as by an internal drive from employees, suppliers, and the management.

Figures 2 and 3 highlight the various stakeholders driving the emphasis on ESG performance, and the increase in interest around ESG across the world and GCC region over a 5-year period, respectively.

Figure 2: Stakeholders driving ESG Focus

Sources: World Bank
Protiviti Analysis

Figure 3: 5-Year Trend in ESG Interest – World Vs GCC Region



Sources: Google Trends (2019-2023)
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In the following sections, we will look at how banks – as one of the principal stakeholders concerned with an organization's performance and, specifically, creditworthiness – can integrate an assessment of ESG factors into their conventional credit assessment methodology. Before exploring avenues for such integration, however, the next section explains how an organization's ESG performance translates into an impact on its creditworthiness in the first place.

03. Understanding ESG: A Lender's Perspective

Banks and financial institutions have long established the practice of using credit rating models for assessing the creditworthiness of their corporate borrowers. These models are tuned to evaluate the borrowers' ability to repay their debt obligations by focusing on traditional drivers of credit performance. The structure of the credit models used across various banks typically differs based on whether the model is developed using a statistical approach (usually using a bank's internal default data), expert judgment (procured through an external party such as a credit rating agency) or a hybrid approach combining the two. Even after accounting for the variance in the structure, most banks' models primarily factor in conventionally established drivers of credit performance across industry risk, business risk, management risk, and financial risk factors.

Figure 4: Conventional Drivers of Credit Performance
illustrates the typical risk factors considered as part of a borrower's credit assessment.

- Regulations
- Supply Chain
- Demand-Supply
- Competition
- Benchmarks & Trends for Financials

- Supplier Concentration
- Buyer Concentration
- Market Share
- Diversification of Income
- Long-term Contracts

- Past Performance
- Governance
- Succession Plan
- Keyman Risk
- Employee Relations

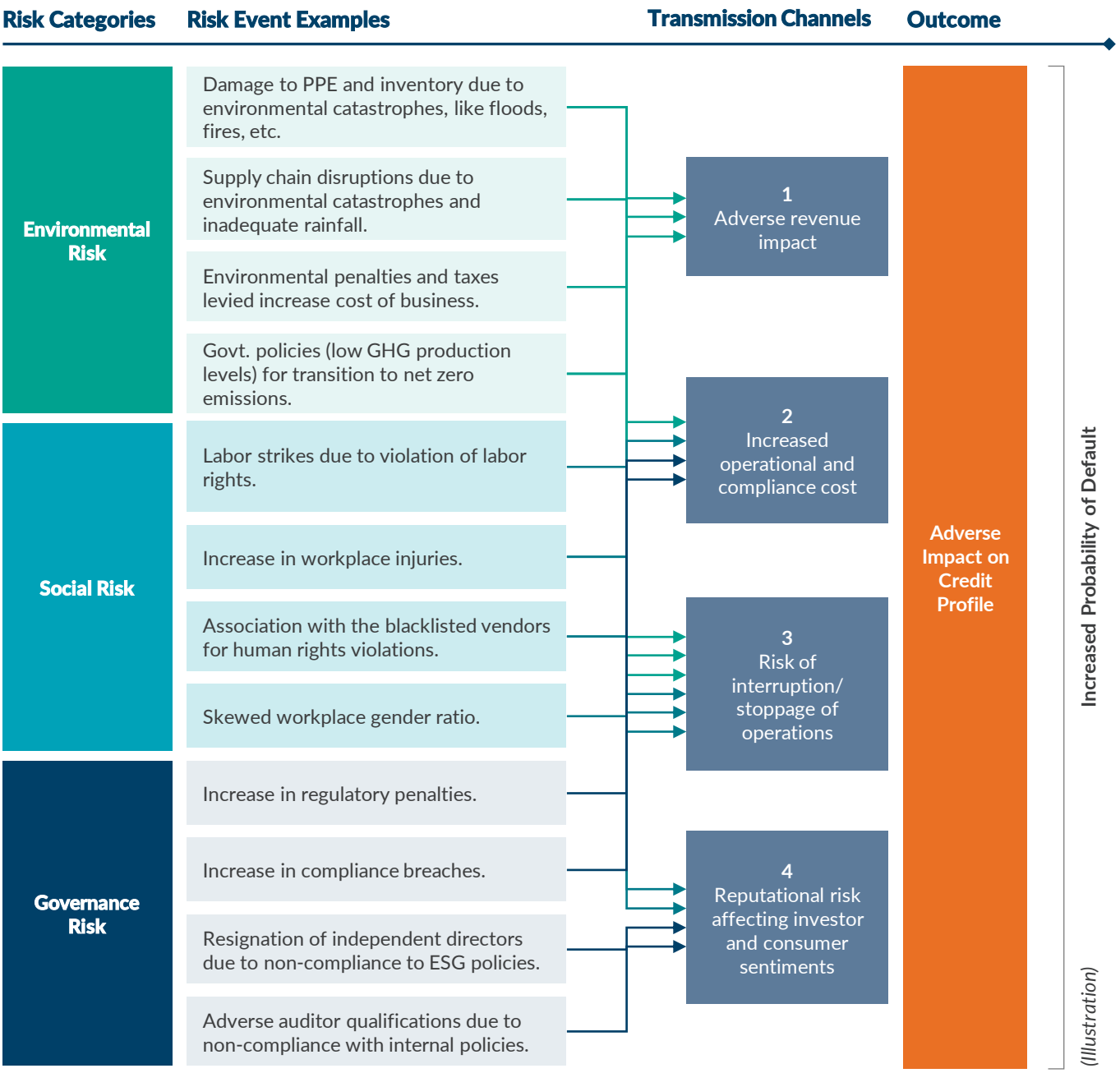
- Leverage
- Liquidity
- Growth & Size
- Capitalization
- Profitability

The focus on the ESG performance of borrowers as highlighted in the previous section brings into the picture additional drivers of credit risk. Such a relationship is predicated on ESG risks translating into actual deterrents to an organization's ability to continue its business operations or grow them as per projections, and consequently service its debt.

Figure 5 highlights examples of ESG risks and the transmission channels through which they can crystalize into an increase in credit risk (represented in terms of a probability of default, or PD).

Figure 5: Transmission channels for ESG risks translating to credit risk

illustrates the typical risk factors considered as part of a borrower's credit assessment.

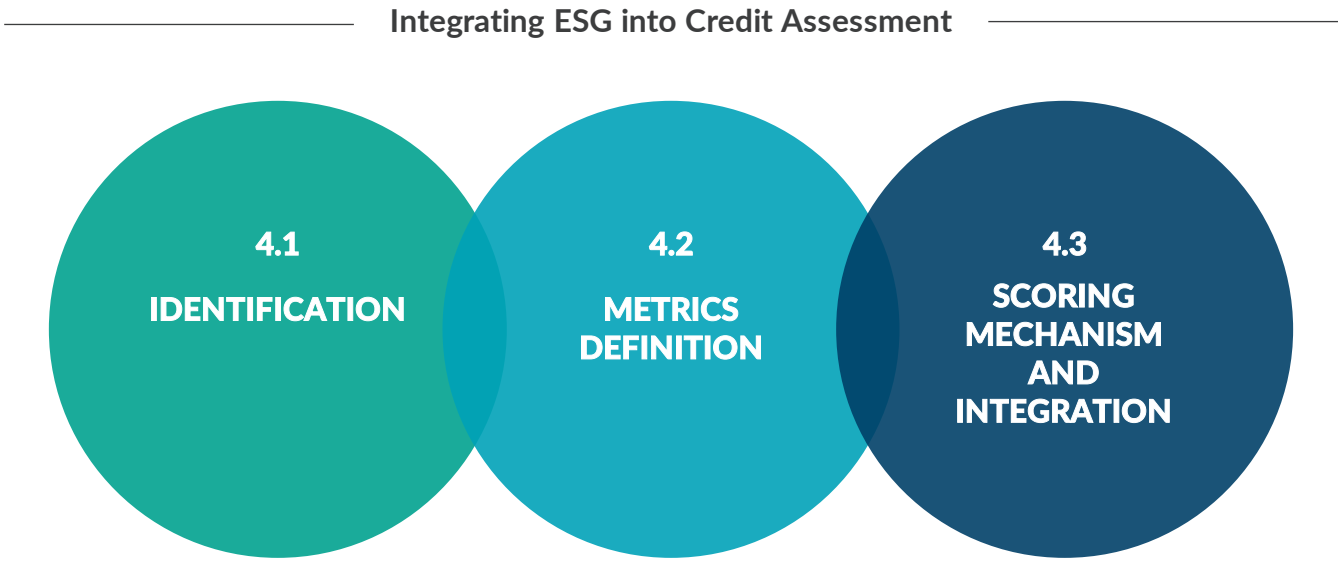


In the presence of such channels of ESG risks translating into real deterrents to an organization's creditworthiness, it is imperative for banks to integrate borrowers' ESG performance with the assessment of their credit risk.

04. Integrating ESG Risks in Credit
A Practical Framework

A structured and practical framework for integrating ESG risks with credit assessment requires the following steps to be addressed by a bank, as highlighted in Figure 6.

Figure 6: Integrating ESG risks in Credit Assessment



- Identify dimensions for ESG assessment of borrowers based on business context and, if relevant, alignment to credit assessment dimensions

- A. Prepare library of ESG metrics
- B. Assign relative criticalities
- C. Define units, limits and tolerances

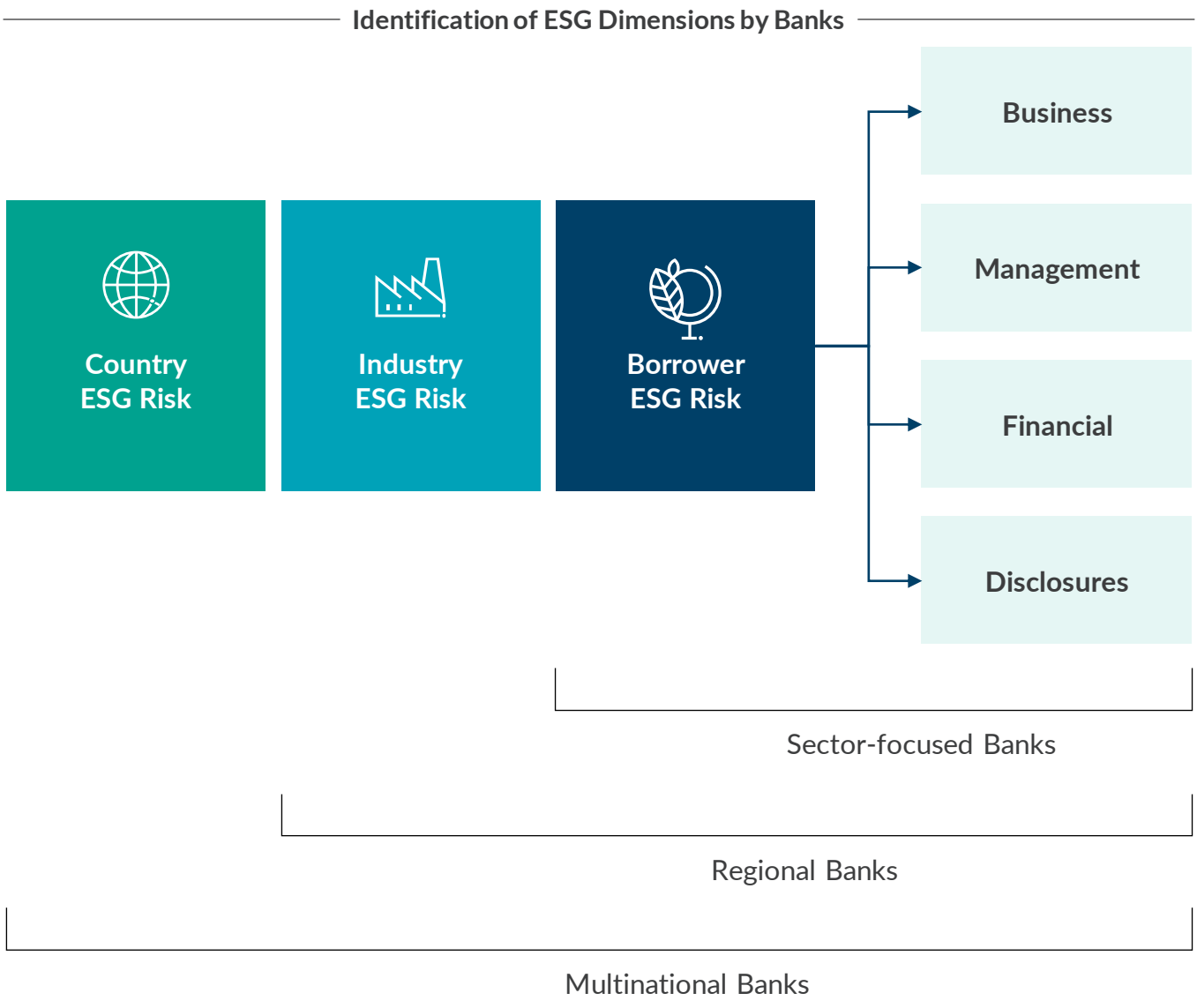
- Define a scoring mechanism to translate & evaluate metrics into decision-making insights
- Define the mechanism for integrating ESG & credit assessment

4.1. Identify ESG dimensions

As a first step towards assessment of ESG risks of borrowers, banks can identify the categories, or 'dimensions', across, which they intend to understand and evaluate their borrowers' ESG performance. Such a step will help establish a structured framework for the evaluation while streamlining banks' focus on dimensions material to their business context (in the absence of historical data for statistical analysis).

For example, regional banks may identify dimensions focused on local nuances in terms of dominant industries and geological characteristics, while multinational banks may identify a larger set of dimensions factoring in country and industry risks (to enable a comparative analysis across a wider set of borrowers). Similarly, a specialized lending institution focused on particular projects or industries may identify more granular dimensions pertaining to the regulatory nature, demand-supply situation, degree of competition, and supply-chain characteristics of the particular industry.

Figure 7: Illustration of ESG dimensions for consideration by banks



4.2. Define ESG metrics across each dimension

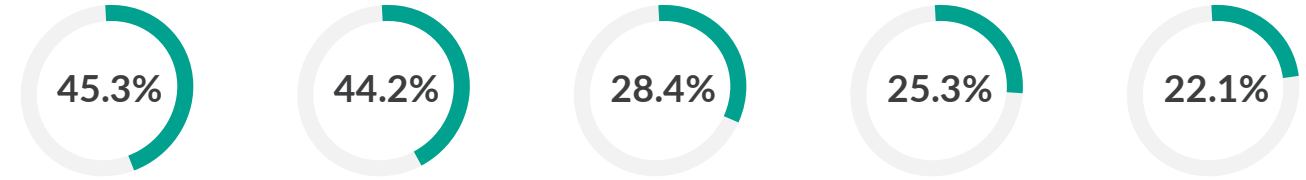
In this step, banks ought to focus on forming an ESG library through identification and definition of specific ESG metrics, and assignment of criticality and limits to the metrics (indicating their relative importance and acceptable levels, respectively).

A. Prepare a library of ESG metrics

Banks should prepare a library of environmental, social, and governance-related metrics for each dimension identified in Step 4.1, that helps assess the performance of the borrower under the said dimension. **Figure 8** highlights the most common ESG metrics based on their reporting frequencies as required by globally accepted reporting standards. Such metrics may form the base of an initial shortlist by the bank for further consideration.

Figure 8: Most common ESG metrics as per global reporting standards and frameworks

Top 5 Global Risks: View of Risk Experts*



Environment Metrics#

GHG Emissions	Freshwater Availability: Water Usage	Energy Efficiency & Mix	Waste: Solid, Water, Hazardous	Air Pollutants
Freq. = 92%	Freq. = 92%	Freq. = 85%	Freq. = 73%	Freq. = 62%

Social Metrics#

Health & Safety: Injury & Fatality	Collective Bargaining Agreements	Workforce Turnover	Workforce Composition	Forced, Compulsory, & Child Labor
Freq. = 100%	Freq. = 69%	Freq. = 69%	Freq. = 69%	Freq. = 54%

Governance Metrics#

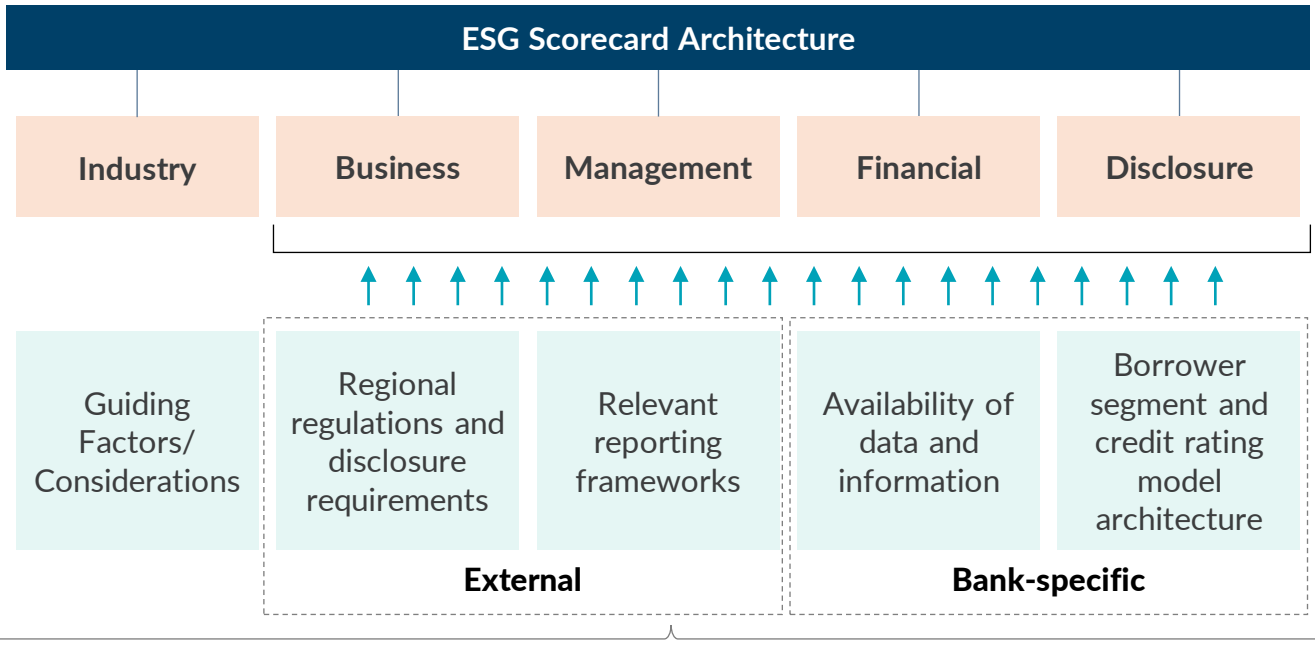
Board Independence	Board Composition: Diversity	Equal Voting Rights	Audit Committee	Executive's Compensation
Freq. = 78%	Freq. = 78%	Freq. = 50%	Freq. = 44%	Freq. = 43%

Sources:
World Economic Forum Global Risks Perception Survey, 2021-2022 | The World Bank Sovereign ESG Data Framework
International Finance Corporation's ESG Guidebook, December 2021 | International Finance Corporation's Climate Governance: Progression Matrix, May 2023 | International Finance Corporation's Toolkit for Disclosure and Transparency, January 2018
WEF Paper on Defining the 'G' in ESG, June 2022 | WEF White Paper on Common Metrics and Consistent Reporting of Sustainable Value Creation, September 2020
Protiviti Analysis

**Based on a total of 1,316 responses captured by GRPS of which 1,249 were used for analysis. The percentage figure indicates the percentage of respondents with a risk management background that considered the risk as one of the top 10 global concerns over the next 5 to 10-year horizon.*
#Metrics listed are illustrative and based on either a common formulation or an amalgamation of different formulations. The right-hand column indicates the frequency of inclusion of the metric in the frameworks and standards analyzed based on an analysis of 12 widely used E&S disclosure frameworks, standards, and information service providers and widely used corporate governance disclosure frameworks, standards, and information service providers.

Upon identification of the initial shortlist, banks will need to map the ESG metrics to each of the dimensions from Step 4.1. This activity may help banks to prioritize parameters that are required or emphasized by regional regulations (and those with globally accepted definitions) to have a more standardized and comparable assessment across borrowers. **Figure 9** highlights specific considerations for the prioritization or selection of ESG metrics.

Figure 9: Specific considerations for identification of ESG dimensions and metrics



GRI Global Reporting Initiative	**CDP** Carbon Disclosure Project	**IIRC** International Integrated Reporting Council	**SASB** Sustainability Accounting Standards Board	**TCFD** Task Force on Climate-Related Financial Disclosures
An independent, international organization that helps organizations take responsibility for impacts, by providing a global common language for communication	A not-for-profit charity that runs the global disclosure system for investors, companies, cities, states and regions to manage their environmental impacts	An international cross section of leaders from corporate, investment, accounting, securities, regulatory, academic & standard-setting sectors as well as civil society.	A non-profit organization helping businesses & investors develop a common language about the financial impacts of sustainability	Created by the Financial Stability Board (FSB) to develop consistent climate-related financial risk disclosures se by companies, banks, & investors for providing stakeholder information

Based on the initial shortlist and subsequent prioritization, banks can now put in place the base architecture of their borrowers' ESG assessment framework. **Figures 10 and 11** highlight such an illustrative architecture through a set of metrics under the dimensions of industry risk, business risk, management risk, financial risk and disclosures, and their mapping to the relevant reporting standards, respectively.

Figure 10: Illustration of the ESG metrics under various risk dimensions

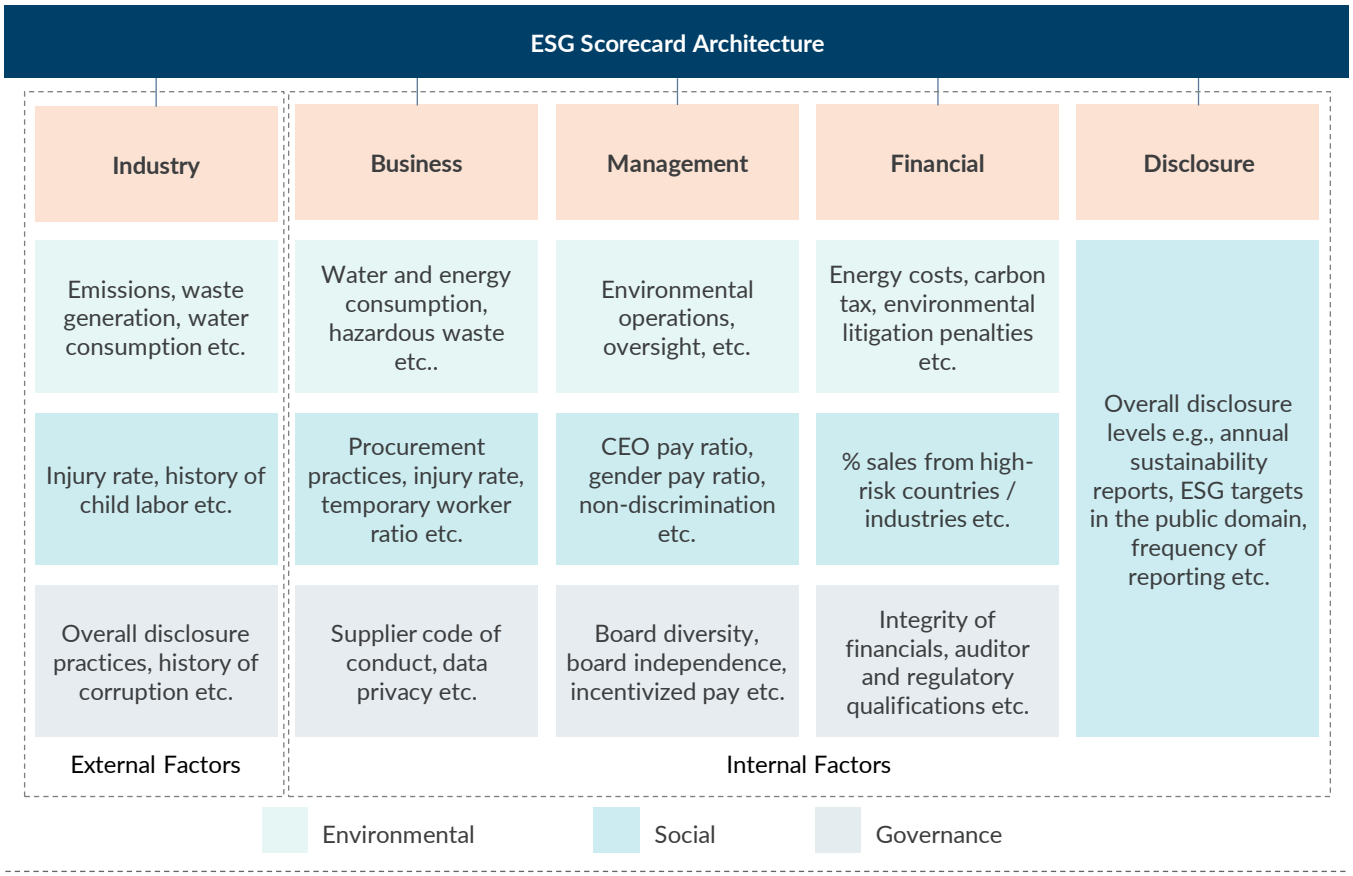
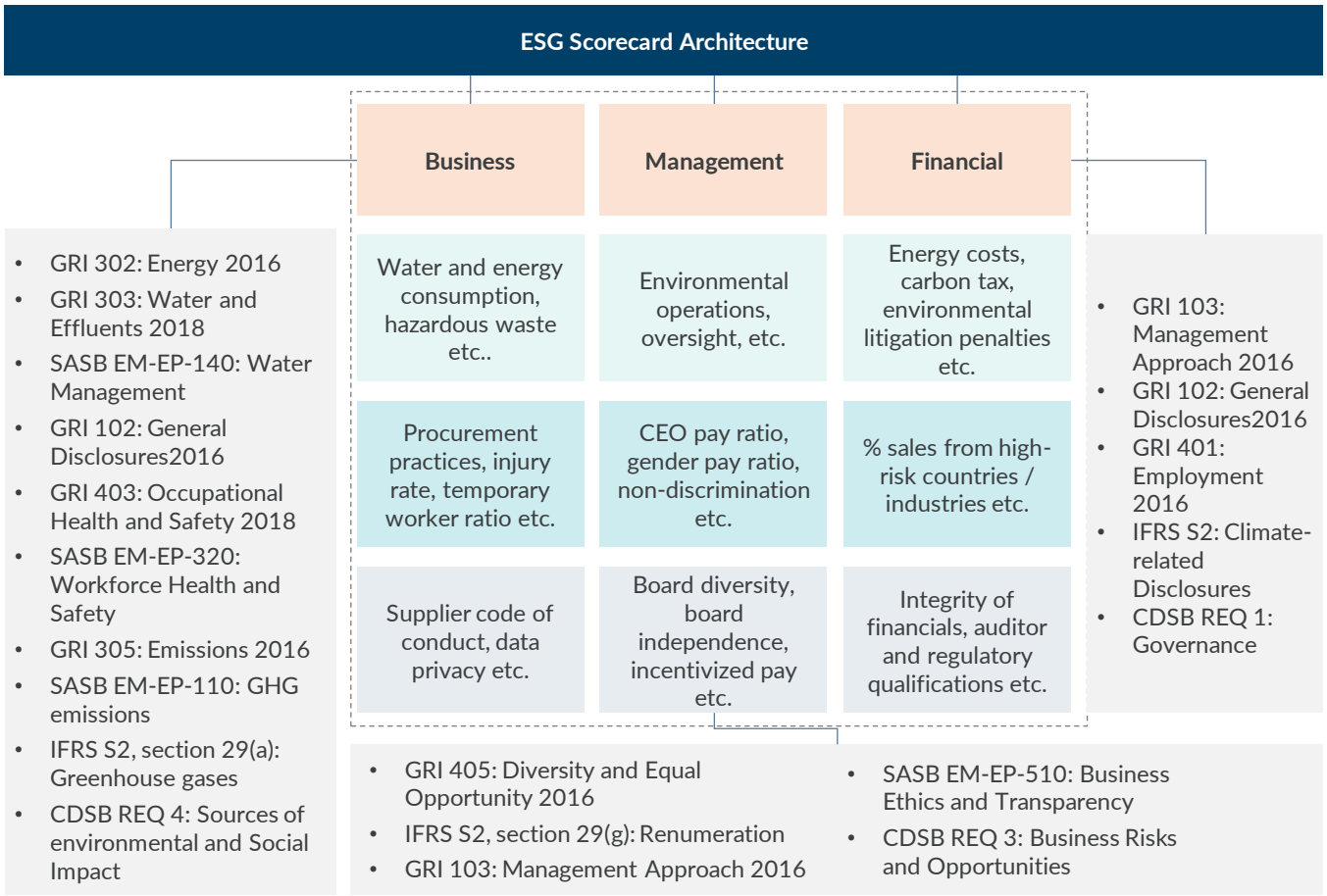


Figure 11: Mapping of ESG metrics to global reporting standards

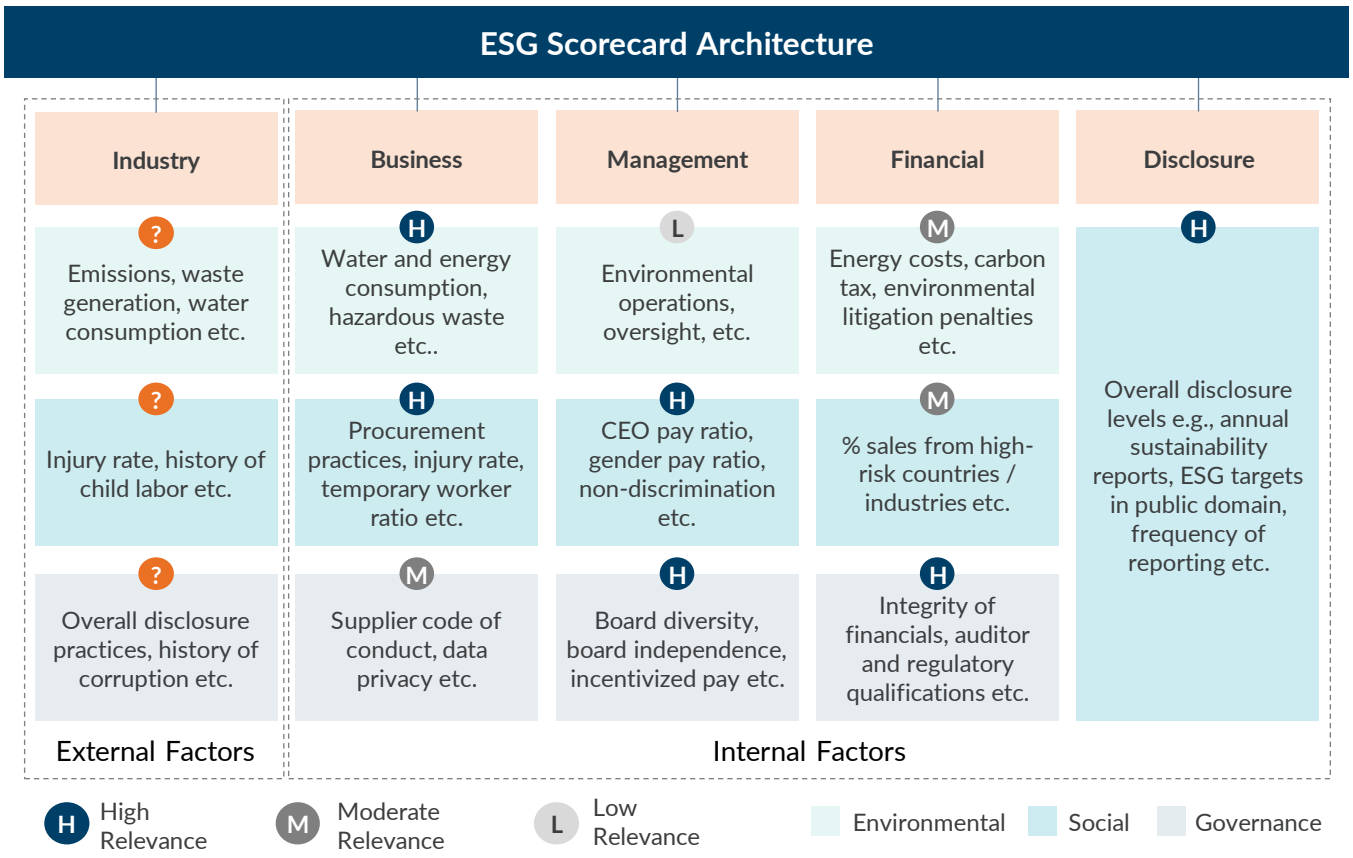


B. Assign relative criticalities (weights) to identified metrics

It may be noticed that the dimensions identified in the previous steps have varying levels of significance across environmental, social, and governance-related factors. For example, an assessment of environmental metrics may highlight concerns about an organization's business risk but may not yield significant insights towards its management risk. Reframing this challenge from the perspective of model design, it may be possible to define the environmental metrics for the dimension of 'business risk' more readily compared to those for 'management risk'. On the other hand, the latter may have more relevant governance-related metrics compared to the former.

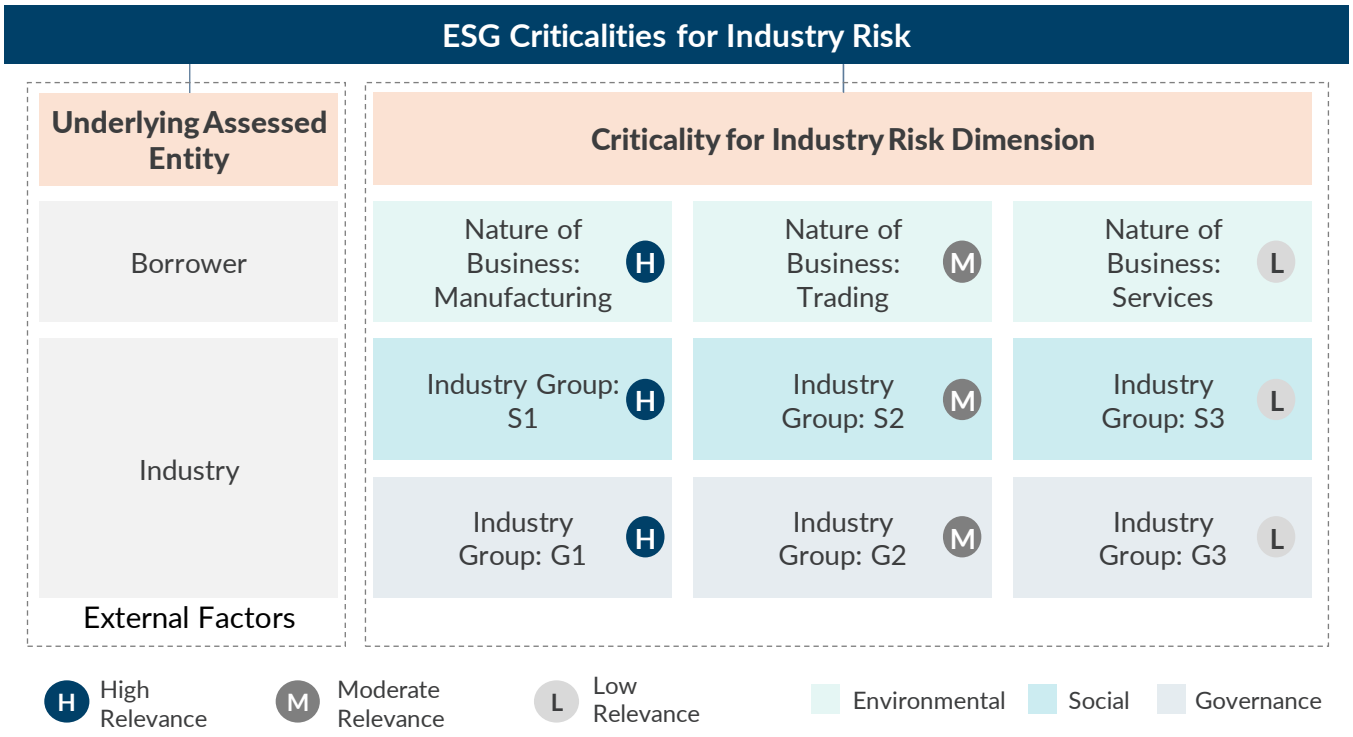
Accordingly, banks can consider accounting for the difference in relative criticality of various metrics in this step through the assignment of weights to each dimension across E, S and G categories. The weights may be of a categorical nature (for example, across a 3-point scale such as 'high', 'medium' and 'low') due to the subjectivity involved in their assignment. **Figure 12** highlights an illustration of relative criticalities applied to the dimensions identified in Steps 4.1 and 4.2.

Figure 12: Illustration of relative criticalities applied to identified ESG dimensions



Another specific challenge that may be observed in the above exercise is that the relative criticality of 'industry risk' across environmental, social, and governance-related factors may vary depending on the nature of the industry (indicated by '?' in Figure 12). To address the same, banks may assign the E, S and G criticalities for 'industry risk' at an industry group level, or, at a minimum, based on whether the nature of business of the borrower relates to manufacturing, services or trading. This approach is illustrated further in Figure 13.

Figure 13: Illustration of ESG criticalities for industry risk
(Illustration)



For grouping industries with respect to the relevance of social and governance-related factors, banks can leverage the industry categorization conducted by external parties such as rating agencies. Alternatively, banks may employ a qualitative approach through an assessment of the industry's fundamentals, further supported by historical data or independent industry research (subject to availability). Some of the qualitative parameters that may be considered for such an assessment are illustrated below.

Social relevance:

- Is the development of the industry part of broader developmental goals such as national vision or UN SDGs?
- What is the percentage of the national workforce employed by the industry?
- Is there a history of adverse human rights records associated with the industry?
- What are the average employee turnover levels in the industry?
- Is there a high prevalence of health and safety incidents associated with the industry?
- Have there been incidents of litigation/payouts related to social factors in the industry?

Governance-related relevance:

- What is the degree of unionization among employees in this industry?
- Is there a high prevalence of whistleblowing incidents in the industry?
- Does the industry have a history of/ high susceptibility towards data privacy breaches?
- Is there a history of greenwashing associated with the industry?
- Have there been incidents of litigation/ payouts related to corruption/ governance breaches in this industry?

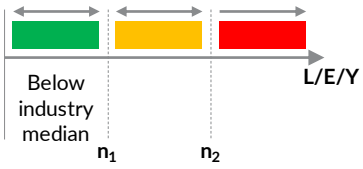
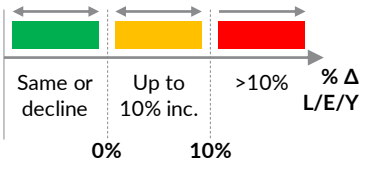
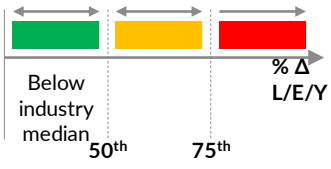
C. Define units, limits and tolerances

In this step, banks can define units and assign specific limits and tolerances to the individual metrics identified in the previous steps, expressed either as qualitative or quantitative measures. Such measures may be defined through a traffic light approach, where the tolerances (amber or alert zones) represent triggers for highlighting potential breaches of limits (red or unacceptable zones) and provide a buffer for the bank to undertake timely corrective action and move back to the acceptable operating levels (green zone). Banks may also define zero-tolerance measures as cultural drivers of acceptable and unacceptable behavior.

Figure 14: Example of defining units, limits, and tolerances for a sample ESG metric

Figure 14 illustrates this step for representative metrics across E, S and G categories. Similar to the approach in Step 4.2.A., banks may leverage units and limits that are required or emphasized by local regulations or global standards for a standardized and comparable assessment across borrowers.

Category	Metric	Guiding Framework
Environment	Water Consumption	GRI 303, CDP Water Security Reporting Guidance 2018

	Option 1	Option 2	Option 3
Description	Standalone – Absolute	Standalone – Trend	Relative to Industry
Definition	Water consumption per employee per year.	YoY change in water consumption per employee per year (avg. for last 3 years)	Water consumption per employee per year w.r.t industry median
Unit	Litres/Employee/Year	% Change in Litres/Employee/Year	% Change in Litres/Employee/ Year w.r.t Industry Median
Limits and Tolerance			
Pros	+ Easy to measure.	+ Easy to measure. + Indicates effectiveness of borrower's measures to reduce E-impact.	+ Factors in industry usage and benchmarks.
Cons	- Does not factor in trends or industry benchmarks.	- Does not factor in trends or industry benchmarks. - Absolute consumption may still be high. Borrower's may not have historical data.	- Requires industry related detailed data.

Potential Road map

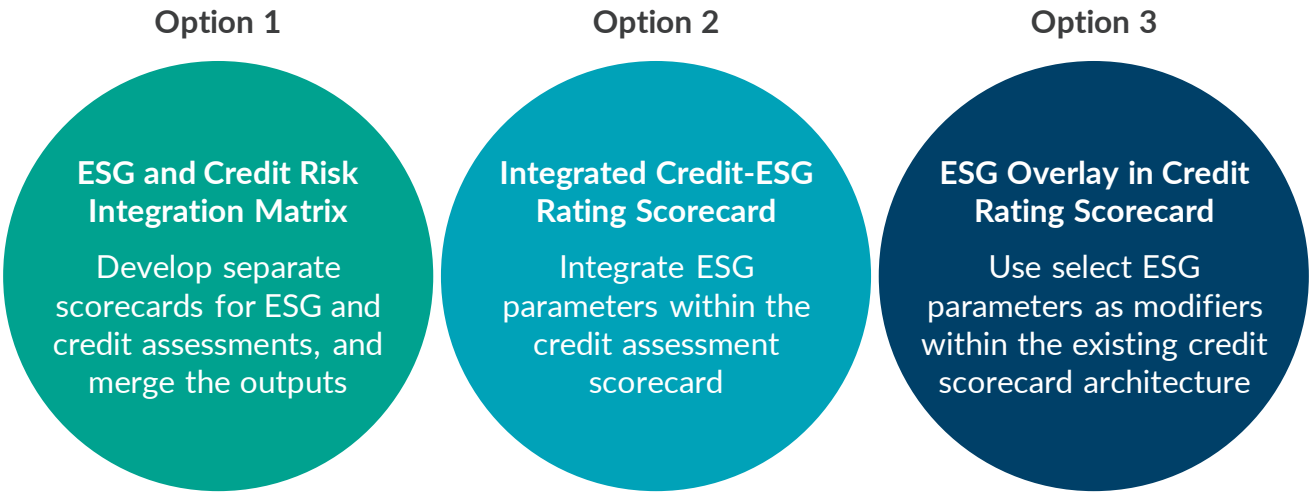
	Short Term	Medium Term	Long Term
Large Corporate Groups	Option 2	Option 3	
Medium Corporates	Option 1	Option 2	Option 3
Small & Medium Enterprises		Option 2	Option 3

4.3. Define the mechanism for scoring and integration with credit decision-making

In the previous steps, we have defined a base architecture of the ESG assessment framework including the library of ESG dimensions, metrics, and their limits. The next step involves combining the evaluation of individual metrics to arrive at a consolidated ESG profile of the borrower, and further integrating the same with the credit assessment to arrive at a holistic risk profile of the borrower.

Figure 15 highlights the various approaches banks may use to integrate the ESG assessment methodology developed above with its traditional credit assessment.

Figure 15: Approach for Integration of ESG Assessment with Traditional Credit Assessment



Option 1: Develop separate scorecards for ESG and credit assessments, and merge the outputs

- In this case, banks will have two outcomes which may be merged to arrive at an adjusted rating
- An illustrative merging approach is highlighted in **Figure 16,** where the values in the cells indicate how many levels the credit-based rating output must be notched down based on the ESG output

Figure 16: Rating adjustment (notch-down) matrix

Rating adjustment (notch-down) matrix		Output of ESG scorecard*				
		ESG1	ESG2	ESG3	ESG4	ESG5
Output of credit risk scorecard*	CR1	0	1	2	3	4
	CR2	0	1	2	3	4
	CR3	0	1	2	3	3
	...	...	...	...	...	...
	CR10	0	0	0	0	0

**On an illustrative 5-point scale, with a higher numerical suffix indicating a higher risk level*

Option 2: Integrate ESG parameters within the credit assessment scorecard

- In this case, there will be a single score/ output linked to a corresponding probability of default
- Examples of this option:
  - The assessment of industry risk may factor in ESG-specific parameters e.g., industries considered inappropriate from an ESG point of view such as tobacco, alcohol, weapons etc.
  - Assessment of business risk may include ESG-specific risks e.g., litigations around environmental or social controversies, labor unrest etc.
  - Assessment of management risk may include factoring in past violations of prudential norms of responsible corporate behavior including environmental, social and governance-related norms related to human rights, working conditions, child labor, anti-corruption etc.

Option 3: Use select ESG parameters as modifiers within the existing credit scorecard architecture

- Similar to Option 2, there is a single score/output, but in this case, ESG parameters may be used as modifiers within the existing scorecard architecture.
- For example, each pillar within a credit scorecard may be notched up/down based on certain ESG criteria (instead of only modifying the end score as in Option 1):
  - Industry risk
  - Business risk
  - Management risk

The selection of the most appropriate option for a particular bank will depend on various considerations such as:

- Complexity of integration methodology
- Impact on the ability to explain model output
- Impact on the stability of existing models
- Operational challenges such as the need for training and impact on systems

Figure 17: Comparison of approaches for integration of ESG and credit assessment

Figure 17 highlights the comparison of the integration approaches based on the considerations highlighted above.

	PROS		CONS
Option 1 **ESG and Credit Risk Integration Matrix** Develop separate scorecards for ESG and credit assessments, and merge the outputs	Provides flexibility if ESG factors do not need to be included in the underwriting decision for certain portfolios / cases	01	The need for alignment with existing credit scorecard imposes limitations when designing the ESG scorecard
	Eliminates need to update / modify the existing credit rating system	02	Introduces more steps and increased complexity on acceptance / rejection threshold decision process
Option 2 **Integrated Credit-ESG Rating Scorecard** Integrate ESG parameters within the credit assessment scorecard	Simplifies the scorecard usage process	01	Restricts ability to bifurcate scorecard output into ESG versus credit concerns
	Provides a foundational structure and does not need development of a separate ESG scorecard from scratch	02	The addition of ESG parameters to existing risk dimensions of the score-card may cause a concern of the model's stability
Option 3 **ESG Overlay in Credit Rating Scorecard** Use select ESG parameters as modifiers within the existing credit scorecard architecture	Simplifies the scorecard usage process	01	Involves more qualitative judgments
	Takes into account the cause/ effect of the ESG with existing risk categories	02	Restricts ability to cover additional risk dimensions beyond the original metrics*

**For example, if the credit scorecard assesses the risk dimensions of management, business and financial risks, then Option 3 would allow modification of the dimension-level scores based on ESG overlays or concerns but cannot incorporate analysis of additional ESG dimensions such as industry risk (as it is not part of the credit scorecard architecture).*

05. Other factors for Operationalization

To ensure success in terms of operationalization and ongoing usage of the developed approach, banks may need to factor in additional initiatives towards building ESG capacity, investing in relevant data architecture and systems, and integrating ESG factors into the larger risk management framework of the bank. **Figure 18** highlights these considerations in greater detail.

Figure 18: Additional considerations for ESG integration

BUILDING ESG CAPACITY

- Training across all three lines of defense
- Hiring people with subject matter expertise who understand the science.

INVESTMENT IN TECHNOLOGY AND DATA

- Bridging the data gap: build or buy, reliance upon 3rd party data sources, internal model development vs. reliance upon 3rd party tools
- Enhancing reporting: KRI/ KPI risk limits, ESG-related policy exception monitoring etc.

RISK MANAGEMENT FRAMEWORK

- Alignment of ESG risks into existing risk taxonomy
- Ensuring the Board of Directors has a line of sight to ESG risk management: regular reporting to Board Risk Committee

In addition to the above considerations, banks will need to ensure that the identified integration framework is aligned with their larger business strategy and risk appetite, expressed in the form of specific and measurable ESG targets. As guided by the Central Bank of Bahrain* in its recent ESG Module, such targets should also be quantitative or directional, and be regularly reviewed and updated to ensure they remain relevant and achievable.

Banks will also need to contextualize their framework to regional nuances to ensure on-the-ground success. For example, given the GCC region's traditional reliance on energy-intensive sectors, banks may have to segment their customers based on their industry and put in place a phased roll-out of limits and tolerances as their customers gradually orient themselves towards more prudent ESG practices.

**Central Bank of Bahrain ESG Requirements Module, released in November 2023*

Regulators will need to ensure a supportive environment that encourages banks' ESG integration efforts. This may involve updating existing regulations to reflect the changing dynamics brought about by investors' ESG focus and publishing consultation papers to address new challenge areas. Some initiatives that can be taken in this space may include standardizing the reporting requirements and metrics' definitions for borrowers, publishing industry-specific and regionally relevant benchmarks for critical ESG parameters and establishing centralized repositories such as those for climate risk data that banks may leverage for a broader use such as stress testing.

Given the critical role of borrowers' ESG performance towards ensuring the overall sustainability of the GCC region's banking sector, banks must leverage prudent and practical measures to assess their borrowers' ESG risks and integrate them effectively as part of the overall credit risk assessment.

About Protiviti

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ESG and Credit Risk

An overlay of ESG for credit appraisal

April 2022

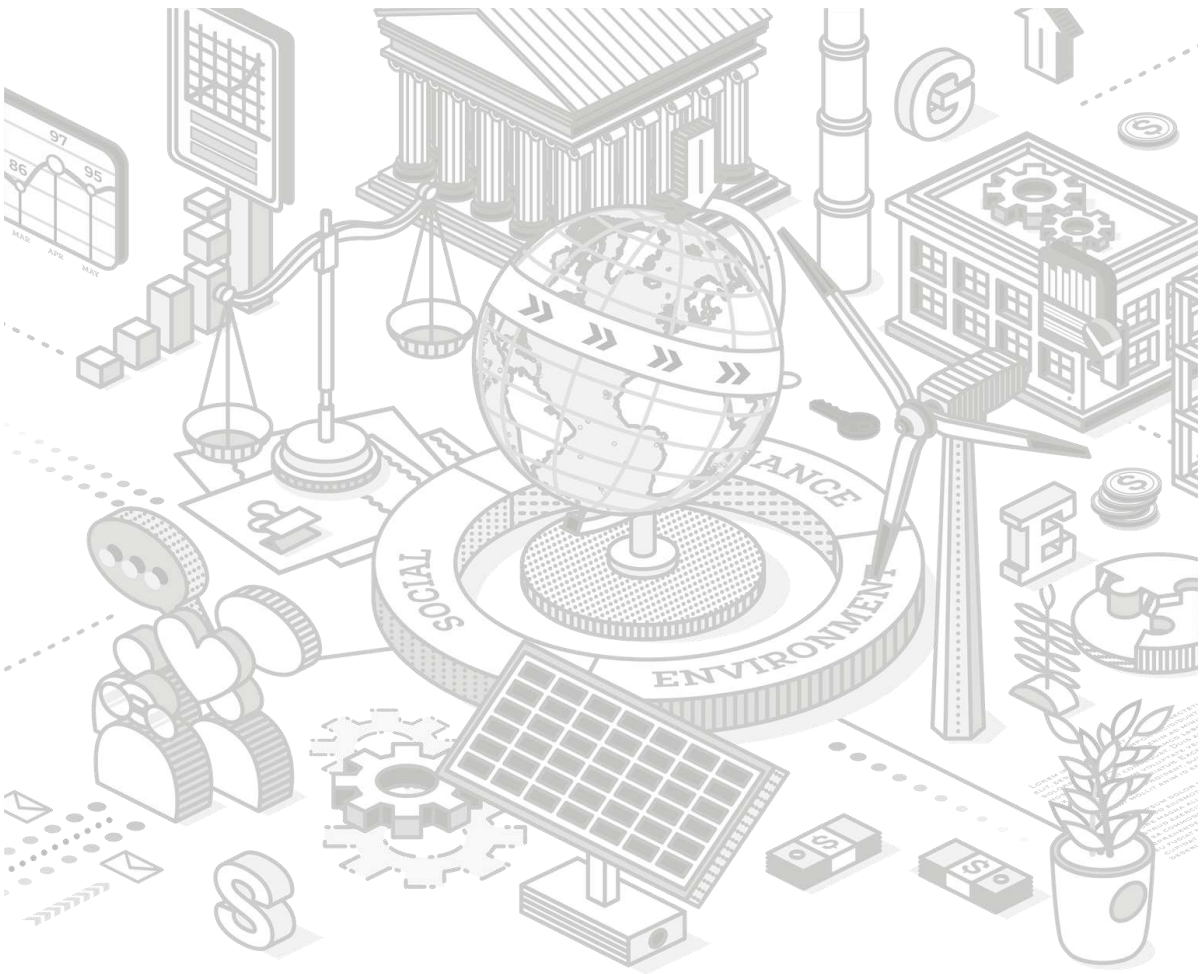
Content

Preface

With the increasing consensus in expanding the conversation around targeted outcomes of running businesses, there has been a growing need to consider the impact a business makes to all stakeholders, the community at large, and the environment. This change in thinking has been triggered by accelerating climate change over the last several years, with the global financial services community coming together to acknowledge how lending institutions can play a key role in not only mitigating adverse fallout, but also facilitate positive change.

Lending is at the core of the business at financial institutions and is driven by, and also influences, the strategic direction for these entities. Having the ESG lens applied to lending decisions is a clear actionable manner in which financial institutions can pro-actively drive towards the objectives mentioned earlier.

Given that achieving this would require a methodology revamp to existing credit rating / appraisal processes, we have developed an ESG overlay mechanism to help with this journey. We believe this overlay brings together a practical approach to introducing these additional dimensions to the credit lending decisioning process, acknowledging the challenges with data required as well as inefficiencies around unnecessarily cumbersome appraisal requirements.



What is ESG assessment in the context of credit appraisal?

- Environmental, Social, and Corporate Governance (ESG) refer to three central factors required to measure the sustainability and societal impact of a company or business investment.
- Assessment of ESG factors help in identifying risks linked to causes such as, climate change, scarcity of resources, labour policies of the company, mismanagement by board members etc.
- The key objective of integrating ESG considerations in credit decisioning is to measure a company's resilience to long-term, industry material ESG risks and to assist the financial institution in better-informed decision-making while evaluating the borrower.

The ESG overlay broadly encompasses to capture following factors:

Environment parameters:
To capture the impact of externalities like climate change, policies regarding the environment on the business operations.

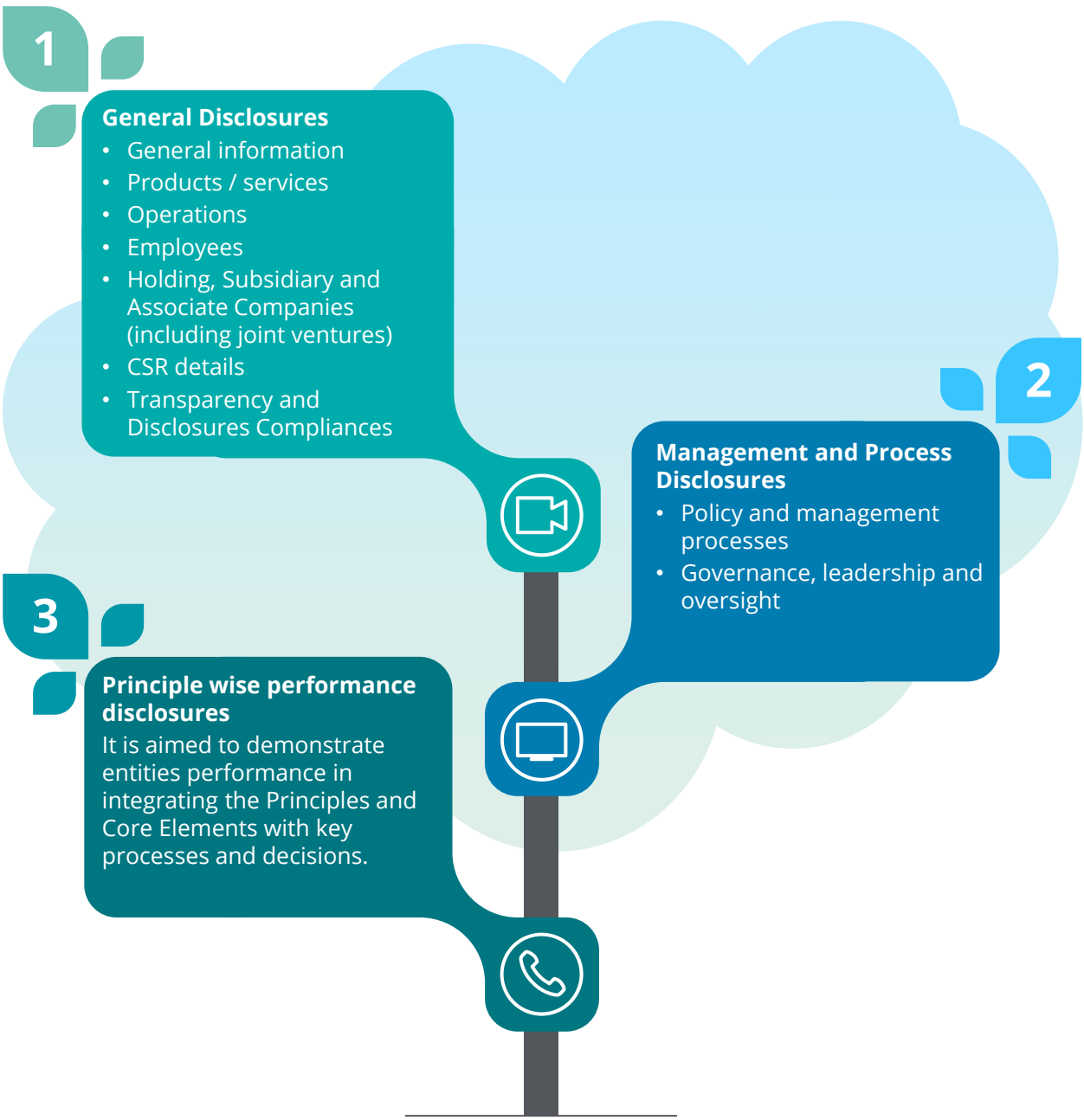
Social parameters typically represent how the organisation focuses on social issues inside and outside the organisation like labour laws, animal welfare etc.

Governance factors deal with the structure and responsibility of the management towards employees, shareholders, society etc.

Relevance of the ESG conversation in credit lending

Global regulations and steps put in place to manage ESG risks

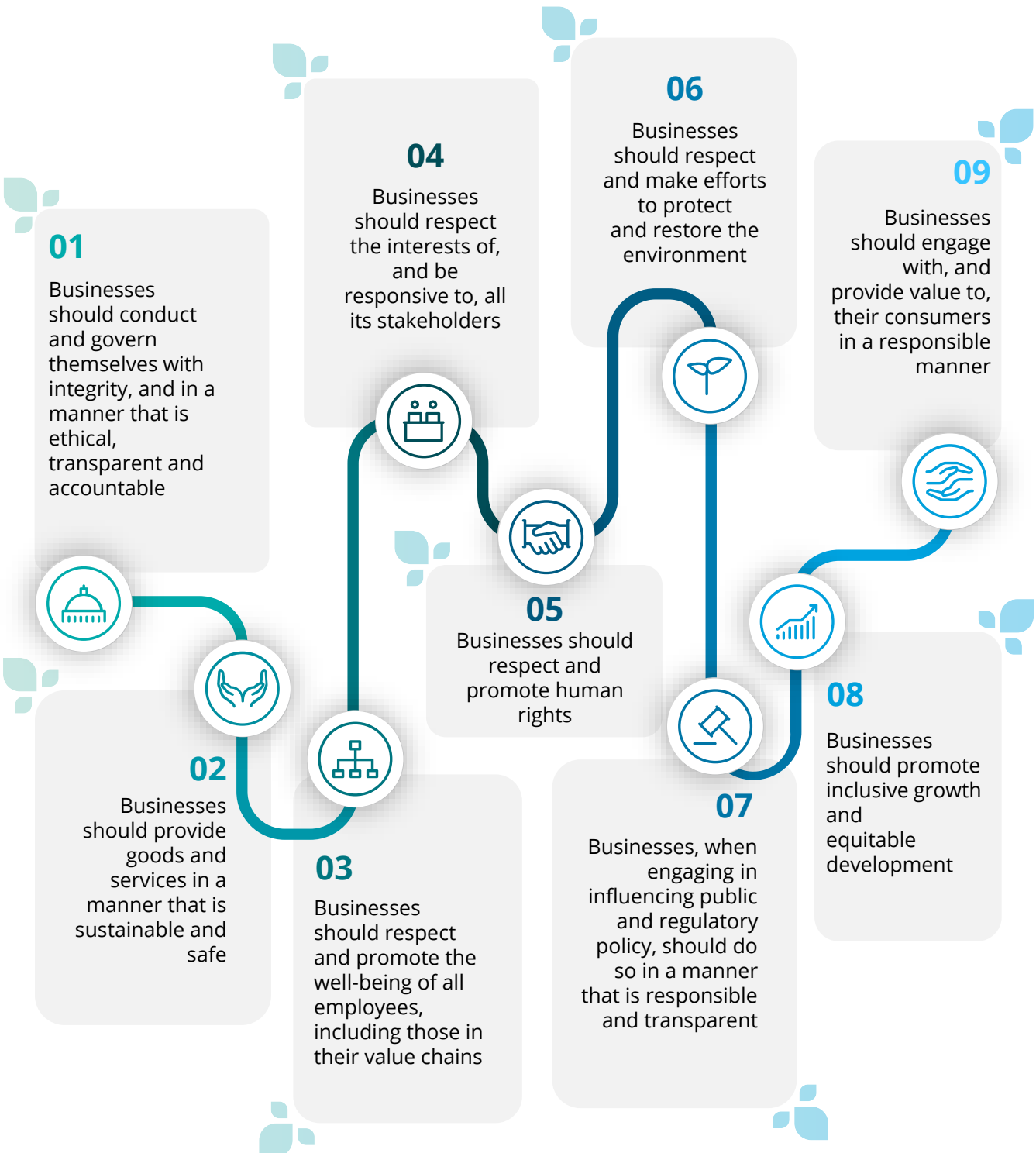
- Domestic regulators / guiding authorities such as SEBI have started to request corporates / entities to disclose ESG-related data.
- The SEBI's 'Business Responsibility And Sustainability Reporting format*' broadly encompasses to capture the following three sections. A detailed list of indicators asked under each of the factors has also been suggested by SEBI in the reporting format.



*Source: 'Business Responsibility and Sustainability Reporting by listed entities' circular issued by SEBI

SEBI Guidance on sustainability reporting

SEBI's Business Responsibility And Sustainability Reporting format broadly captures the following principles 'under Section 3 - Principle wise performance disclosure':



ESG Factors considered for evaluation of borrowers

Factors that can be considered for evaluation of Environmental Social and Governance are indicated below:

Social factors cover evaluation around:

- Workforce ethics
- Products and services
- Treatment and welfare of communities

Environmental norms cover following aspects:

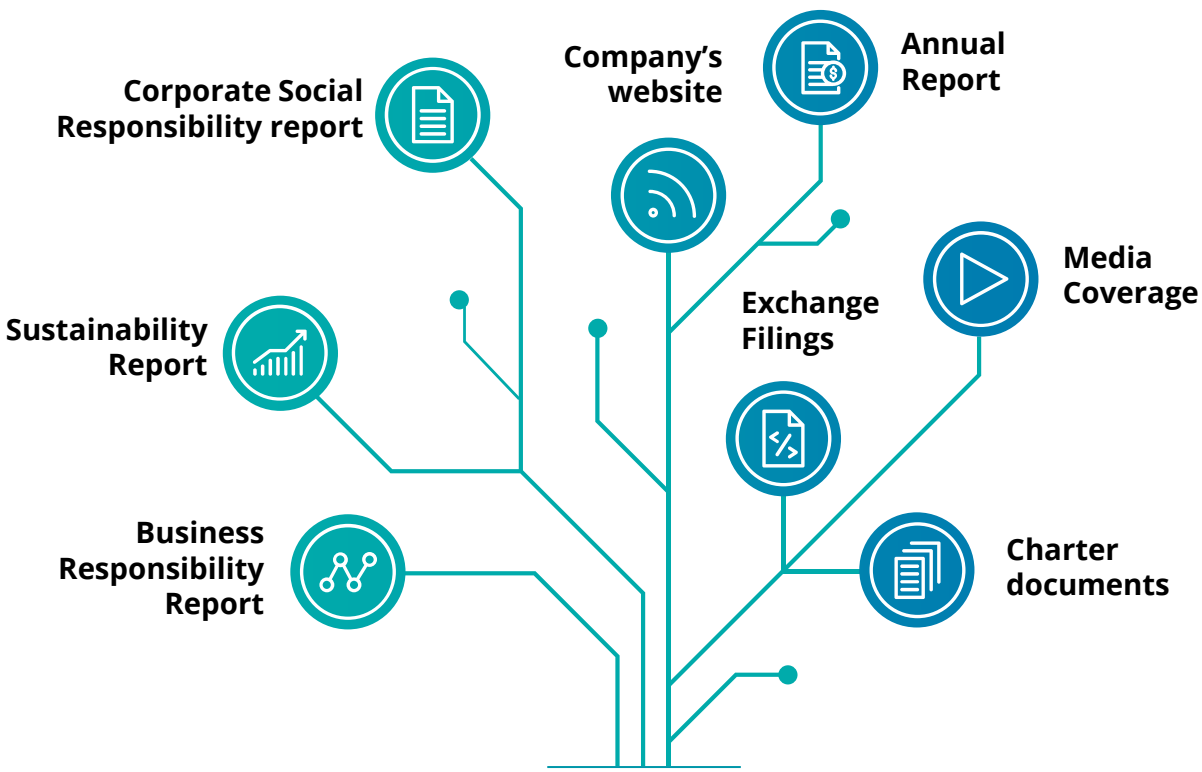
- Water and energy consumption
- Waste management
- Emissions
- Environmental compliance

Governance aspects covers evaluation around:

- Rights and equitable treatment of shareholders
- Disclosures and Transparency
- Responsibilities of the board

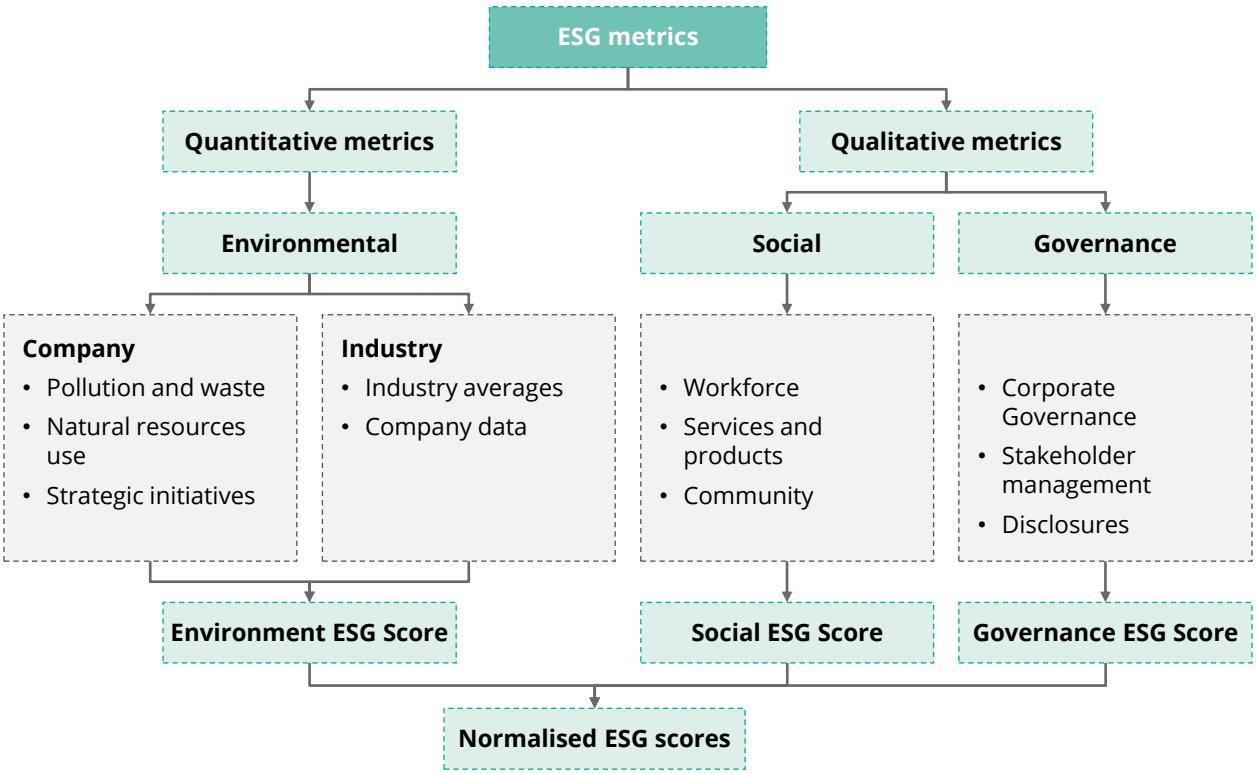
Data sources for evaluation of ESG metrics

- Given that ESG assessment is a relatively new concept, disclosures and availability of information varies across different geographies, and is a known challenge.
- According to the SEBI BRSR expectations, it is mandatory for the top 500 companies to disclose ESG parameters to govern their operations with regards to issues related with environment, social and governance factors.
- Broadly the information for ESG parameters can be extracted from the following sources:



ESG overlay metrices

ESG assessment metrics consider both quantitative and qualitative elements of the concerned borrower.



Environmental factors considered for ESG evaluation

Assessment of environmental parameters help in understanding the company's contribution in climate change and steps taken to mitigate the carbon footprint. The following factors help in assessment of environmental factors:

Greenhouse gases emission:

The GHG Emission parameter includes the direct (emissions from sources owned or controlled by the organisation) and indirect (emissions from purchased or acquired electricity, heating, cooling and steam) greenhouse gases emitted by an organisation.

Water Consumption:

Water consumption measures the amount of water used by an organisation that is no longer available for use by the local community or the ecosystem.

Water Treatment:

Water treatment evaluates the ability of the company to recycle the water and re-use the water thus reducing water consumption

Energy consumption:

This includes non-renewable fuel consumed, renewable fuel consumed, net electricity, net heat, net steam and net cooling consumed

Waste generation and treatment:

The waste parameter monitors the waste generated and is disposed off by the organisation's activities upstream or downstream in its value chain

The assessment of the above factors can be conducted based on disclosures in annual reports and in various environmental permissions and disclosures done by the company on a periodic basis

E S G

E S G

Environment Overlay: Steps to evaluate risk

The environmental overlay incorporates both quantitative and qualitative assessments of the concerned borrower. The environment score calculation is done through a five-step process:

STEP 01

Input data

Input data is required for calculating the performance of the concerned company, and all other companies operating in the same industry

STEP 02

Data evaluation and Parameter Score

- Performance of the concerned company and peers is calculated
- Companies are segregated into the worst-performing and best-performing
- Parameter score is computed based on benchmarking the company with peers

STEP 03

Environment weights matrix

- Weights are assigned to each parameter and are industry-specific
- Weights are based on expert judgement and on the importance / relevance of a particular parameter for the industry

STEP 04

Disclosure weights

- Based on the ease of availability of input data, a disclosure weight is also assigned to the company
- For example, a higher score is assigned to a company if the input data is publicly available

STEP 05

Final Environment score

A final scaled environment score is generated for the concerned company based on a combination of the parameter score, environment weights and disclosure weights

E S G

Social factors considered for ESG evaluation

Assessment of social parameters helps in understanding the company's outlook on workforce welfare and responsibilities towards local communities and consumers. The following factors help in the assessment of these social factors:

Human Rights:
Human rights parameters assess the firm's responsibility for:
- Equal treatment of individuals
- Prohibiting unfair practices
- Diversity inclusion and equality

Healthcare & Safety
These parameters assess the firm's responsibility for:
- Managing healthcare and safety of employees
- Ability to prevent accidents / incidents in workplace

Testing
Assess the firm's responsibility for:
- Quality assurance of product / services
- Responsible testing

Data Privacy
Focus on the firm's responsibility for:
- Ensuring no breaches of customer data take place
- Establishing a protocol to handle cyber attacks and data breach

Responsible Marketing
Help assess the firm's responsibility for:
- Sustainable marketing
- Disclosure of manufacturing processes / raw materials etc.

The assessment of the above factors can be conducted based on disclosures in annual reports and also based on qualitative assessment based on publicly available information

E S G

Governance factors considered for ESG evaluation

Assessment of governance parameters help in understanding the company's view towards minority shareholders and responsibilities of the board in effective governance. The following factors help in the assessment of governance aspects:

Role of stakeholders in corporate governance

A corporate governance framework must ensure active co-operation among the parties involved. The assessment covers:

- Ability of the company to protect the rights of its lenders, creditors, and suppliers with necessary mechanisms.
- Effective mechanism for the company to address the employee welfare and health

Rights and equitable treatment of shareholders

Assessment covers the following aspects:

- Fair and equal treatment of all common equity shareholders
- Framework established for minority shareholders

Disclosures and transparency

The framework covers the company's disclosure and transparency policy which allows investors and other stakeholders to monitor their financial performance and corporate behavior.

Responsibilities of the board

This assessment covers the effectiveness and control of the board in ensuring good governance and effectiveness of policies and framework.

Integration of ESG factors

The final ESG score can be used for credit worthiness assessment, product design, pricing and sales decisions for a borrower. There are options to choose bespoke approaches to arrive at the final ESG score, which can later be integrated with credit underwriting process.

ESG integration strategies

The individual parameter scores under each ESG dimension can be used to integrate in multiple ways to adjust for ESG related risks

Weightages

The different factors under ESG may be assigned specific weights based on their relative importance and judgement of the bank to arrive at the final ESG score

Deflator

Each of the factors under ESG may be used as deflators to reduce the overall credit rating of the borrower.

Individual ESG factors

The individual ESG scores may be used to set the exposure limits for the borrower. For e.g., a borrower which scores low on either or all of the ESG factors may be subject to higher scrutiny during the credit underwriting process.

The Deloitte difference

Key differentiators

Rich experience in financial services: Our experience working with banks on emerging non-financial risks across the last several years has streamlined our approach to how such risks are to be integrated with existing risk management frameworks; be it across policy and governance, identification and assessment, or monitoring and reporting.

Deep expertise in credit rating models: We have worked with the largest banks in India on rating model re-development, aligning model structures to business requirements and leading practices, while ensuring optimal balance between risk assessment and ease of business use

Accelerators and enablers: All this experience, specifically focused on the credit and climate change intersection, has led to the development of this scoring methodology for ESG assessment for credit appraisal; this is supported by working prototypes that can be customised across the methodology to align with banks' credit and ESG strategies

Quant-oriented skill-sets: The team has significant experience in several statistical modelling techniques that can be leveraged to assess and quantify climate risks such as risk modelling, survival analysis, stochastic calculus, multivariate modelling, time series analysis, loss reserving, contingency modelling, and financial analysis

Global expertise and network: Our team that focuses on climate risk considerations is supported by a global network of experts in this area, who have led and delivered transformational engagements at large banks in response to regulatory experiences, as well as liaising with regulatory authorities in shaping expectations related to risk management and disclosures.

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Impact of ESG on Corporate Credit Risk

Rupali Vashisht

Abstract

The paper exploits a panel quantile regression technique to uncover the asymmetric impact of material Environmental, Social, and governance (ESG) ratings on conditional quantiles of US corporate bond spreads. This work contributes to the literature by 1) comparing the ESG-bond spreads relationship between the heavily polluting sample (comprising of bonds belonging to heavily emitting companies) and the lightly polluting sample (comprising of bonds belonging to lightly emitting companies) 2) breaking down the effect of composite ESG ratings into effects of individual weighted pillars of ESG on bond spreads, 3) studying the impact of ESG on bond spreads across quantiles of bond spreads. The novel split-panel jackknife bias-correction approach has been employed to alleviate the bias arising from having a small T relative to N. Three main findings emerge from the analyses. First, improvements in ESG ratings lead to lower spreads due to the risk mitigation effect for brown firms. On the other hand, for green firms, ESG rating upgrades lead to higher spreads. Next, E pillar is the strongest pillar in determining the bond spreads of brown firms. All pillars E, S, and G pillars are important determinants of bond spreads for green firms. Lastly, improvements in ESG ratings are heterogeneous across quantiles.

Keywords: Panel quantile regression, split-panel jackknife bias correction, ESG, credit risk

1 Introduction

Climate risk is broadly categorized into two categories namely, physical risk and transition risk. Physical risks stem from changes in the climate resulting in damage to productive assets. Transition risks stem from the transition to a low-carbon economy. The drivers of physical risks include increasing temperatures, rising sea levels, etc. And, the drivers for transition risks include changes in the policies, technological change geared towards a low-carbon economy, and the overall sentiment of stakeholders (investors, customers, employees, governments, etc.) towards climate change. Climate risk is caused by rising global temperatures that are a result of accumulated greenhouse gases (GHGs) in the atmosphere. According to the United Nations, at the moment the world is heading for a rise in excess of 3°C this century. In response to the climate crisis, the UN has laid out 17 Sustainable Development Goals (SDGs) - these goals are an urgent call for action by all nations of the world.

In light of this urgent call for action and increasing climate risk, sustainability has gained immense traction over the past two decades. For businesses, it is hard to think about sustainability without thinking about ESG. The acronym 'ESG' stands for Environmental (E), Social (S), and Governance (G) which provides investors with an understanding of how a business is doing with respect to various sustainability metrics. Therefore, ESG can be thought of as a means of evaluating a company's sustainability. Other stakeholders including customers, employees, regulators, and governments are also paying attention to the ESG credentials of businesses.

According to Bloomberg, global ESG assets are expected to surpass $53 trillion by 2025 (this figure represents one-third of $140.5 trillion - the projected total assets under management). This transition to a more sustainable way of doing business requires capital. Hence, capital markets play a key role in tackling ESG issues thereby achieving sustainability targets. It is well-documented that climate risks are reflected in the capital structure and the cost of capital of firms. Ginglinger and Moreau (2019) find that post-2015 (Paris climate agreement - implementation of TCFD) high climate

risk firms found it hard to increase their leverage levels compared to low climate risk firms. It is also established that climate risk reflects in the cost of capital - in the form of increased cost of debt and equity (Chava, 2014; Kling et al., 2021; Balvers et al., 2017). ESG too is found to be priced in the capital markets (Ng and Rezaee, 2015; Apergis et al., 2022; Berg et al., 2022).

This study focuses on the impact of ESG performance on bond spreads. There are various channels through which ESG performance affects bond spreads. Theoretically, the direction of the impact of ESG performance on bond spreads can go either way - positive or negative. As per the agency theory, the management is interested in their reputation and self-image and therefore, may over-invest in ESG activities to boost stakeholder support, improve social influence or conceal misconduct of the organization. This results in overspending on corporate social responsibility (CSR) thereby causing the wastage of an organization's limited resources. Over-investment in ESG activities due to the principal-agent problem may eventually cause distrust among stakeholders translating into increased risk and therefore, higher bond spreads. Trade-off theory also suggests that firms investing in ESG initiatives beyond a point may cause organizations to divert their resources away from economically beneficial investment avenues. This may lead to lower cash flows and hence, higher risks causing the bond investors to demand compensation for those risks. On the other hand, investment in ESG activities may also have a reduction effect on bond spreads. Stakeholder theory argues that engaging in ESG activities builds long-term trust with stakeholders. When trust improves, the firm accumulates reputation capital which in turn helps companies to withstand adverse shocks by making the company more resilient. Next, regulatory risks[1] are also easier to deal with for organizations that perform well in ESG. Good ESG credentials also help alleviate concerns regarding potential liabilities arising from operations and legal risks (Apergis et al., 2022). Barth et al. (2022) argue that the association between ESG and firm risks translates

[1]Climate change regulations have the greatest impact on companies, particularly energy-intensive ones (Lian et al., 2023)

into the valuation of credit risk or a firm's probability of default. They highlight that if companies doing well in ESG exhibit higher and more stable cash flows that result in higher asset values, better ESG performers should have lower probabilities of default and hence, lower credit spreads.

Most of the literature in this area, finds that there exists a negative relationship between ESG performance and credit spreads (Barth et al., 2022; Lian et al., 2023; Apergis et al., 2022). However, the relationship between ESG and bond spreads could be much more nuanced and vary across sectors and across the distribution of bond spreads. The direction of the impact of ESG performance on bond spreads may not be negative and equally strong for all types of industries. Moreover, the relationship between ESG and bond spreads can vary along the distribution of bond spreads. As bond spreads carry information about the credit risk associated with the bond, analyzing how ESG interacts with bond spreads at different points along bond spreads' distribution can be insightful. Therefore, to empirically model and estimate the relationship between ESG and bond spreads, the method of moments panel quantile regression approach (developed by Machado and Silva (2019)) has been adopted. Split-panel jackknife bias correction has been applied to alleviate the bias arising from a small T dimension.

This paper contributes to the existing literature in multiple ways. One, it analyzes the impact of ESG on bond spreads for highly polluting (brown) and relatively less polluting (green) samples. Two, the paper analyzes the contribution of individual pillars of the ESG score to changes in the bond spreads. Three, weighted ESG pillars are considered to ensure that the pillars are comparable across industries and the results are generalizable. Finally, the impact of ESG and its pillars on the different points along bond spreads' distribution is analyzed to account for the heterogeneity in the effect of ESG across bond spreads' distribution.

2 Literature Review

First, the literature review considers studies capturing the relationship between climate risk and the cost of capital in general, followed by studies pertaining to the impact of ESG performance on bond spreads.

2.1 Climate risk and cost of capital

To understand how ESG performance (a proxy for firms' efforts towards alleviating climate risks) affects bond spreads, it is important to first understand how climate risks impact firms' cost of capital. Ginglinger and Moreau (2019) study the impact of physical climate risk rating on capital structure and cost of capital. They find that physical climate risk results in lower leverage post-2015 (Paris climate agreement). They attribute this reduction in leverage to an increase in operational costs and expected distress costs resulting from potential climate risks[2]. They find that the reduction in leverage post-2015 is primarily observed for firms with low CSR performance. This suggests that firms with higher CSR performance are better prepared to withstand climate risks. Kim et al. (2015) investigate the impact of carbon risk on the cost of equity. They find that carbon intensity[3], a proxy for carbon risk, is positively associated with the cost of equity. Chava (2014) cover a wide variety of factors (environmental strengths and concerns) that proxy for environmental risks to investigate the impact of a firm's environmental profile on its cost of capital. The main findings of the paper are twofold. One, firms with climate change concerns exhibit a notably higher cost of equity as well as a higher cost of debt capital. Two, the cost of equity and debt capital is not significantly different for firms with environmental strengths compared to firms without these strengths. Kling et al. (2021) analyze the effects of climate-related vulnerability on firms' cost of capital and access to finance in high and

[2]The loss could stem from damage to assets owned by firms because of extreme climate events or reduction in firms' asset values

[3]measured by dividing total carbon emissions by sales

low-climate-risk countries. They construct a climate vulnerability index to instrument for climate vulnerability (to avoid potential endogeneity issues) to gauge the impact of climate vulnerability on firms' cost of debt and equity and access to capital. They find that firms in climate-vulnerable countries have higher financing costs (cost of debt and equity) and, climate-vulnerable countries are financially more constrained i.e. have relatively less access to capital. Chen and Silva Gao (2012) study the relationship between climate risk and measures of the cost of capital. They show that after controlling for a range of factors, climate risk is positively associated with the implied cost of equity and bond yield to maturity spread (a measure of the cost of debt). Morrone et al. (2022) investigate the impact of environmental disclosure on the cost of debt and cost of capital in the energy sector. They show that the impact of environmental disclosure is negative on the cost of debt and the cost of capital. And, the impact of carbon intensity is positive on the cost of debt and cost of capital.

2.2 ESG, firm risk and bond spreads

Recently, the literature on the linkage between ESG performance and credit spreads has gained momentum. The impact of investors' sustainable preferences is also captured by the 'greenium' - the price premium that the investors are willing to pay for green bonds over non-green/conventional bonds. Cheong and Choi (2020) review the literature on green bonds and they find evidence for both - a negative and a positive greenium on green bonds. Hachenberg and Schiereck (2018) provide support for the existence of a positive greenium for bonds with 'A' rating. Zerbib (2019) too provides support for the existence of a small positive greenium for green bonds. By employing a matching method and a two-step regression procedure, they find that on average, the difference between the yield of a green bond and a non-green bond is -2 bps (this implied a positive greenium). Immel et al. (2022) examine if the green bonds exhibit a greenium (or a negative premium) over their non-green counterparts by employing a dummy variable that assumes value '1' if the bond is

green and '0' otherwise. They find that the green bonds yield a negative premium of around 8 to 14 basis points relative to non-green bonds. Moreover, Immel et al. (2022) also explore how ESG ratings affect the spreads of green bonds. They show that higher ESG ratings translate into lower spreads thereby, concluding that the greenness of green bonds matters in determining their spreads.

Apergis et al. (2022) investigates the relationship between the cost of debt (measured as the bond yield spread) and the ESG ratings. Their findings indicate that better ESG ratings are liked to a lower cost of debt. They show that the composite ESG rating as well as the individual pillars namely, 'E','S', and 'G' are associated with a lower bond yield spread. Similarly, Barth et al. (2022) also provide evidence in favor of a negative relationship between ESG performance and credit default swap (CDS) spreads. They also employ quantile regression to examine the possibility of the existence of a U-shaped relationship between the two. Their results show that the relationship between ESG performance and CDS spreads is indeed U-shaped indicating that the risk mitigation effect of ESG performance is maximum at moderate levels. Lian et al. (2023) also adds to the literature in a similar way - by empirically establishing a negative relationship between ESG performance and bond credit spreads. They also show that the relationship is robust to different measures of ESG and after accounting for endogeneity (by utilizing an instrumental variable approach).

There is no evidence of heterogeneity in the impact of ESG on bond spreads across different types of sectors. This is where the main contribution of this paper lies.

3 Data

3.1 Data collection and variable description

Data used in this analysis pertains to corporate bonds issued by companies incorporated in the USA and active (not matured) as of 2nd March 2023. The panel includes 2922 bond-year observations. The bonds included in the sample are fixed-rate, senior,

bullet, unsecured, and conventional (non-green). Green bonds are excluded from the analysis as they were very few and have different properties. Data employed in this analysis is primarily retrieved from Bloomberg. The period considered is from December 2017 to December 2022. The data is annual which implies that 6 years for a cross-section of 487 bonds is analyzed. All missing values and observations with value '0' are excluded from the sample. Observations with abnormal values (such as bonds that reported negative spreads in one or more years) were also excluded from the final sample. The summary statistics and the sectoral distribution of the bonds included in the sample are reported in Table 1. The response variable (ln Lead Spread) is the natural log of one-month ahead bond ask spreads which are essentially the differential between the offering yield to maturity of the corporate bond over the yield of a treasury bond of similar maturity. Since the distribution of credit spread is typically positively skewed, the natural logarithm of the bond spread is employed as the dependent variable in the analysis.

The control variables include bond characteristics and firm characteristics. The bond-level control variables used are Rating - Moody's credit rating (assigned to each bond at the time of issuance), ln ISSUESIZE - the size of the issue, and Maturity (in years) - the maturity of bond. Moody's rating scale ranges from Aaa to C. Each rating has been assigned a numerical value from 1 to 19 - where 1 represents the lowest rating and 19 represents the highest rating. The table reflects a minimum value of 3 indicating that any bonds that were assigned a rating below 3 were dropped while cleaning the data. The average rating is 11.848, indicating that on average, companies are assigned higher credit ratings. The natural logarithm of the issue size has been used. The issue The mean value of Maturity is 24.107 indicating that the sample largely consists of very long-term bonds.

The firm-level controls comprise ROA - return on assets ratio (measure of profitability), ICR - interest coverage ratio (measure of the ability of a company to honor its repayment obligations), Growth - sales growth (measure of a company's growth),

LEV - total debt to total assets ratio (measure of how leveraged the business is), and ln Mkt Cap - natural logarithm of market capitalization of a company (measure of the size of a company).

Year-end values (values as of 31st December of each year) for all independent variables are considered, while bond spread values are taken from one month after the year-end (values as of 31st January of the next year). This has been done to allow sufficient time for the market to account for the independent variables in their decision making and to alleviate any concerns around endogeneity.

Table 2 presents the correlations between the variables employed in the analysis. It can be noticed that the bond spread is correlated with all control variables in the expected way. It is positively correlated with maturity and leverage, while it is negatively correlated with rating, profitability, interest coverage ratio, growth, size and size of the issue. Interestingly, the bond spread is also negatively correlated with the composite ESG score, which indicates that bonds belonging to companies with high ESG scores exhibit lower spreads. However, for the individual weighted pillar scores, it is observed that while bond spreads exhibit a negative correlation with the weighted S and G pillars, it has a positive correlation with the weighted E pillar.

3.2 ESG Ratings (Scores)

Bloomberg's ESG scores and their individual pillars i.e. E, S, and G are the variables of interest in this analysis. Bloomberg assigns these ESG scores to companies annually, assessing how effectively they manage financially material ESG issues. Since financial materiality varies across industries, Bloomberg assigns weights to various sub-issues based on their relevance to the industry group.

To calculate the composite ESG scores, Bloomberg uses a weighted shifted power-mean (p-mean) methodology. First, sub-issue weights and scores are aggregated to determine the issue scores. Then, these issue scores are again weighted according to their industry materiality and combined, to arrive at the pillar scores. Finally, the

pillar weights and scores are aggregated to derive the overall composite ESG score.

Investors can make more informed investment decisions based on ESG performance when financial materiality is considered (Madison and Schiehll, 2021). The composite ESG scores provided by Bloomberg are computed after taking into account pillar weights anad therefore financial materiality. While, the individual pillar scores reported by Bloomberg are not comparable across industries unless adjusted (using pillar weights) to reflect their financial materiality to the industry group. So, in this study, pillar weights and pillar scores are combined using the weighted shifted p-mean methodology used by Bloomberg to arrive at the weighted pillar scores. And, composite ESG score is employed as it is reported. The summary statistics for these scores are reported in Table 1.

3.3 Sample selection and descriptive statistics

In this study, three samples are analysed. The first sample analysed is the full sample (consisting of 2,922 bond-year observations) as described in section 3.1. The full sample is divided into two sub-samples i.e. brown (heavily polluting) and green (less polluting) based on emission intensity (Classification-1). Emission intensity has been widely used in the literature to measure how green the company is (In et al., 2017; Garvey et al., 2018; Bauer et al., 2022). Emission intensity is computed as the ratio of total CO2 equivalent emissions in a year normalized by the revenues of the company in that year. These emission intensities are then averaged across all years to arrive at the average emission intensity for each company. Following Garvey et al. (2018), based on the average emission intensity, the bonds with an emission intensity above the 70th percentile are categorized as brown and, bonds with an emission intensity below the 30th percentile are categorized as green. The summary statistics for these two sub-samples are presented in Table 3.

Table 4 reports two correlation matrices - one for the brown sample (Panel A) and one for green sample (Panel B). The correlation coefficient between bond spread

and composite ESG score is negative for brown sample while it is positive for green sample. Similarly, the correlation coefficient between bond spread and the weighted E pillar score is negative for brown sample and positive for green sample. This result implies that brown firms with high composite ESG score and weighted E pillar score tend to have lower spreads while the opposite is true for green firms.

On the other hand, both brown and green samples exhibit a positive correlation coefficient between bond spreads and weighted S pillar scores. Finally, the correlation coefficient between bond spreads and the weighted G pillar score is positive for brown sample and negative for the green sample.

4 Empirical Methodology

4.1 Panel fixed effects model

To uncover the impact of ESG on bond spreads for different samples, this study employs a panel data fixed effect estimation technique. The panel data fixed effect estimation allows to quantify the change in bond spreads (within variation) caused by changes in the ESG ratings while taking into account the effect any observed as well as time-invariant unobserved bond characteristics. Due to the fact that bond effects are taken into account, any unobserved characteristics relating to the industry or the firm (to which the bond belongs) are also accounted for. Apart from the bond-level fixed effects, time dummies are also included in the model to account for any time (year) related shocks that may have occurred. Hausman's specification test has also been conducted to select if the random effects or the fixed effects model fits the data better. The results of the Hausman test indicate that a fixed effects model is the appropriate choice. Therefore, the following fixed effects models are estimated:

$$\ln(\text{LeadSpread})_{i(t+1)} = \beta_0 + \beta_1 \text{CompositeESGScore}_{it} + \beta_2 \text{ROA}_{jt} + \beta_3 \text{ICR}_{it} + \beta_4 \text{Growth}_{it} + \beta_5 \text{LEV}_{it} + \beta_6 \ln(\text{MktCap})_{it} + \alpha_i + \mu_t + \epsilon_{it} \quad (1)$$

$$\ln(\text{LeadSpread})_{i(t+1)} = \beta_0 + \beta_1 \text{WeightedEPillar}_{it} + \beta_2 \text{WeightedSPillar}_{it} + \beta_3 \text{WeightedGPillar}_{it} + \beta_4 \text{ROA}_{it} + \beta_5 \text{ICR}_{it} + \beta_6 \text{Growth}_{it} \beta_7 \text{LEV}_{it} + \beta_8 \ln(\text{MktCap})_{it} + \alpha_i + \mu_t + \epsilon_{it} \quad (2)$$

In the equations above, α_i and μ_t denote bond-specific and time-specific fixed effects, respectively. The dependent variable i.e. $ln(LeadSpread)_{i(t+1)}$ denotes the lead spread measured one month ahead of the measurement date of the right hand side variables.

4.2 Panel quantile fixed effect model

The longitudinal fixed effects models described by equations 1 and 2 fail to capture the differences in the relationship between bond spreads and ESG across the different segments of the distribution of bond spreads. This is problematic if the distribution of the response variable (bond spreads in this case) is not normal[4]. Quantile regression on the other hand, makes no assumptions about the distribution of the response variable. Quantile regression enables estimation of the impact of the explanatory variables on the response variable across various points (quantiles) along the distribution of the latter. So, panel quantile regression estimation was done to model the impact of ESG on bond spreads at different quantiles (ranging from 10th quantile to 90th quantile). This paper makes use of the Method of Moments Panel Quantile Regression

[4]Jarque-Bera test was conducted to check for normality of the distribution of bond spreads. The results indicated that the bond spread distribution is not normal.

(with individual fixed effects) estimator developed by Machado and Silva (2019). This estimator estimates the conditional quantiles for a location-scale model which can be expressed as follows:

$$\mathrm{Y_{it}} = \alpha_{\mathrm{i}} + \mathrm{X'_{it}}\beta + (\rho_{\mathrm{i}} + \mathrm{D_{it}}\theta)\epsilon_{\mathrm{it}} \tag{3}$$

Y_{it} denotes the ln Lead Spread. α_i and ρ_i denote bond specific effects for every bond 'i'. X_{it} denotes the vector of the time-varying independent variables. D_{it} denotes a vector of known differentiable transformations of X_{it}. $Pr(\rho_i + D_{it}\theta > 0 = 1)$. ϵ_{it} is i.i.d across 'i' and 't', satisfies the moment conditions and is independent of X_{it} statistically. Next, equation 3 can be used to express conditional quantiles as follows:

$$\mathrm{Q_Y}(\tau|\mathrm{X_{it}}) = (\alpha_{\mathrm{i}} + \rho_{\mathrm{i}}\mathrm{q}(\tau)) + \mathrm{X'_{it}}\beta + \mathrm{D'_{it}}\theta\mathrm{q}(\tau) \tag{4}$$

Using equation 4, the impact of ESG on bond spreads is assessed across the conditional distribution of the latter. An important feature of this model is that the quantile-τ fixed effects, representing the time-invariant bond characteristics, captured by $\alpha_i + \rho_i q(\tau)$ have different effects on different segments of the conditional distribution of bond spreads. Split-panel jackknife bias correction proposed by Dhaene and Jochmans (2015) has been utilized to alleviate the concerns about bias caused by incidental parameters problem. Implementation of this technique also enables credible inference when bias arising from moderate values of T is present (Machado and Silva, 2019).

5 Empirical Results

In the ensuing tables, pooled OLS fixed effect results are presented alongside the results of panel quantile fixed effects model results based on model 4 after implementing split-panel jackknife bias correction. This enables clear comparison between panel

OLS FE results and results across quantiles. Column (1) presents results based on model 1 if impact of composite ESG on bond spreads is studied, and model 2 if impact of ESG's individual weighted pillars is being studied.

Table 5 presents the impact of ESG on bond spreads for the full sample. The pooled OLS fixed effects regression resuts in column (1) show negative (but insignificant) impact of the composite ESG rating on lead bond spread. However, panel quantile regression results show evidence of a negative and significant impact of ESG ratings on bond spreads in the first three columns (corresponsing to the 10th, 20th and the 30th quantiles). This result implies that at lower values of spreads (spreads below 30th percentile), higher ESG ratings of the company are associated with low risk associated with bonds thereby, causing the investors to accept lower returns on bonds resulting in lower spreads. The bonds having lower spreads are more likely to be from larger corporations that are highly capitalized which signals that, ESG ratings are a matter of consideration for companies having a large market share. This result is plausible as Zumente and Lāce (2021) point out that larger companies typically have more resources to formulate sustainability policies, leading to higher ESG scores. If that is the case, it is also more likely to reduce information asymmetry about larger corporations compared to their smaller peers - which reflects in Table 5 results.

Table 1: Summary statistics: Full Sample

Panel A: Descriptive Statistics

Variable	Obs	Mean	Std. dev.	Min	Max
Weighted E Pillar	2,922	0.792	0.229	0.176	1.293
Weighted S Pillar	2,922	0.742	0.174	0.192	1.418
Weighted G Pillar	2,922	0.890	0.109	0.530	1.153
Composite ESG Score	2,922	4.912	0.885	1.580	7.470
ln Lead Spread	2,922	5.023	0.544	1.751	7.628
Maturity (in years)	2,922	24.107	8.292	5.000	50.000
Rating	2,922	11.848	1.951	3.000	19.000
ROA	2,922	3.044	6.548	-30.946	32.666
ICR	2,922	4.698	8.956	-34.583	74.169
Growth	2,922	2.309	21.460	-64.863	233.828
LEV	2,922	36.125	15.335	9.894	243.874
ln ISSUESIZE	2,922	18.650	1.941	14.255	22.572
ln Mkt Cap	2,922	10.856	1.131	6.414	14.874

Panel B: Sectoral Distribution

	Frequency	%
Sector		
Communications	222	8%
Consumer Discretionary	204	7%
Consumer Staples	174	6%
Healthcare	216	7%
Industrials	1,488	51%
Materials	144	5%
Oil&Gas	144	5%
Real Estate	30	1%
Technology	126	4%
Utilities	174	6%
Total	2,922	100%

Notes: This table presents the summary statistics of bond-year observations for the full sample. The sample period is from December 2017 to December 2022 and the frequency of observations is annual. The sample comprises 147 US corporate bonds. Panel A presents the descriptive statistics for all the variables for the full sample. Panel B presents the sectoral distribution of the bond-year observations.

Table 2: Correlation matrix: Full sample

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1	Maturity (in years)	1												
2	Rating	-0.0377	1											
3	ROA	0.3497	0.2996	1										
4	ICR	0.2817	0.419	0.6492	1									
5	Growth	0.1412	0.0235	0.3031	0.1991	1								
6	LEV	0.1982	-0.2922	0.2246	-0.0632	-0.0296	1							
7	ln Mkt Cap	0.0311	0.494	0.1967	0.2177	0.0161	-0.0841	1						
8	ln ISSUESIZE	0.5997	0.0155	0.4775	0.3544	0.165	0.2834	0.1578	1					
9	Composite ESG Score	-0.2956	0.1983	-0.1924	-0.0862	-0.0424	-0.2744	0.0974	-0.3543	1				
10	Weighted E Pillar	-0.0145	-0.0941	-0.0282	-0.0176	0.0252	0.0177	-0.1689	-0.1731	0.4963	1			
11	Weighted S Pillar	-0.0816	0.1803	0.0249	0.0103	-0.0027	-0.0978	0.2758	0.0614	0.251	-0.5936	1		
12	Weighted G Pillar	-0.3475	0.2701	-0.3215	-0.1313	-0.1342	-0.3612	0.0987	-0.352	0.2976	-0.2932	0.0918	1	
13	ln Lead Spread	0.0798	-0.5778	-0.4208	-0.3343	-0.1068	0.051	-0.4357	-0.2446	-0.0464	0.1108	-0.1469	-0.0848	1

Notes: This table presents the correlation matrices for variables employed in the study. The sample comprises 147 US corporate bonds observed annually from December 2017 to December 2022.

Table 3: Summary statistics: Brown and Green sub-samples (based on classification-1)

Panel A: Descriptive Statistics

Classification-1: based on emissions' intensity (EI)

	Brown Sample: High EI (sample with bonds above 70th percentile of EI)				Green Sample: Low EI (sample with bonds below 30th percentile of EI)				
Variable	Obs	Mean	Std. dev.	Min	Max	Obs	Mean	Std. dev.	Min	Max
Weighted E Pillar	366	1.058	0.124	0.590	1.293	396	0.672	0.271	0.251	1.193
Weighted S Pillar	366	0.564	0.138	0.192	1.065	396	0.804	0.167	0.527	1.418
Weighted G Pillar	366	0.843	0.123	0.643	1.134	396	0.886	0.092	0.730	1.028
Composite ESG Score	366	5.099	0.770	2.270	6.830	396	4.611	0.819	3.210	6.350
ln Lead Spread	366	5.055	0.449	3.731	6.533	396	4.870	0.605	2.110	6.149
Maturity (in years)	366	27.049	6.756	12.000	50.000	396	29.455	9.792	10.000	50.000
Rating	366	11.180	1.468	6.000	14.000	396	11.667	2.172	8.000	15.000
ROA	366	4.711	8.200	-30.946	29.718	396	4.348	5.813	-8.310	16.570
ICR	366	4.438	7.349	-24.658	74.169	396	6.377	9.330	-11.117	33.762
Growth	366	8.112	28.004	-64.863	233.828	396	2.960	21.061	-40.269	104.899
LEV	366	38.551	9.337	12.868	58.355	396	39.383	14.086	9.894	60.988
ln ISSUESIZE	366	19.017	1.601	14.745	21.129	396	20.267	1.052	16.090	22.572
ln Mkt Cap	366	10.430	0.922	7.528	11.989	396	11.369	0.793	9.379	12.712
E Weight	366	45.176	2.699	38.460	50.000	396	28.445	11.099	11.110	45.450
S Weight	366	26.073	6.435	12.500	38.460	396	40.749	9.625	27.270	55.560
G Weight	366	28.745	4.103	23.080	37.500	396	30.801	2.460	27.270	33.330

Panel B: Sectoral Distribution

Brown Sample			Green Sample		
	Frequency	%		Frequency	%
Sector			Sector		
Industrials	90	25%	Communications	30	8%
Materials	72	20%	Consumer Discretionary	66	17%
Oil&Gas	96	26%	Consumer Staples	18	5%
Utilities	108	30%	Healthcare	90	23%
Total	366	100%	Industrials	126	32%
			Technology	66	17%
			Total	396	100%

Notes: This table presents the summary statistics of bond-year observations for the brown sample (sample with bonds belonging to companies with emission intensity above 70th percentile) and green sample (sample with bonds belonging to companies with emission intensity below 30th percentile). The sample period is from December 2017 to December 2022 and the frequency of observations is annual. The brown sample comprises 61 US corporate bonds and the green sample comprises 66 US corporate bonds. Panel A presents the descriptive statistics for all the variables for the full sample. Panel B presents the sectoral distribution of the bond-year observations.

Table 4: Correlation matrices for Brown and Green samples

Panel A: Correlation matrix for Brown sample

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1	Maturity	1.000												
2	Rating	-0.047	1.000											
3	ROA	0.073	0.312	1.000										
4	ICR	0.090	0.330	0.666	1.000									
5	Growth	0.056	-0.111	0.277	0.284	1.000								
6	LEV	-0.020	-0.077	-0.372	-0.382	-0.007	1.000							
7	ln Mkt Cap	-0.378	0.637	0.347	0.208	-0.027	0.134	1.000						
8	ln ISSUESIZE	0.734	-0.011	0.127	0.125	0.044	0.037	-0.209	1.000					
9	Composite ESG Score	-0.443	-0.050	-0.143	-0.162	0.098	0.247	0.200	-0.321	1.000				
10	Weighted E Pillar	-0.454	-0.088	-0.096	-0.075	0.085	0.229	0.270	-0.306	0.879	1.000			
11	Weighted S Pillar	-0.178	0.235	0.007	0.018	0.083	0.237	0.316	-0.184	0.455	0.303	1.000		
12	Weighted G Pillar	0.101	-0.235	-0.093	-0.160	-0.050	-0.161	-0.363	0.121	-0.101	-0.206	-0.831	1.000	
13	ln Lead Spread	0.446	-0.572	-0.298	-0.154	0.038	0.143	-0.645	0.242	-0.127	-0.118	-0.237	0.222	1

Panel B: Corrrelation matrix for Green sample

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1	Maturity	1.000												
2	Rating	-0.349	1.000											
3	ROA	-0.164	0.399	1.000										
4	ICR	-0.104	0.344	0.590	1.000									
5	Growth	-0.035	0.087	0.305	0.261	1.000								
6	LEV	0.142	-0.609	-0.144	-0.320	-0.096	1.000							
7	ln Mkt Cap	-0.029	0.556	0.278	0.172	0.124	-0.508	1.000						
8	ln ISSUESIZE	-0.262	0.122	0.029	-0.056	0.013	-0.023	-0.005	1.000					
9	Composite ESG Score	-0.042	-0.094	-0.328	-0.219	0.227	0.056	-0.071	0.180	1.000				
10	Weighted E Pillar	0.231	-0.536	-0.499	-0.112	-0.158	0.346	-0.435	-0.085	0.551	1.000			
11	Weighted S Pillar	-0.258	0.369	0.353	-0.076	0.422	-0.156	0.357	0.209	0.183	-0.667	1.000		
12	Weighted G Pillar	-0.284	0.729	0.192	0.055	0.102	-0.624	0.495	0.203	-0.066	-0.674	0.470	1.000	
13	ln Lead Spread	0.574	-0.701	-0.384	-0.359	-0.104	0.507	-0.485	-0.102	0.077	0.415	-0.316	-0.500	1.000

Notes: This table presents the correlation matrices for brown and green samples. Panel A presents correlation matrices of variables for the brown sample. Panel B presents correlation matrices of variables for the green sample.

Table 5: Impact of ESG on bond spreads: Full sample

	OLS	10th quantile	20th quantile	30th quantile	40th quantile	50th quantile	60th quantile	70th quantile	80th quantile	90th quantile
DV: ln Lead Bond Spread										
ESG	-0.028	-0.075***	-0.058**	-0.044**	-0.033	-0.028	-0.022	-0.012	0.002	0.018
	(0.017)	(0.021)	(0.026)	(0.021)	(0.020)	(0.021)	(0.019)	(0.016)	(0.012)	(0.015)
ROA	-0.015***	-0.017***	-0.017***	-0.016***	-0.015***	-0.015***	-0.015***	-0.014***	-0.014***	-0.013***
	(0.002)	(0.003)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
ICR	0.005***	0.004**	0.005***	0.005***	0.005***	0.005***	0.006***	0.006***	0.006***	0.006***
	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
GROWTH	0.0001	0.001***	0.001***	0.0004	0.0002	0.0001	-0.0001	-0.0003	-0.0006**	-0.001***
	(0.0003)	(0.0004)	(0.0003)	(0.0003)	(0.0002)	(0.0002)	(0.0003)	(0.0002)	(0.0003)	(0.0003)
LEV	0.005***	0.004**	0.004***	0.005***	0.005***	0.005***	0.005***	0.006***	0.006***	0.006***
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
ln(MKTCAP)	-0.089***	-0.088***	-0.088***	-0.089***	-0.089***	-0.089***	-0.090***	-0.090***	-0.091***	-0.091***
	(0.009)	(0.013)	(0.012)	(0.009)	(0.007)	(0.009)	(0.008)	(0.009)	(0.012)	(0.008)
Constant	5.782***									
	(0.138)									
t2	0.499***	0.439***	0.461***	0.479***	0.492***	0.499***	0.506***	0.519***	0.537***	0.558***
	(0.016)	(0.015)	(0.016)	(0.021)	(0.016)	(0.014)	(0.019)	(0.016)	(0.016)	(0.021)
t3	0.110***	0.244***	0.195***	0.155***	0.126***	0.110***	0.093***	0.064***	0.022	-0.024
	(0.017)	(0.012)	(0.025)	(0.023)	(0.014)	(0.014)	(0.016)	(0.019)	(0.016)	(0.019)
t4	0.116***	0.170***	0.150***	0.134***	0.122***	0.116***	0.109***	0.098***	0.081***	0.062***
	(0.024)	(0.028)	(0.030)	(0.025)	(0.025)	(0.018)	(0.025)	(0.023)	(0.029)	(0.023)
t5	0.149***	0.211***	0.189***	0.170***	0.157***	0.149***	0.142***	0.128***	0.109***	0.088***
	(0.024)	(0.032)	(0.035)	(0.026)	(0.019)	(0.023)	(0.022)	(0.021)	(0.024)	(0.027)
t6	0.224***	0.284***	0.262***	0.244***	0.231***	0.224***	0.217***	0.204***	0.185***	0.165***
	(0.029)	(0.039)	(0.029)	(0.026)	(0.028)	(0.028)	(0.024)	(0.024)	(0.027)	(0.028)
Bond FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents the regression results based on Equation 1 and results of panel quantile fixed effects model after split-panel jackknife bias correction based on model 4. The dependent variable (DV) is the natural logarithm of one-month-ahead bond spreads. The explanatory variables are Environmental, Social, and Governance ratings provided by Bloomberg (ESG), Return on Assets (ROA), Interest Coverage Ratio (ICR), Sales growth (GROWTH), Total debt to total assets (LEV), the natural logarithm of market capitalization (ln(MKTCAP)), and dummy variables for each year t2-t6. The sample includes 487 US corporate bonds from year 2017 to 2022. All the variables are described in Table 1. The standard errors are reported in parentheses. All model specifications include fixed -effects at the bond level.
*,**,*** signify the significance levels at 10, 5 and 1% thresholds, respectively.

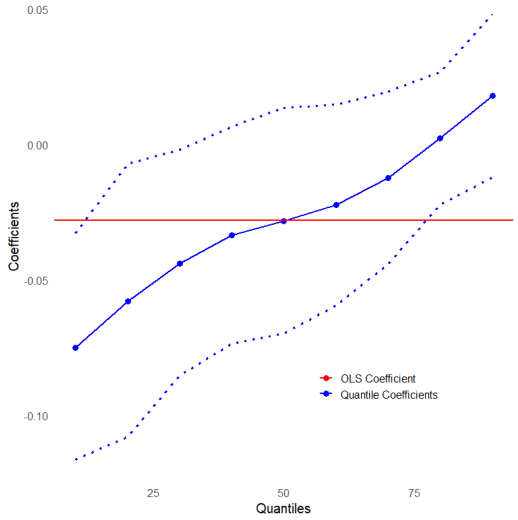

Figure 1: ESG Score coefficients across quantiles for full sample

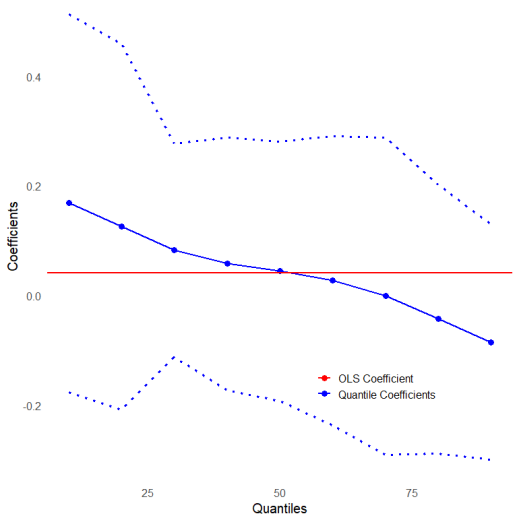

Figure 2: E Score coefficients across quantiles for full sample

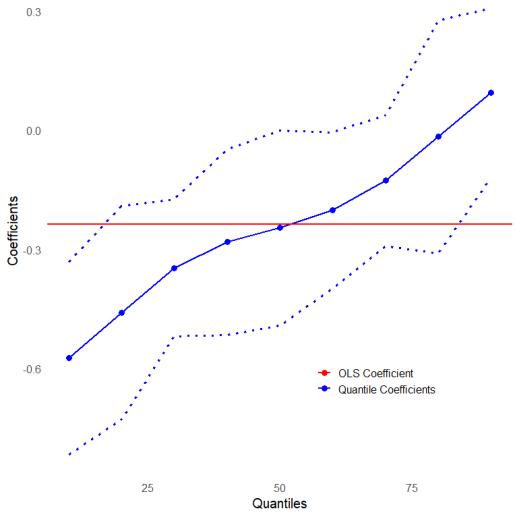

Figure 3: S Score coefficients across quantiles for full sample

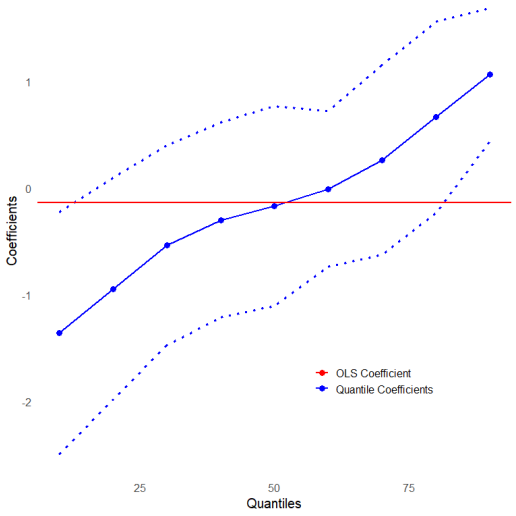

Figure 4: G Score coefficients across quantiles for full sample

Table 6 presents the impact of the individual weighted pillars (E, S, and G) of ESG on bond spreads for the full sample. Column (1) reveals that the weighted S pillar is the only significant pillar in influencing the bond spread. This result is similar to the findings of Li and Adriaens (2024), who also find that only S pillar bears an impact on bond spreads when a mix of companies from different industries are analysed.

The results in Table 6 indicate that a one-point increase in the weighted S pillar will lead to a 0.237 decrease in the average bond spread. The effect of weighted E and G pillars is insignificant. However, the panel quantile regression results show that the impact of the weighted G pillar is significant only at the tails (extreme quantiles) of the bond spread distribution. The effect is only signficant at the 10th, 20th and the 90th quantiles. Interestingly, at the 10th and the 20th quantile the effect of the weighted G pillar on the bond spreads is negative while it is positive at the 90the quantile. This implies that the investors reward improvements in the weighted G pillar, by accepting lower returns on bonds, only at lower values of spread. At higher values of spread, investors penalize improvements in weighted G pillar by demanding higher returns on bonds, thereby leading to higher spreads. Panel quantile regression results also show that the effect of weighted S pillar on bond spreads is negative and significant only for values of bond spread below 70th percentile. The effect becomes smaller with each successive quantile.

Table 7 presents the impact of composite ESG on bond spreads for the brown sample. From column (1), it is evident that the impact of ESG on is negative and stronger than observed for the full sample (in Table 5). The panel quantile regression results indicate that the impact of ESG on bond spread is increasing in quantiles i.e. the impact becomes stronger at higher quantiles. This monotonicity in the coefficient of ESG implies that the impact of ESG on bond spreads is larger(smaller) for higher(lower) values of bond spreads. This result is in line with quite a few studies conducted in this area (Lian et al., 2023; Li et al., 2024). This shows that investors accept lower(higher) return on their bonds when ESG ratings are high(low) in case of brown/heavily emitting companies and, this relationship is more robust in case of bond with higher spreads.

Table 6: Impact of weighted E, S, and G pillars on bond spreads: Full sample

	OLS	10th quantile	20th quantile	30th quantile	40th quantile	50th quantile	60th quantile	70th quantile	80th quantile	90th quantile
DV: ln Lead Bond Spread										
Weighted E pillar	0.041	0.169	0.126	0.083	0.058	0.045	0.028	-0.001	-0.043	-0.085
	(0.122)	(0.176)	(0.170)	(0.099)	(0.118)	(0.121)	(0.134)	(0.148)	(0.125)	(0.109)
Weighted S pillar	-0.237**	-0.574***	-0.460***	-0.347***	-0.282**	-0.246**	-0.201**	-0.126	-0.016	0.095
	(0.112)	(0.124)	(0.137)	(0.088)	(0.119)	(0.125)	(0.100)	(0.084)	(0.150)	(0.109)
Weighted G pillar	-0.136	-1.356**	-0.942*	-0.534	-0.298	-0.168	-0.006	0.266	0.665	1.066***
	(0.423)	(0.579)	(0.531)	(0.478)	(0.466)	(0.477)	(0.373)	(0.454)	(0.456)	(0.318)
ROA	-0.015***	-0.018***	-0.017***	-0.016***	-0.015***	-0.015***	-0.015***	-0.014***	-0.014***	-0.013***
	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.003)
ICR	0.005***	0.005***	0.005***	0.005***	0.005***	0.005***	0.005***	0.005***	0.006***	0.006***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
GROWTH	0.0001	0.001***	0.001	0.0003**	0.0002	0.0001	-0.00002	-0.0002	-0.0005	-0.001*
	(0.0003)	(0.0003)	(0.0004)	(0.0002)	(0.0003)	(0.0003)	(0.0003)	(0.0004)	(0.0003)	(0.0004)
LEV	0.006***	0.006***	0.006***	0.006***	0.006***	0.006***	0.006***	0.006***	0.006***	0.006***
	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
ln(MKTCAP)	-0.085***	-0.068***	-0.074***	-0.080***	-0.083***	-0.085***	-0.087***	-0.091***	-0.096***	-0.102***
	(0.011)	(0.015)	(0.007)	(0.011)	(0.010)	(0.011)	(0.012)	(0.013)	(0.009)	(0.011)
Constant	5.849***									
	(0.360)									
t2	0.498***	0.435***	0.456***	0.477***	0.490***	0.496***	0.505***	0.519***	0.539***	0.560***
	(0.016)	(0.016)	(0.020)	(0.017)	(0.013)	(0.016)	(0.017)	(0.020)	(0.019)	(0.028)
t3	0.102***	0.218***	0.179***	0.140***	0.118***	0.105***	0.090***	0.064***	0.026***	-0.012
	(0.018)	(0.028)	(0.019)	(0.023)	(0.013)	(0.018)	(0.021)	(0.021)	(0.016)	(0.018)
t4	0.109***	0.129***	0.122***	0.115***	0.111***	0.109***	0.106***	0.102***	0.095***	0.088***
	(0.025)	(0.027)	(0.030)	(0.025)	(0.023)	(0.025)	(0.031)	(0.021)	(0.019)	(0.027)
t5	0.141***	0.181***	0.167***	0.154***	0.146***	0.142***	0.137***	0.128***	0.115***	0.102***
	(0.025)	(0.024)	(0.032)	(0.029)	(0.021)	(0.025)	(0.020)	(0.028)	(0.024)	(0.025)
t6	0.212***	0.242***	0.232***	0.222***	0.216***	0.213***	0.209***	0.202***	0.192***	0.183***
	(0.030)	(0.031)	(0.043)	(0.028)	(0.031)	(0.027)	(0.024)	(0.034)	(0.025)	(0.034)
Bond FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents the regression results based on Equation 2 and results of panel quantile fixed effects model after split-panel jackknife bias correction based on model 4. The dependent variable (DV) is the natural logarithm of one-month-ahead bond spreads. The explanatory variables are weighted E, S, and G pillar provided by Bloomberg, Return on Assets (ROA), Interest Coverage Ratio (ICR), Sales growth (GROWTH), Total debt to total assets (LEV), the natural logarithm of market capitalization (ln(MKTCAP)), and dummy variables for each year t2-t6. The sample includes 487 US corporate bonds from year 2017 to 2022. All the variables are described in Table 1. The standard errors are reported in parentheses. All model specifications include fixed -effects at the bond level.
*,**,*** signify the significance levels at 10, 5 and 1% thresholds, respectively.

Table 7: Impact of composite ESG ratings on bond spreads: Brown sample

	OLS	10th quantile	20th quantile	30th quantile	40th quantile	50th quantile	60th quantile	70th quantile	80th quantile	90th quantile
DV: ln Lead Bond Spread										
ESG	-0.115**	-0.045	-0.083**	-0.098*	-0.105**	-0.115**	-0.123***	-0.139***	-0.149***	-0.176***
	(0.048)	(0.067)	(0.042)	(0.054)	(0.049)	(0.052)	(0.040)	(0.041)	(0.045)	(0.044)
ROA	-0.0001	-0.0004	-0.0002	-0.0002	-0.0001	-0.0001	-0.00002	0.0001	0.0001	0.0003
	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)	(0.005)	(0.002)	(0.003)
ICR	0.005**	0.008**	0.006**	0.006*	0.006*	0.005*	0.005	0.005*	0.004*	0.003
	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.004)
GROWTH	-0.0005	-0.0001	-0.0003***	-0.0004	-0.0004	-0.0005	-0.001	-0.001**	-0.001	-0.001*
	(0.0004)	(0.001)	(0.001)	(0.0005)	(0.0004)	(0.001)	(0.0004)	(0.0003)	(0.001)	(0.0005)
LEV	0.009**	0.015***	0.012***	0.011***	0.010***	0.009**	0.009***	0.007	0.006*	0.004
	(0.004)	(0.005)	(0.004)	(0.004)	(0.003)	(0.004)	(0.003)	(0.005)	(0.003)	(0.003)
ln(MKTCAP)	-0.336***	-0.130	-0.242***	-0.287***	-0.308***	-0.338***	-0.361***	-0.408***	-0.440***	-0.520***
	(0.090)	(0.118)	(0.089)	(0.086)	(0.102)	(0.095)	(0.109)	(0.115)	(0.112)	(0.091)
Constant	8.538***									
	(1.070)									
t2	0.307***	0.546***	0.416***	0.364***	0.339***	0.305***	0.279***	0.224***	0.187***	0.094**
	(0.037)	(0.056)	(0.043)	(0.044)	(0.046)	(0.040)	(0.039)	(0.029)	(0.022)	(0.039)
t3	0.243***	0.346***	0.290***	0.268***	0.257***	0.242***	0.231***	0.207***	0.191***	0.151***
	(0.054)	(0.084)	(0.066)	(0.051)	(0.060)	(0.051)	(0.044)	(0.058)	(0.040)	(0.059)
t4	0.285***	0.305***	0.294***	0.290***	0.288***	0.285***	0.283***	0.278***	0.275***	0.267***
	(0.074)	(0.095)	(0.072)	(0.076)	(0.074)	(0.082)	(0.071)	(0.074)	(0.052)	(0.066)
t5	0.256***	0.206***	0.233***	0.244***	0.249***	0.257***	0.262***	0.274***	0.282***	0.301***
	(0.080)	(0.080)	(0.079)	(0.070)	(0.094)	(0.081)	(0.079)	(0.083)	(0.083)	(0.096)
t6	0.316***	0.363***	0.337***	0.327***	0.322***	0.315***	0.310***	0.299***	0.292***	0.274***
	(0.077)	(0.089)	(0.079)	(0.066)	(0.076)	(0.079)	(0.057)	(0.063)	(0.078)	(0.057)
Bond FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents the regression results based on Equation 1 and results of panel quantile fixed effects model after split-panel jackknife bias correction based on model 4. The dependent variable (DV) is the natural logarithm of one-month-ahead bond spreads. The explanatory variables are Environmental, Social, and Governance ratings provided by Bloomberg (ESG), Return on Assets (ROA), Interest Coverage Ratio (ICR), Sales growth (GROWTH), Total debt to total assets (LEV), the natural logarithm of market capitalization (ln(MKTCAP)), and dummy variables for each year t2-t6. The sample includes 61 US corporate bonds from year 2017 to 2022. All the variables are described in Table 3. The standard errors are reported in parentheses. All model specifications include fixed -effects at the bond level.
*,**,*** signify the significance levels at 10, 5 and 1% thresholds, respectively.

Table 8 presents the impact of the individual weighted pillars (E, S, and G) of ESG on bond spreads. From column (1), it can be observed that weighted E pillar is significant and negative. While weighted S and weighted G pillars are insignificant. This result implies that a one-point increase in the weighted E pillar leads to a 0.579 point decrease in the average bond spread. This result is in line with the findings in the literature that the E pillar has a negative relationship with the cost of debt (Apergis et al., 2022). However, it is important to note that the effect of E pillar on bond spread is not even across all quantiles. The panel quantile regression results reveal that the weighted E pillar has a significant and stronger (more negative) impact on the bond spreads at higher quantiles (50th to 90th). This result indicates that the weighted E pillar becomes an important determinant of corporate bond spread at higher spreads. This finding implies that while the impact of weighted E pillar is insignificant at lower quantiles of bond spreads, for more risky bonds (bonds corresponding to higher spreads), this impact is significant and more profound. Panel qunatile regression results also indicate that weighted G pillar has a positive and significant impact on bond spreads at lower quantiles (10th to 40th). This result suggests that an improvement in weighted G pillar causes the average bond spread to increase - investors demand higher returns on their bonds when weighted G pillar rating improves. This result is not unique as Jang et al. (2020) find that improvement in G score leads to increase in bond returns. They highlight that this result is plausible as any efforts to improve corporate governance undertaken by the management are viewed negatively by the bond holders, these efforts primarily benefit the equity holders (Klock et al., 2005). This result is also observed in Table 6 for the right-hand extreme quantile of the full sample.

Table 8: Impact of E, S, and G on bond spreads: Brown sample

	OLS	10th quantile	20th quantile	30th quantile	40th quantile	50th quantile	60th quantile	70th quantile	80th quantile	90th quantile
DV: ln Lead Bond Spread										
Weighted E pillar	-0.579**	0.109	-0.216	-0.424	-0.490	-0.627***	-0.681**	-0.792***	-0.995***	-1.222***
	(0.275)	(0.557)	(0.350)	(0.304)	(0.353)	(0.207)	(0.269)	(0.280)	(0.224)	(0.189)
Weighted S pillar	-0.317	-0.151	-0.229	-0.279	-0.295	-0.328	-0.341	-0.368	-0.417	-0.472
	(0.334)	(0.391)	(0.353)	(0.334)	(0.356)	(0.400)	(0.345)	(0.365)	(0.439)	(0.470)
Weighted G pillar	1.502	4.130**	2.891**	2.094	1.841*	1.320	1.111	0.688	-0.086	-0.954
	(1.056)	(1.859)	(1.344)	(1.380)	(1.024)	(1.124)	(1.026)	(1.117)	(0.807)	(0.831)
ROA	-0.00001	0.001	0.0005	0.0002	0.0001	-0.0001	-0.0001	-0.0003	-0.001	-0.001
	(0.003)	(0.005)	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)	(0.005)	(0.002)
ICR	0.006**	0.007	0.007**	0.006**	0.006**	0.006*	0.006**	0.005*	0.005*	0.004*
	(0.002)	(0.006)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)
GROWTH	-0.001	-0.0001	-0.0003	-0.0004	-0.0005	-0.001	-0.001	-0.001	-0.001**	-0.001
	(0.0004)	(0.001)	(0.001)	(0.001)	(0.0004)	(0.0004)	(0.001)	(0.0004)	(0.0003)	(0.001)
LEV	0.009**	0.018***	0.014***	0.011**	0.010***	0.008***	0.008*	0.006**	0.003	0.0004
	(0.004)	(0.007)	(0.005)	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)	(0.005)	(0.004)
ln(MKTCAP)	-0.371***	-0.197**	-0.279***	-0.332***	-0.348***	-0.383***	-0.397***	-0.425***	-0.476***	-0.533***
	(0.089)	(0.097)	(0.095)	(0.084)	(0.080)	(0.106)	(0.092)	(0.115)	(0.122)	(0.121)
Constant	7.852***									
	(1.455)									
t2	0.296***	0.503***	0.406***	0.343***	0.323***	0.281***	0.265***	0.232***	0.170***	0.102***
	(0.039)	(0.059)	(0.044)	(0.045)	(0.044)	(0.046)	(0.043)	(0.039)	(0.029)	(0.030)
t3	0.245***	0.289***	0.268***	0.255***	0.250***	0.241***	0.238***	0.231***	0.217***	0.203***
	(0.055)	(0.075)	(0.069)	(0.061)	(0.055)	(0.052)	(0.054)	(0.057)	(0.062)	(0.043)
t4	0.284***	0.274**	0.278***	0.281***	0.282***	0.284***	0.285***	0.287***	0.290***	0.293***
	(0.075)	(0.121)	(0.090)	(0.070)	(0.079)	(0.071)	(0.080)	(0.079)	(0.074)	(0.051)
t5	0.250***	0.130	0.187**	0.223***	0.235***	0.259***	0.268***	0.288***	0.323***	0.363***
	(0.080)	(0.117)	(0.092)	(0.085)	(0.073)	(0.082)	(0.079)	(0.087)	(0.082)	(0.076)
t6	0.305***	0.254**	0.278***	0.294***	0.299***	0.309***	0.313***	0.321***	0.336***	0.353***
	(0.078)	(0.121)	(0.091)	(0.085)	(0.073)	(0.064)	(0.078)	(0.059)	(0.062)	(0.073)
Bond FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents the regression results based on Equation 2 and results of panel quantile fixed effects model after split-panel jackknife bias correction based on model 4. The dependent variable (DV) is the natural logarithm of one-month-ahead bond spreads. The explanatory variables are weighted E, S, and G pillar provided by Bloomberg, Return on Assets (ROA), Interest Coverage Ratio (ICR), Sales growth (GROWTH), Total debt to total assets (LEV), the natural logarithm of market capitalization (ln(MKTCAP)), and dummy variables for each year t2-t6. The sample includes 61 US corporate bonds from year 2017 to 2022. All the variables are described in Table 3. The standard errors are reported in parentheses. All model specifications include fixed -effects at the bond level.
*,**,*** signify the significance levels at 10, 5 and 1% thresholds, respectively.

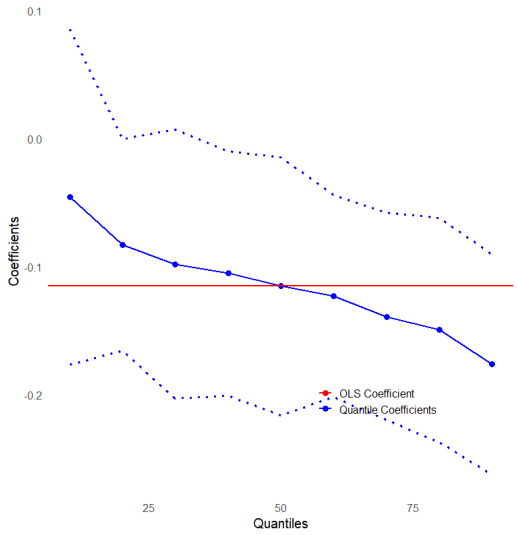

Figure 5: ESG Score coefficients across quantiles for brown sample

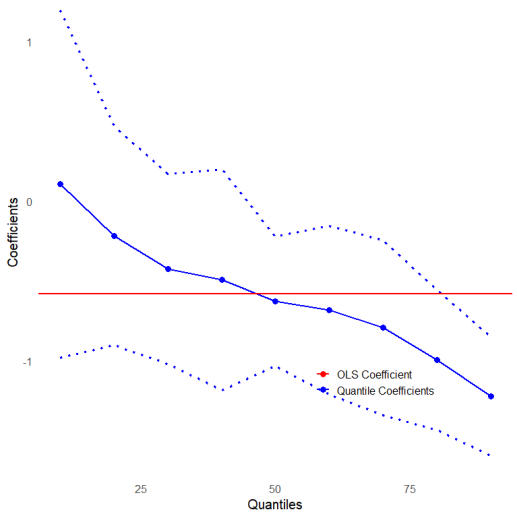

Figure 6: E Score coefficients across quantiles for brown sample

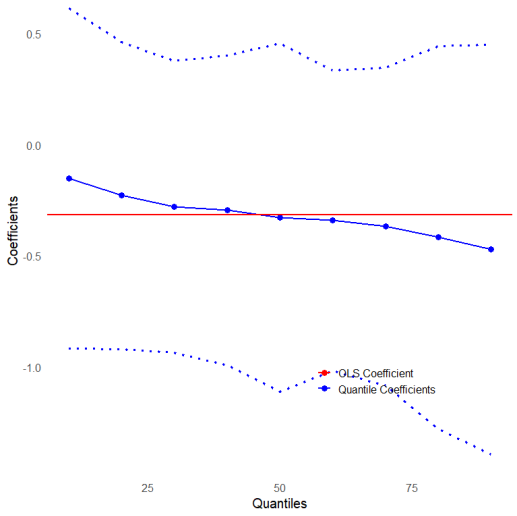

Figure 7: S Score coefficients across quantiles for brown sample

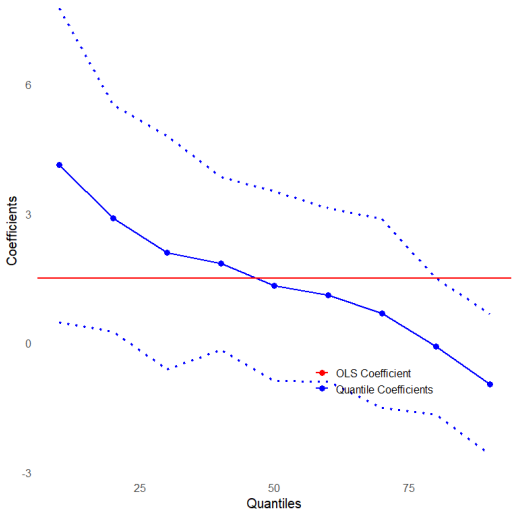

Figure 8: G Score coefficients across quantiles for brown sample

Table 9 presents the impact of ESG on bond spreads for the green sample. There is a clear contrast between the results presented in Table 7 for brown sample and results presented in Table 9 for green sample. Column (1) result indicates that the composite ESG score has a positive and significant impact on bond spreads. There is scant evidence pertaining to sectoral differences in the impact of ESG on

bond spreads. However, some studies (Li and Adriaens, 2024; Halling et al., 2021) acknowledge that there could be heterogeneities in the relationship between ESG and bond spreads based on the industrial composition of the sample being studied. The results presented in Table 9 somewhat correspond to the results in Li and Adriaens (2024). Li and Adriaens (2024) find that the impact of ESG on bond spreads is positive for a sample comprising the consumer staples, consumer discretionary and the health care sectors. The sectors comprising the green sample employed here account for 45% of the entire sample. Palmieri et al. (2023) find that companies operating in brown sectors (energy, industrials, and materials) have a significant positive impact on the probability of default of companies. Whereas, companies operating in green sectors (such communications, technology, health, consumer staples, and consumer discretionary products) have no statistically significant impact on probability of default. They highlight that this result may stem from the fact that brown sectors are intrinsically more exposed to sustainability issues. This finding and the rationale behind it affirms that since green sectors are at a lower risk of default, investors deem green sectors as safe/low risk[5]. So, any efforts directed towards addressing ESG related issues are considered wasteful and therefore, penalized by investors. The coefficients of ESG across quantiles are monotonically increasing but do not increase steeply. This indicates that the quantile effect (caused by the location effect) is negligible and not as great as it is in case of the brown sample.

Table 10 presents the impact of E, S, and G on bond spreads for the green sample. Column (1) results indicate that all weighted individual pillars exert a positive impact of bond spreads. The weighted governance pillar affects the bond spreads the most followed by the weighted E pillar and the weighted S pillar. Columns (2) to (10) indicate that the effect of weighted E pillar is decreasing with quantiles. It highlights that bonds with lower spreads in the green sample are more strongly affected by the

[5]It is is also evident from Table 3 that brown sample has a wider mean spread compared to the green sample which indicates that investors demand a higher return on brown companies' bonds compared to green companies' bonds.

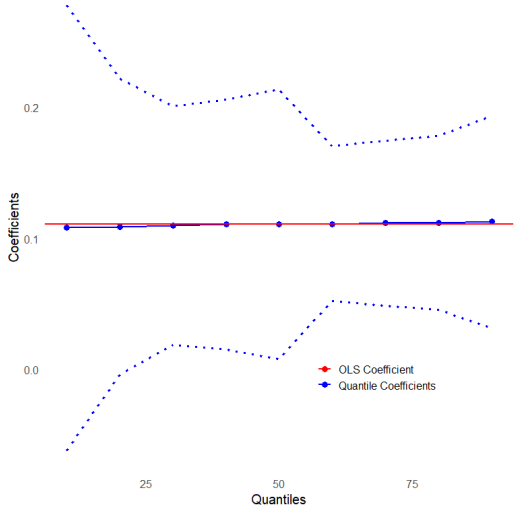

Figure 9: ESG Score coefficients across quantiles for green sample

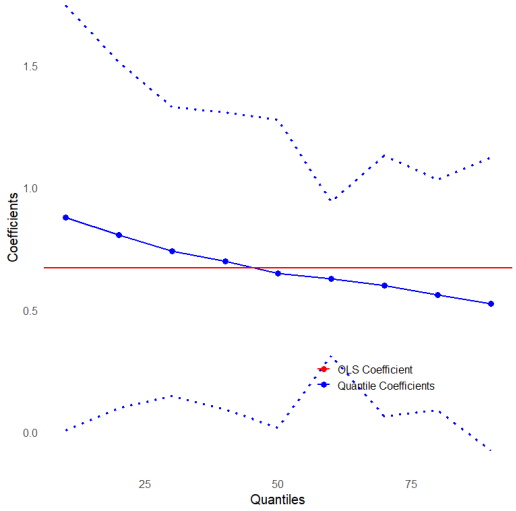

Figure 10: E Score coefficients across quantiles for green sample

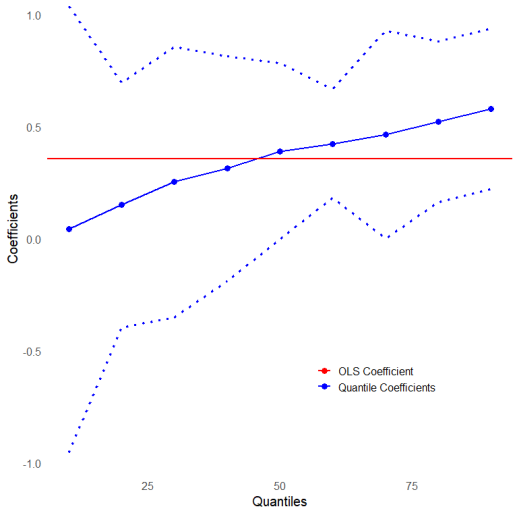

Figure 11: S Score coefficients across quantiles for green sample

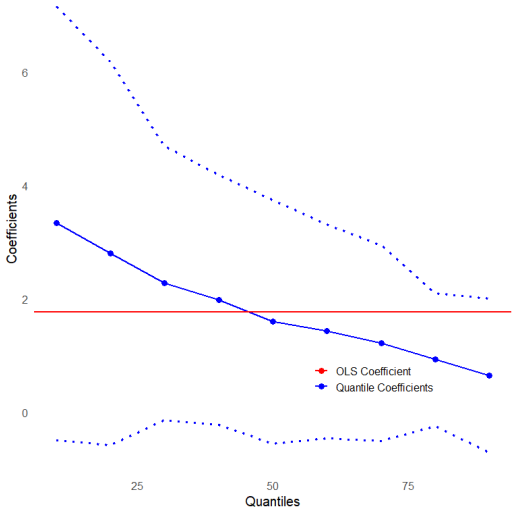

Figure 12: G Score coefficients across quantiles for green sample

weighted E pillar compared to bonds with high spreads. This implies that firms with lower spreads (indicating firms having a very low credit risk) are penalized more for making efforts to address their environmental issues. This is in line with the rationale behind investors penalizing firms (in form of demanding higher returns) for making efforts to improve their ESG performance. A similar result is obtained for weighted G

pillar - the coefficient of the weighted G pillar decreases with the quantiles. However, it is only significant for the 30th and 40th quantiles. Interestingly, the coefficient of weighted S pillar is higher at higher quantiles and significant only for quantiles above the 40th (50th quanilte onwards). This finding indicates that the impact of the weighted S pillar on bond spreads becomes tangible only for values of bond spread above the median (or equivalently for high values of bond spreads indicating relatively high risk bonds). Equivalently, high risk bonds bear higher penalty for improving their weighted S pillar.

Table 9: Impact of ESG on bond spreads: Green sample

	OLS	10th quantile	20th quantile	30th quantile	40th quantile	50th quantile	60th quantile	70th quantile	80th quantile	90th quantile
DV: ln Lead Bond Spread										
ESG	0.111**	0.108	0.109*	0.110**	0.111**	0.111**	0.111***	0.112***	0.112***	0.113***
	(0.042)	(0.087)	(0.058)	(0.047)	(0.049)	(0.052)	(0.030)	(0.032)	(0.034)	(0.041)
ROA	-0.019***	-0.030***	-0.026***	-0.023***	-0.020***	-0.019***	-0.017***	-0.015***	-0.013***	-0.012***
	(0.003)	(0.009)	(0.007)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.004)	(0.004)
ICR	-0.0003	0.007	0.004	0.002	-0.00001	-0.001	-0.002	-0.003	-0.004	-0.006**
	(0.002)	(0.005)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
GROWTH	-0.001*	-0.005***	-0.004**	-0.003*	-0.002**	-0.001	-0.001	0.000005	0.001	0.001
	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.0005)	(0.001)
LEV	0.001***	0.011***	0.010***	0.009***	0.008**	0.007***	0.007***	0.006***	0.005**	0.005**
	(0.002)	(0.004)	(0.003)	(0.003)	(0.004)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
ln(MKTCAP)	-0.044	0.038	0.008	-0.016	-0.041	-0.048	-0.062*	-0.074***	-0.089***	-0.104***
	(0.033)	(0.049)	(0.058)	(0.031)	(0.033)	(0.033)	(0.033)	(0.027)	(0.028)	(0.029)
Constant	4.569***									
t2	0.424***	0.457***	0.445***	0.436***	0.426***	0.423***	0.417***	0.412***	0.406***	0.400***
	(0.038)	(0.058)	(0.049)	(0.038)	(0.032)	(0.032)	(0.043)	(0.030)	(0.047)	(0.037)
t3	0.083**	0.246***	0.186***	0.139***	0.090*	0.075***	0.046	0.022	-0.007	-0.036
	(0.034)	(0.073)	(0.057)	(0.037)	(0.035)	(0.029)	(0.034)	(0.028)	(0.038)	(0.044)
t4	-0.039	0.028	0.003	-0.016	-0.036	-0.042	-0.054	-0.064*	-0.076	-0.088
	(0.048)	(0.089)	(0.059)	(0.051)	(0.049)	(0.044)	(0.046)	(0.036)	(0.058)	(0.063)
t5	0.021	0.183*	0.123*	0.077	0.027	0.013	-0.015	-0.040	-0.068*	-0.098**
	(0.049)	(0.101)	(0.066)	(0.053)	(0.051)	(0.052)	(0.050)	(0.039)	(0.037)	(0.049)
t6	-0.033	-0.063	-0.052	-0.044	-0.034	-0.032	-0.026	-0.022	-0.017	-0.011
	(0.064)	(0.120)	(0.097)	(0.079)	(0.071)	(0.067)	(0.049)	(0.041)	(0.042)	(0.049)
Bond FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents the regression results based on Equation 1 and results of panel quantile fixed effects model after split-panel jackknife bias correction based on model 4. The dependent variable (DV) is the natural logarithm of one-month-ahead bond spreads. The explanatory variables are Environmental, Social, and Governance ratings provided by Bloomberg (ESG), Return on Assets (ROA), Interest Coverage Ratio (ICR), Sales growth (GROWTH), Total debt to total assets (LEV), the natural logarithm of market capitalization (ln(MKTCAP)), and dummy variables for each year t2-t6. The sample includes 66 US corporate bonds from year 2017 to 2022. All the variables are described in Table 3. The standard errors are reported in parentheses. All model specifications include fixed -effects at the bond level.
*,**,*** signify the significance levels at 10, 5 and 1% thresholds, respectively.

Table 10: Impact of E, S, and G on bond spreads: Green sample

	OLS	10th quantile	20th quantile	30th quantile	40th quantile	50th quantile	60th quantile	70th quantile	80th quantile	90th quantile
DV: ln Lead Bond Spread										
Weighted E pillar	0.671**	0.877**	0.806**	0.739**	0.699**	0.649**	0.627***	0.599**	0.561**	0.525*
	(0.271)	(0.444)	(0.361)	(0.302)	(0.310)	(0.321)	(0.161)	(0.272)	(0.240)	(0.306)
Weighted S pillar	0.356*	0.043	0.151	0.254	0.313	0.391*	0.423***	0.466**	0.523***	0.579***
	(0.206)	(0.508)	(0.279)	(0.308)	(0.256)	(0.201)	(0.124)	(0.237)	(0.183)	(0.183)
Weighted G pillar	1.770*	3.336	2.799	2.283*	1.984*	1.597	1.432	1.219	0.931	0.652
	(1.036)	(1.952)	(1.723)	(1.232)	(1.124)	(1.098)	(0.961)	(0.879)	(0.599)	(0.690)
ROA	-0.017***	-0.025***	-0.023***	-0.020***	-0.019***	-0.017***	-0.016***	-0.015***	-0.013***	-0.012***
	(0.004)	(0.006)	(0.004)	(0.005)	(0.004)	(0.003)	(0.004)	(0.004)	(0.003)	(0.004)
ICR	-0.003	0.001	0.00002	-0.001	-0.002	-0.003	-0.004	-0.004	-0.005**	-0.006
	(0.003)	(0.004)	(0.003)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)	(0.004)
GROWTH	-0.001	-0.004***	-0.003**	-0.002***	-0.002*	-0.001	-0.0005	-0.00002	0.001	0.001*
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
LEV	0.006***	0.009**	0.008***	0.007***	0.007**	0.006***	0.006***	0.005**	0.005****	0.004**
	(0.002)	(0.004)	(0.003)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
ln(MKTCAP)	-0.056*	0.024	-0.003	-0.030	-0.045	-0.065*	-0.074**	-0.085***	-0.099**	-0.114***
	(0.033)	(0.049)	(0.055)	(0.047)	(0.034)	(0.039)	(0.031)	(0.029)	(0.040)	(0.041)
Constant	2.966***									
	(0.969)									
t2	0.424***	0.484***	0.463***	0.444***	0.432***	0.418***	0.411***	0.403***	0.392***	0.382***
	(0.038)	(0.049)	(0.038)	(0.041)	(0.026)	(0.034)	(0.038)	(0.033)	(0.017)	(0.047)
t3	0.083**	0.240***	0.186***	0.134***	0.105***	0.066	0.049*	0.028	-0.001	-0.029
	(0.034)	(0.053)	(0.050)	(0.044)	(0.035)	(0.041)	(0.027)	(0.039)	(0.035)	(0.049)
t4	-0.028	0.093	0.051	0.012	-0.012	-0.041	-0.054	-0.071	-0.093	-0.114
	(0.053)	(0.076)	(0.070)	(0.065)	(0.050)	(0.049)	(0.045)	(0.053)	(0.057)	(0.070)
t5	0.041	0.242**	0.173**	0.106	0.068	0.018	-0.003	-0.030	-0.067	-0.103**
	(0.054)	(0.098)	(0.069)	(0.080)	(0.058)	(0.069)	(0.039)	(0.054)	(0.045)	(0.047)
t6	-0.022	-0.036	-0.031	-0.027	-0.024	-0.021	-0.019	-0.018	-0.015	-0.013
	(0.067)	(0.119)	(0.105)	(0.080)	(0.070)	(0.064)	(0.035)	(0.061)	(0.052)	(0.058)
Bond FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents the regression results based on Equation 2 and results of panel quantile fixed effects model after split-panel jackknife bias correction based on model 4. The dependent variable (DV) is the natural logarithm of one-month-ahead bond spreads. The explanatory variables are weighted E, S, and G pillar provided by Bloomberg, Return on Assets (ROA), Interest Coverage Ratio (ICR), Sales growth (GROWTH), Total debt to total assets (LEV), the natural logarithm of market capitalization (ln(MKTCAP)), and dummy variables for each year t2-t6. The sample includes 66 US corporate bonds from year 2017 to 2022. All the variables are described in Table 3. The standard errors are reported in parentheses. All model specifications include fixed -effects at the bond level.
*,**,*** signify the significance levels at 10, 5 and 1% thresholds, respectively.

6 Robustness Checks

6.1 Robustness check - I: Using an alternate classification criterion

In this section, the results using an alternate classification of green and brown are presented. This classification is broader but it shares many similar features with the classification based on emission intensity. In this classification, the full sample is divided into brown and green based on the weight assigned to the E and S pillars of the composite ESG score (Classification-2). The pillar weights indicate the materiality/relevance of each pillar to the company. For example, Bloomberg assigns a high E pillar weight of 45.45% to Apache Corp (an Oil & Gas prodcution and exploration company). This is because it a member company of a sector that has a very high impact on the physical environment through its operations. So, the ESG issues that are most relevant to the company's materiality are those related to the environmental pillar or the 'E' of the ESG score. Therefore, companies that are heavily weighted on E are also typically those that have the highest environmental impact. These companies are classified as brown. On the other hand, a company such as Pfizer Inc has a heavy weight of 55.56% on the social pillar or 'S' of the ESG score and only a small weight of 11.11% on the E pillar. This is because Pfizer Inc is a biotechnology and pharamaceutical company and for a pharma company its social impact (that is captured by the S pillar) is the most important. The S pillar considers topics like inequality, working conditions, human rights, product safety, etc. Since product safety is the most consequential issue for a pharma company, the S pillar has the highest weight attached to it. Companies having a high weight on S, automaically have a low weight on E implying that these companies are relatively less environmentally sensitive or greener. Therefore, we use pillar weights as the classification criteria to verify if the results observed for brown and green samples still hold. Companies having a pillar weight of 40% or higher on E are classified as brown. And, companies having a pillar weight of 40% or higher on S are classified as green. These companies are termed green as they have a much

smaller mean E weight of 22.48 as opposed to 44.63 for brown sample (refer to Table 11) implying that environmental issues are in general not a matter of great concern for such companies. This is also the case for classification 1, where the mean E weight for the brown sample is 45.18% while it is 28.45% for the green sample and the mean S weight for the brown sample is 26.07% and 40.75% for the green sample. The summary statistics and the sectoral distribution of bonds for the above classification are reported in Table 11.

Apart from the similarity in average pillar weights across the two classification criteria, the evolution of the average composite ESG scores over time is also similar (see Figure 13 and 14). The average ESG score curve for brown sample is above the green samples' ESG score curve for both classifications.

The average ln lead bond spreads' curves, the individual weighted pillar scores are also similar for sub-samples created in both classifications.

Tables 12 and 13 present the results of sub-samples (brown and green) created based on classification 2. It can be observed from the summary statistics reported in Table 11 that the total number of observations in the brown sample is 882 and in the green sample is 720 which is much greater compared to classification 1 (3). This implies that the sub-samples in Classification 2 are much broader compared to classification 1. As a result, the brown sub-sample (in classification 2) can be expected to include firms that are less brown while the green sub-sample (in classification 2) can be expected to include firms that are less green. Following this, it is plausible that the results obtained using this alternate classification are broadly similar but not the same.

From Table 12, the impact of ESG on bond spreads for brown sample (sample with heavy E) has been presented. It can be observed that the coefficient of ESG is negative and significant in column (1) presenting OLS results as well as in columns (2) to (10) presenting the panel quantile regression results. This shows that improvements

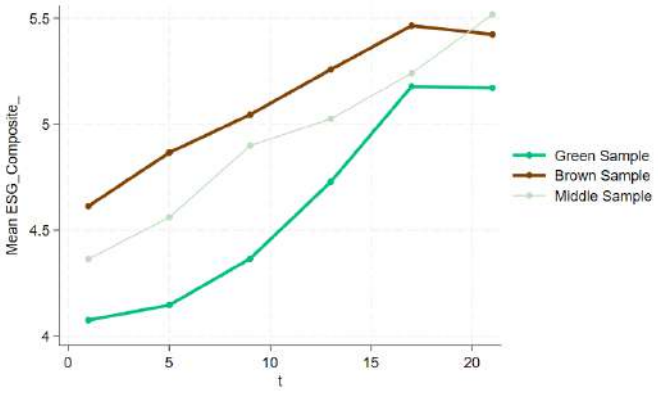

Figure 13: ESG Score across time for brown, green, and unclassified(middle) sample: classifcation-1

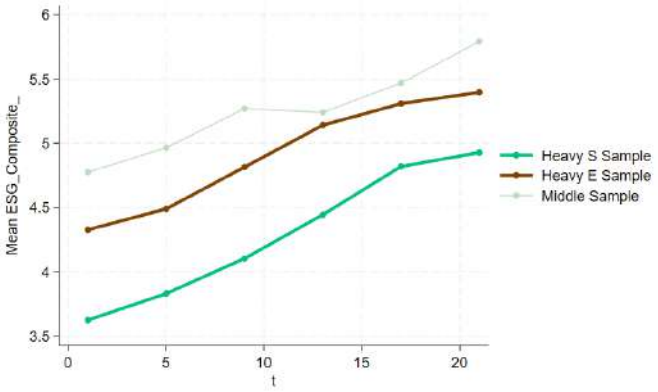

Figure 14: ESG Score across time for brown, green, and unclassified(middle) sample: classifcation-2

in the ESG score result in a decrease in credit risk associated with bonds belonging to brown industries. This result is strong(significant) across the distribution of bond spreads.

Table 13 presents the impact of ESG on bond spreads for the green sample (sample with heavy S). The coefficient of ESG is positive and significant in column (1) presenting the OLS results and in columns (2) through (10) presenting the results of panel quantile regression. This implies that improvements in the ESG score result in an increase in the credit risk associated with the bonds belonging to the green industries.

Table 11: Summary statistics: Brown and Green sub-samples (based on classification-2)

Panel A: Descriptive Statistics

	Classification-2: based on pillar weights								
	Heavy E weight (sample with bonds above 40% weight assigned to pillar E)					Heavy S weight (sample with bonds above 40% weight assigned to pillar S)			
Variable	Obs	Mean	Std. dev.	Min	Max	Obs	Mean	Std. dev.	Min	Max
Weighted E Pillar	882	1.010	0.150	0.533	1.293	720	0.513	0.197	0.176	0.836
Weighted S Pillar	882	0.595	0.134	0.192	0.894	720	0.908	0.196	0.558	1.418
Weighted G Pillar	882	0.817	0.118	0.566	1.153	720	0.871	0.099	0.530	1.028
Composite ESG Score	882	4.912	0.949	2.090	6.980	720	4.292	0.896	1.580	7.470
ln Lead Spread	882	5.052	0.463	2.992	6.533	720	4.922	0.656	1.751	7.628
Maturity (in years)	882	28.061	7.470	5.000	50.000	720	27.842	7.721	10.000	50.000
Rating	882	11.354	1.750	6.000	14.000	720	11.550	2.968	3.000	19.000
ROA	882	5.156	6.588	-30.946	29.718	720	4.833	6.090	-18.001	27.353
ICR	882	5.678	7.217	-32.443	74.169	720	6.525	11.601	-34.583	59.781
Growth	882	7.395	21.765	-62.866	233.828	720	4.115	20.020	-50.058	104.899
LEV	882	39.414	11.542	14.401	77.724	720	36.373	10.570	9.894	68.877
ln ISSUESIZE	882	19.380	1.494	14.745	22.292	720	20.190	0.855	18.084	21.976
ln Mkt Cap	882	10.419	0.928	7.351	12.460	720	11.277	1.349	6.414	14.874
E WEIGHT	882	44.634	2.601	40.000	50.000	720	22.482	7.908	11.110	33.330
S WEIGHT	882	26.969	5.492	12.500	33.330	720	47.385	5.865	40.000	55.560
G WEIGHT	882	28.391	3.536	25.000	37.500	720	30.129	2.758	25.000	33.330

Panel B: Sectoral Distribution

Brown Sample			Green Sample		
	Frequency	%		Frequency	%
Sector			Sector		
Consumer Discretionary	108	12%	Communications	222	31%
Consumer Staples	96	11%	Consumer Discretionary	42	6%
Industrials	168	19%	Healthcare	216	30%
Materials	144	16%	Industrials	132	18%
Oil&Gas	144	16%	Technology	108	15%
Real Estate	30	3%	Total	720	100%
Technology	18	2%			
Utilities	174	20%			
Total	882	100%			

Table 12: Impact of ESG on bond spreads: Brown sample (Heavy E)

	OLS	10th quantile	20th quantile	30th quantile	40th quantile	50th quantile	60th quantile	70th quantile	80th quantile	90th quantile
DV: ln Lead Bond Spread										
ESG	-0.073***	-0.086***	-0.081***	-0.077***	-0.074***	-0.073***	-0.072***	-0.069***	-0.065***	-0.062**
	0.022	0.031	0.019	0.019	0.022	0.024	0.027	0.022	0.024	0.027
ROA	0.0003	0.002	0.001	0.001	0.0005	0.0003	0.0001	-0.0002	-0.001	-0.001
	0.002	0.002	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.003
ICR	0.0001	0.002	0.001	0.001	0.0003	0.0001	-0.0001	-0.0005	-0.001	-0.001
	0.002	0.002	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002
GROWTH	-0.001	-0.001	-0.001*	-0.001*	-0.001***	-0.001***	-0.001**	-0.001**	-0.001**	-0.001
	0.0004	0.001	0.0004	0.0004	0.0003	0.0003	0.0004	0.0004	0.0004	0.001
LEV	0.007**	0.006**	0.006***	0.007***	0.007***	0.007***	0.007***	0.007**	0.007*	0.007**
	0.003	0.003	0.002	0.002	0.002	0.002	0.003	0.003	0.004	0.003
ln(MKTCAP)	-0.279***	-0.348***	-0.320***	-0.298***	-0.285***	-0.277***	-0.269***	-0.255***	-0.236***	-0.216***
	0.044	0.052	0.060	0.048	0.037	0.046	0.033	0.048	0.042	0.046
Constant	7.865									
	0.492									
t2	0.301***	0.400***	0.360***	0.328***	0.309***	0.298***	0.288***	0.268***	0.240***	0.212***
	0.021	0.030	0.026	0.024	0.025	0.016	0.019	0.024	0.019	0.024
t3	0.186***	0.328***	0.271***	0.224***	0.198***	0.182***	0.167***	0.138***	0.098***	0.057
	0.027	0.038	0.030	0.034	0.028	0.025	0.032	0.036	0.032	0.035
t4	0.205***	0.245***	0.229***	0.216***	0.209***	0.204***	0.200***	0.192***	0.181***	0.170***
	0.040	0.049	0.036	0.043	0.044	0.032	0.044	0.050	0.045	0.044
t5	0.200***	0.270***	0.242***	0.219***	0.206***	0.198***	0.190***	0.176***	0.157***	0.137***
	0.041	0.053	0.041	0.048	0.041	0.042	0.040	0.052	0.047	0.044
t6	0.250***	0.354***	0.312***	0.278***	0.259***	0.247***	0.236***	0.215***	0.186***	0.156***
	0.039	0.045	0.042	0.041	0.034	0.037	0.037	0.049	0.049	0.049
Bond FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents the regression results based on Equation 1 and results of panel quantile fixed effects model after split-panel jackknife bias correction based on model 4. The dependent variable (DV) is the natural logarithm of one-month-ahead bond spreads. The explanatory variables are Environmental, Social, and Governance ratings provided by Bloomberg (ESG), Return on Assets (ROA), Interest Coverage Ratio (ICR), Sales growth (GROWTH), Total debt to total assets (LEV), the natural logarithm of market capitalization (ln(MKTCAP)), and dummy variables for each year t2-t6. The sample includes 147 US corporate bonds from year 2017 to 2022. All the variables are described in Table 11. The standard errors are reported in parentheses. All model specifications include fixed -effects at the bond level.
*,**,*** signify the significance levels at 10, 5 and 1% thresholds, respectively.

Table 13: Impact of ESG on bond spreads: Green sample (Heavy S)

	OLS	10th quantile	20th quantile	30th quantile	40th quantile	50th quantile	60th quantile	70th quantile	80th quantile	90th quantile
DV: ln Lead Bond Spread										
ESG	0.054*	0.072*	0.066	0.061***	0.055**	0.054*	0.051***	0.047	0.041*	0.033
	(0.028)	(0.038)	(0.043)	(0.022)	(0.026)	(0.031)	(0.019)	(0.029)	(0.024)	(0.030)
ROA	-0.010***	-0.012***	-0.011***	-0.011***	-0.010***	-0.010***	-0.010***	-0.010**	-0.009**	-0.008**
	(0.003)	(0.004)	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)
ICR	0.002	-0.0001	0.001	0.001	0.002	0.002	0.003	0.003	0.004	0.005**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
GROWTH	0.0001	0.001	0.0004	0.0003	0.0001	0.0001	0.00003	-0.0001	-0.0002	-0.0004
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
LEV	0.008***	0.011***	0.010***	0.009***	0.008**	0.008***	0.008***	0.007***	0.007**	0.006***
	(0.003)	(0.004)	(0.002)	(0.003)	(0.004)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)
ln(MKTCAP)	-0.160**	-0.039	-0.080	-0.115*	-0.150**	-0.159***	-0.176***	-0.200***	-0.243***	-0.292***
	(0.062)	(0.078)	(0.067)	(0.065)	(0.073)	(0.050)	(0.057)	(0.066)	(0.062)	(0.062)
Constant	6.220***									
	(0.767)									
t2	0.284***	0.286***	0.285***	0.284***	0.284***	0.284***	0.283***	0.283***	0.282***	0.281***
	(0.021)	(0.034)	(0.025)	(0.023)	(0.022)	(0.023)	(0.022)	(0.028)	(0.033)	(0.033)
t3	-0.007	0.002	-0.001	-0.004	-0.007	-0.007	-0.009	-0.010	-0.013	-0.017
	(0.028)	(0.054)	(0.035)	(0.039)	(0.035)	(0.028)	(0.027)	(0.031)	(0.032)	(0.030)
t4	-0.127***	-0.186***	-0.166***	-0.149***	-0.132***	-0.128***	-0.119***	-0.108**	-0.087**	-0.063*
	(0.040)	(0.056)	(0.045)	(0.049)	(0.042)	(0.035)	(0.035)	(0.047)	(0.043)	(0.032)
t5	-0.044	-0.103	-0.083	-0.066	-0.049	-0.044	-0.036	-0.024	-0.003	0.021
	(0.050)	(0.067)	(0.056)	(0.051)	(0.054)	(0.048)	(0.053)	(0.051)	(0.040)	(0.042)
t6	-0.062	-0.315**	-0.228**	-0.157**	-0.082	-0.063	-0.027	0.023	0.113***	0.216***
	(0.065)	(0.126)	(0.108)	(0.068)	(0.073)	(0.074)	(0.058)	(0.062)	(0.044)	(0.051)
Bond FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents the regression results based on Equation 1 and results of panel quantile fixed effects model after split-panel jackknife bias correction based on model 4. The dependent variable (DV) is the natural logarithm of one-month-ahead bond spreads. The explanatory variables are Environmental, Social, and Governance ratings provided by Bloomberg (ESG), Return on Assets (ROA), Interest Coverage Ratio (ICR), Sales growth (GROWTH), Total debt to total assets (LEV), the natural logarithm of market capitalization (ln(MKTCAP)), and dummy variables for each year t2-t6. The sample includes 120 US corporate bonds from year 2017 to 2022. All the variables are described in Table 11. The standard errors are reported in parentheses. All model specifications include fixed -effects at the bond level.
*,**,*** signify the significance levels at 10, 5 and 1% thresholds, respectively.

6.2 Robustness check - II: Using an alternate measure of ESG

This section presents the results for model 1 alongside the results for panel quantile fixed effects regression as described in section 4.2 for a different measure of ESG - the Refinitiv ESG scores. The scoring methodology varies across all ESG data providers, so it can be expected that the results obtained using data from different providers may be similar but not the same. The Refinitiv ESG scores range from 0 to 100. To avoid any inconsistencies, observations (bonds) with any missing ESG values and ESG values equal to 0 have been removed from the analysis.

The results for the full sample have been reported in Table 14. The results in this table are comparable to the results in Table 5. The coefficient of ESG is negative and significant at lower quantiles of spread. This implies tha improvements in ESG reduce the bond spreads at lower quantiles of spread.

Next, the results for the brown and the green samples are reported in Tables 15 and 16 respectively. It can be observed from the results that even though the direction of the effect of ESG on bond spreads is similar to the main findings of the paper (reported in Tables 7 and 9), the effect is not significant. As the coefficients of the alternate ESG rating retains the same signs, it is safe to say that the direction of the impact (for brown and green companies) remains consistent irrespective of the measure of ESG used, the strength of the impact may vary with the ESG measure employed.

Table 14: Impact of ESG (Refinitiv) on bond spreads: Full sample

	OLS	10th quantile	20th quantile	30th quantile	40th quantile	50th quantile	60th quantile	70th quantile	80th quantile	90th quantile
DV: ln Lead Bond Spread										
ESG	-0.001	-0.003*	-0.002*	-0.002	-0.001	-0.001	-0.001	-0.0002	0.001	0.001
	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
ROA	-0.015***	-0.016***	-0.015***	-0.015***	-0.015***	-0.015***	-0.015***	-0.015***	-0.015***	-0.014***
	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
ICR	0.005***	0.004***	0.005***	0.005***	0.005***	0.005***	0.005***	0.006***	0.006***	0.006***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)
GROWTH	0.0001	0.001***	0.001**	0.001***	0.0003	0.0001	0.00002	-0.0002	-0.001	-0.001
	(0.0003)	(0.0004)	(0.0003)	(0.0002)	(0.0002)	(0.0003)	(0.0002)	(0.0003)	(0.0004)	(0.0004)
LEV	0.005***	0.005**	0.005***	0.005***	0.005***	0.005***	0.005***	0.005***	0.005***	0.005***
	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
ln(MKTCAP)	-0.090***	-0.084***	-0.086***	-0.088***	-0.089***	-0.090***	-0.091***	-0.092***	-0.094***	-0.096***
	(0.009)	(0.012)	(0.010)	(0.008)	(0.008)	(0.007)	(0.006)	(0.011)	(0.009)	(0.009)
Constant	5.739***									
	(0.151)									
t2	0.497***	0.418***	0.446***	0.468***	0.484***	0.498***	0.508***	0.524***	0.550***	0.576***
	(0.016)	(0.014)	(0.015)	(0.014)	(0.014)	(0.014)	(0.021)	(0.019)	(0.019)	(0.027)
t3	0.101***	0.190***	0.159***	0.133***	0.115***	0.100***	0.089***	0.070***	0.041***	0.011
	(0.016)	(0.024)	(0.018)	(0.013)	(0.017)	(0.015)	(0.018)	(0.017)	(0.017)	(0.015)
t4	0.099***	0.105***	0.103***	0.101***	0.100***	0.099***	0.098***	0.097***	0.095***	0.092***
	(0.020)	(0.018)	(0.020)	(0.017)	(0.017)	(0.015)	(0.018)	(0.019)	(0.024)	(0.020)
t5	0.127***	0.155***	0.145***	0.137***	0.132***	0.127***	0.123***	0.118***	0.109***	0.099***
	(0.017)	(0.022)	(0.023)	(0.020)	(0.018)	(0.021)	(0.017)	(0.017)	(0.017)	(0.015)
t6	0.196***	0.186***	0.190***	0.192***	0.194***	0.196***	0.197***	0.199***	0.202***	0.205***
	(0.019)	(0.034)	(0.027)	(0.020)	(0.020)	(0.018)	(0.020)	(0.020)	(0.020)	(0.022)
Bond FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents the regression results based on Equation 1 and results of panel quantile fixed effects model after split-panel jackknife bias correction based on model 4. The dependent variable (DV) is the natural logarithm of one-month-ahead bond spreads. The explanatory variables are Environmental, Social, and Governance ratings provided by Refinitiv (ESG), Return on Assets (ROA), Interest Coverage Ratio (ICR), Sales growth (GROWTH), Total debt to total assets (LEV), the natural logarithm of market capitalization (ln(MKTCAP)), and dummy variables for each year t2-t6. The sample includes 147 US corporate bonds from year 2017 to 2022. All the variables are described in Table 1. The standard errors are reported in parentheses. All model specifications include fixed -effects at the bond level.
*,**,*** signify the significance levels at 10, 5 and 1% thresholds, respectively.

Table 15: Impact of ESG (Refinitiv) on bond spreads: Brown sample

	OLS	10th quantile	20th quantile	30th quantile	40th quantile	50th quantile	60th quantile	70th quantile	80th quantile	90th quantile
DV: ln Lead Bond Spread										
ESG	-0.002	-0.005	-0.003	-0.002	-0.002	-0.002	-0.002	-0.001	0.0001	0.001
	(0.003)	(0.003)	(0.004)	(0.003)	(0.002)	(0.003)	(0.003)	(0.004)	(0.003)	(0.004)
ROA	-0.002	-0.161	0.001	-0.001	-0.001	-0.001	-0.002	-0.004	-0.005	-0.006**
	(0.003)	(0.005)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.005)	(0.003)
ICR	0.007***	0.003	0.007***	0.007***	0.007***	0.007***	0.007***	0.008***	0.008***	0.009***
	(0.002)	(0.005)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)
GROWTH	-0.001	0.006	-0.0005	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001**	-0.001
	(0.0005)	(0.001)	(0.001)	(0.001)	(0.0005)	(0.0004)	(0.001)	(0.0005)	(0.0004)	(0.001)
LEV	0.011***	-0.0003***	0.015***	0.013***	0.013***	0.012***	0.011**	0.008***	0.006	0.004
	(0.004)	(0.006)	(0.004)	(0.004)	(0.004)	(0.003)	(0.005)	(0.004)	(0.006)	(0.004)
ln(MKTCAP)	-0.273***	0.019*	-0.220**	-0.251**	-0.248**	-0.265***	-0.279***	-0.321***	-0.354***	-0.380***
	(0.093)	(0.094)	(0.100)	(0.103)	(0.101)	(0.097)	(0.092)	(0.117)	(0.125)	(0.131)
Constant	7.400***									
	(1.038)									
t2	0.283***	0.540***	0.404***	0.334***	0.340***	0.300***	0.269***	0.171***	0.095***	0.037
	(0.034)	(0.046)	(0.040)	(0.036)	(0.042)	(0.042)	(0.034)	(0.039)	(0.028)	(0.028)
t3	0.191***	0.368***	0.275***	0.226***	0.230***	0.203***	0.181***	0.113**	0.061	0.021
	(0.042)	(0.059)	(0.055)	(0.042)	(0.033)	(0.047)	(0.040)	(0.045)	(0.053)	(0.043)
t4	0.201***	0.351***	0.272***	0.230***	0.234***	0.211***	0.192***	0.135*	0.090	0.056
	(0.057)	(0.086)	(0.067)	(0.047)	(0.054)	(0.061)	(0.065)	(0.070)	(0.069)	(0.054)
t5	0.148**	0.222***	0.183***	0.162***	0.164***	0.153***	0.144**	0.116	0.094	0.077
	(0.061)	(0.057)	(0.058)	(0.052)	(0.059)	(0.059)	(0.066)	(0.076)	(0.066)	(0.070)
t6	0.216***	0.309***	0.260***	0.234***	0.237***	0.222***	0.211***	0.175***	0.148**	0.127*
	(0.066)	(0.065)	(0.059)	(0.061)	(0.059)	(0.053)	(0.073)	(0.063)	(0.067)	(0.074)
Bond FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents the regression results based on Equation 1 and results of panel quantile fixed effects model after split-panel jackknife bias correction based on model 4. The dependent variable (DV) is the natural logarithm of one-month-ahead bond spreads. The explanatory variables are Environmental, Social, and Governance ratings provided by Refinitiv (ESG), Return on Assets (ROA), Interest Coverage Ratio (ICR), Sales growth (GROWTH), Total debt to total assets (LEV), the natural logarithm of market capitalization (ln(MKTCAP)), and dummy variables for each year t2-t6. The sample includes 61 US corporate bonds from year 2017 to 2022. All the variables are described in Table 3. The standard errors are reported in parentheses. All model specifications include fixed -effects at the bond level.
*,**,*** signify the significance levels at 10, 5 and 1% thresholds, respectively.

Table 16: Impact of ESG (Refinitiv) on bond spreads: Green sample

	OLS	10th quantile	20th quantile	30th quantile	40th quantile	50th quantile	60th quantile	70th quantile	80th quantile	90th quantile
DV: ln Lead Bond Spread										
ESG	0.005	0.008	0.007	0.006	0.005	0.005	0.004	0.004	0.003	0.003
	(0.005)	(0.010)	(0.006)	(0.005)	(0.007)	(0.007)	(0.005)	(0.003)	(0.004)	(0.005)
ROA	-0.023***	-0.030***	-0.027***	-0.025***	-0.024***	-0.022***	-0.021***	-0.020***	-0.019***	-0.017***
	(0.003)	(0.008)	(0.006)	(0.003)	(0.004)	(0.004)	(0.004)	(0.003)	(0.005)	(0.006)
ICR	0.001	0.007	0.004	0.003	0.002	0.0001	-0.0005	-0.001	-0.002	-0.004
	(0.002)	(0.005)	(0.003)	(0.003)	(0.003)	(0.001)	(0.002)	(0.002)	(0.003)	(0.003)
GROWTH	-0.001	-0.004**	-0.003*	-0.002	-0.001	-0.0001	0.0002	0.001	0.001*	0.002**
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
LEV	0.007***	0.010**	0.009***	0.008***	0.008**	0.007***	0.007***	0.006***	0.006**	0.005*
	(0.002)	(0.004)	(0.003)	(0.003)	(0.004)	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)
ln(MKTCAP)	-0.040	-0.014	-0.024	-0.033	-0.036	-0.044	-0.047	-0.050*	-0.056**	-0.062*
	(0.034)	(0.054)	(0.062)	(0.031)	(0.033)	(0.033)	(0.034)	(0.027)	(0.026)	(0.032)
Constant	4.621***									
	(0.510)									
t2	0.423***	0.411***	0.416***	0.420***	0.421***	0.425***	0.426***	0.427***	0.430***	0.432***
	(0.040)	(0.075)	(0.057)	(0.040)	(0.040)	(0.035)	(0.040)	(0.033)	(0.044)	(0.040)
t3	0.125***	0.222***	0.184***	0.153***	0.139***	0.110***	0.100***	0.088***	0.067*	0.045
	(0.029)	(0.084)	(0.056)	(0.033)	(0.035)	(0.030)	(0.027)	(0.023)	(0.035)	(0.037)
t4	0.032	0.047	0.041	0.037	0.034	0.030	0.029	0.027	0.024	0.021
	(0.039)	(0.066)	(0.047)	(0.041)	(0.040)	(0.040)	(0.041)	(0.034)	(0.049)	(0.046)
t5	0.134*	0.250***	0.204***	0.168***	0.151***	0.117***	0.105**	0.091***	0.066	0.040
	(0.032)	(0.050)	(0.036)	(0.035)	(0.026)	(0.041)	(0.046)	(0.034)	(0.049)	(0.037)
t6	0.071	0.008	0.033	0.052	0.062	0.080	0.087**	0.094***	0.108**	0.122***
	(0.048)	(0.146)	(0.076)	(0.077)	(0.053)	(0.051)	(0.034)	(0.024)	(0.045)	(0.033)
Bond FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents the regression results based on Equation 1 and results of panel quantile fixed effects model after split-panel jackknife bias correction based on model 4. The dependent variable (DV) is the natural logarithm of one-month-ahead bond spreads. The explanatory variables are Environmental, Social, and Governance ratings provided by Refinitiv (ESG), Return on Assets (ROA), Interest Coverage Ratio (ICR), Sales growth (GROWTH), Total debt to total assets (LEV), the natural logarithm of market capitalization (ln(MKTCAP)), and dummy variables for each year t2-t6. The sample includes 66 US corporate bonds from year 2017 to 2022. All the variables are described in Table 3. The standard errors are reported in parentheses. All model specifications include fixed -effects at the bond level.
*,**,*** signify the significance levels at 10, 5 and 1% thresholds, respectively.

6.3 Robustness check - III: Using an alternate estimation method

This section reports and discusses the results of the panel quantile estimation method developed by Koenker (2004). Essentially, this method estimates the regression coefficients considering that the individual fixed effects have the same effect in each quantile. This method uses a penalized fixed effects estimation approach in which the individual fixed effects are shrunk toward a common value using a penalty term.

The results in Tables 17, 18, and 19 are similar to the results in 5, 7, and 9. The coefficient of ESG is significant and negative only for the 10th quantile (the lower extreme) implying that improvements in ESG ratings reduce the bond spreads at low values of bond spreads while at higher quantiles of bond spreads, the effect becomes positive but is insignificant. The coefficients of ESG for the brown sample (as reported in Table 18) are negative - indicating that improvements in ESG ratings result in a reduction in bond spreads. This result attests to the main results and results from other robustness exercises presented in the paper. Finally, the results for the green sample in Table 19 indicate that the coefficient of ESG takes positive values throughout the distribution of bond spreads. This result is also aligned with the main result of the paper and the results of other robustness exercises.

Table 17: Impact of ESG on bond spreads

	10th quantile	20th quantile	30th quantile	40th quantile	50th quantile	60th quantile	70th quantile	80th quantile	90th quantile
DV: ln Lead Bond Spread									
ESG	-0.009	-0.026*	-0.019	-0.003	0.002	0.0005	-0.002	-0.003	0.011
	(0.014)	(0.015)	(0.014)	(0.013)	(0.012)	(0.161)	(0.011)	(0.012)	(0.012)
lnISSUESIZE	-0.095***	-0.095***	-0.100***	-0.097***	-0.095***	-0.089***	-0.089***	-0.0856***	-0.074***
	(0.011)	(0.010)	(0.009)	(0.008)	(0.008)	(0.012)	(0.008)	(0.008)	(0.009)
RATING	-0.113***	-0.116***	-0.123***	-0.125***	-0.126***	-0.128***	-0.128***	-0.135***	-0.142***
	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)	(0.008)	(0.005)	(0.007)	(0.007)
ln(MKTCAP)	-0.094***	-0.089***	-0.079***	-0.075***	-0.076***	-0.078***	-0.084***	-0.0792***	-0.081***
	(0.010)	(0.009)	(0.008)	(0.007)	(0.007)	(0.005)	(0.006)	(0.008)	(0.007)
ROA	-0.016***	-0.015***	-0.015***	-0.016***	-0.017***	-0.016***	-0.015***	-0.013***	-0.013***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.007)	(0.002)	(0.002)	(0.011)
ICR	-0.001	0.0003	0.002	0.003**	0.004***	0.004***	0.003***	0.003**	0.004**
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)
LEV	0.002**	0.001	0.001*	0.001*	0.001**	0.001	0.001	0.001	0.0004
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
GROWTH	0.0001	-0.0003	0.0001	0.0004	0.0004	0.001	0.001	0.0005	0.0002
	(0.001)	(0.0004)	(0.0003)	(0.0003)	(0.0003)	(0.001)	(0.0004)	(0.0005)	(0.001)
MATURITY	0.023***	0.021***	0.021***	0.020***	0.020***	0.019***	0.018***	0.017***	0.017***
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.0004)	(0.001)	(0.002)	(0.0005)
Constant	8.210***	8.425***	8.486***	8.418***	8.418***	8.467***	8.606***	8.670***	8.623***
	(0.213)	(0.199)	(0.184)	(0.170)	(0.169)	(0.001)	(0.152)	(0.161)	(0.002)
t2	0.422***	0.429***	0.463***	0.492***	0.538***	0.533***	0.575***	0.616***	0.618***
	(0.027)	(0.023)	(0.024)	(0.024)	(0.025)	(0.026)	(0.029)	(0.040)	(0.044)
t3	0.157***	0.166***	0.183***	0.173***	0.157***	0.130***	0.113***	0.085***	0.023
	(0.028)	(0.023)	(0.021)	(0.019)	(0.020)	(0.020)	(0.022)	(0.030)	(0.029)
t4	0.066**	0.114***	0.159***	0.168***	0.173***	0.177***	0.154***	0.134***	0.092**
	(0.027)	(0.032)	(0.027)	(0.028)	(0.030)	(0.025)	(0.023)	(0.032)	(0.039)
t5	0.129***	0.180***	0.203***	0.202***	0.190***	0.167***	0.151***	0.124***	0.040
	(0.033)	(0.032)	(0.026)	(0.024)	(0.025)	(0.024)	(0.023)	(0.030)	(0.033)
t6	0.208***	0.257***	0.267***	0.254***	0.242***	0.224***	0.217***	0.197***	0.146***
	(0.039)	(0.030)	(0.025)	(0.025)	(0.026)	(0.027)	(0.026)	(0.033)	(0.036)
Bond FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents the regression results based on Equation 1 and results of panel quantile fixed effects model after split-panel jackknife bias correction based on panel quantile fixed effects regression technique proposed by Koenker (2004). The dependent variable (DV) is the natural logarithm of one-month-ahead bond spreads. The explanatory variables are Environmental, Social, and Governance ratings provided by Bloomberg (ESG), Return on Assets (ROA), Interest Coverage Ratio (ICR), Sales growth (GROWTH), Total debt to total assets (LEV), the natural logarithm of market capitalization (ln(MKTCAP)), natural logarithm of the size of issue (lnISSUESIZE), credit rating provided by Moody's (RATING), maturity in years (MATURITY), and dummy variables for each year t2-t6. The sample includes 147 US corporate bonds from year 2017 to 2022. All the variables are described in Table 3. The standard errors are reported in parentheses. All model specifications include fixed -effects at the bond level.
*,**,*** signify the significance levels at 10, 5 and 1% thresholds, respectively.

Table 18: Impact of ESG on bond spreads: Brown sample

	10th quantile	20th quantile	30th quantile	40th quantile	50th quantile	60th quantile	70th quantile	80th quantile	90th quantile
DV: ln Lead Bond Spread									
ESG	-0.071	-0.063	-0.081*	-0.092**	-0.088**	-0.070*	-0.073**	-0.047	-0.069*
	(0.060)	(0.055)	(0.047)	(0.041)	(0.038)	(0.383)	(0.035)	(0.033)	(0.036)
lnISSUESIZE	-0.010	0.007	-0.001	-0.013	-0.010	-0.008	-0.006	-0.011	0.002
	(0.026)	(0.020)	(0.018)	(0.016)	(0.015)	(0.037)	(0.017)	(0.020)	(0.022)
RATING	-0.089**	-0.090***	-0.082***	-0.091***	-0.083***	-0.082***	-0.080***	-0.098***	-0.084***
	(0.035)	(0.031)	(0.031)	(0.031)	(0.029)	(0.015)	(0.031)	(0.030)	(0.029)
ln(MKTCAP)	-0.179***	-0.156***	-0.139***	-0.145***	-0.154***	-0.176***	-0.201***	-0.179***	-0.182***
	(0.058)	(0.050)	(0.052)	(0.051)	(0.050)	(0.029)	(0.047)	(0.043)	(0.039)
ROA	-0.002	-0.004	-0.004	-0.001	-0.0001	-0.002	-0.004	-0.004	-0.005
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.047)	(0.004)	(0.003)	(0.004)
ICR	0.009*	0.007**	0.005*	0.004	0.004	0.008**	0.012***	0.013***	0.012***
	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)	(0.004)
LEV	0.015***	0.010**	0.007**	0.009***	0.008**	0.009***	0.009***	0.009***	0.008***
	0.005)	(0.004)	(0.004)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)
GROWTH	-0.0001	-0.0003	0.0002	0.00002	-0.0003	-0.001	-0.001	-0.002***	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.001)	(0.001)	(0.001)
MATURITY	0.017***	0.014**	0.014**	0.017***	0.016***	0.015***	0.012**	0.010	0.007
	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)	(0.001)	(0.006)	(0.006)	(0.008)
Constant	6.936***	6.700***	6.908***	7.202***	7.258***	7.414***	7.782***	7.862***	7.720***
	(0.658)	(0.472)	(0.450)	(0.417)	(0.406)	(0.005)	(0.395)	(0.430)	(0.450)
t2	0.364***	0.417***	0.376***	0.375***	0.340***	0.296***	0.219***	0.152***	0.155***
	(0.086)	(0.070)	(0.063)	(0.054)	(0.046)	(0.049)	(0.055)	(0.045)	(0.052)
t3	0.327***	0.307***	0.234***	0.256***	0.241***	0.215***	0.153**	0.119**	0.144***
	(0.093)	(0.072)	(0.065)	(0.058)	(0.054)	(0.060)	(0.062)	(0.057)	(0.055)
t4	0.284***	0.287***	0.271***	0.315***	0.269***	0.225***	0.169*	0.135	0.250***
	(0.106)	(0.102)	(0.096)	(0.083)	(0.075)	(0.079)	(0.087)	(0.088)	(0.074)
t5	0.168*	0.183*	0.163*	0.188**	0.198**	0.204**	0.138*	0.149*	0.203***
	(0.086)	(0.103)	(0.096)	(0.085)	(0.082)	(0.080)	(0.082)	(0.086)	(0.075)
t6	0.279***	0.307***	0.289***	0.311***	0.289***	0.248***	0.200**	0.156**	0.251***
	(0.092)	(0.099)	(0.099)	(0.087)	(0.076)	(0.081)	(0.090)	(0.079)	(0.071)
Bond FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents the regression results based on Equation 1 and results of panel quantile fixed effects model after split-panel jackknife bias correction based on panel quantile fixed effects regression technique proposed by Koenker (2004). The dependent variable (DV) is the natural logarithm of one-month-ahead bond spreads. The explanatory variables are Environmental, Social, and Governance ratings provided by Bloomberg (ESG), Return on Assets (ROA), Interest Coverage Ratio (ICR), Sales growth (GROWTH), Total debt to total assets (LEV), the natural logarithm of market capitalization (ln(MKTCAP)), natural logarithm of the size of issue (lnISSUESIZE), credit rating provided by Moody's (RATING), maturity in years (MATURITY), and dummy variables for each year t2-t6. The sample includes 61 US corporate bonds from year 2017 to 2022. All the variables are described in Table 3. The standard errors are reported in parentheses. All model specifications include fixed -effects at the bond level.
*,**,*** signify the significance levels at 10, 5 and 1% thresholds, respectively.

Table 19: Impact of ESG on bond spreads: Green sample

	10th quantile	20th quantile	30th quantile	40th quantile	50th quantile	60th quantile	70th quantile	80th quantile	90th quantile
DV: ln Lead Bond Spread									
ESG	0.004	0.025	0.067*	0.065**	0.062**	0.065**	0.084***	0.099***	0.107***
	(0.048)	(0.040)	(0.037)	(0.031)	(0.027)	(0.029)	(0.028)	(0.024)	(0.024)
lnISSUESIZE	0.070**	0.061**	0.035*	0.034**	0.028**	0.028**	0.024*	0.023*	0.012
	(0.030)	(0.024)	(0.020)	(0.014)	(0.012)	(0.012)	(0.013)	(0.013)	(0.019)
RATING	-0.083***	-0.082***	-0.084***	-0.088***	-0.080***	-0.081***	-0.084***	-0.090***	-0.087***
	(0.015)	(0.012)	(0.012)	(0.012)	(0.010)	(0.011)	(0.010)	(0.012)	(0.013)
ln(MKTCAP)	-0.008	-0.047	-0.059	-0.066*	-0.068**	-0.059**	-0.056*	-0.041	-0.060
	(0.043)	(0.039)	(0.040)	(0.038)	(0.033)	(0.030)	(0.030)	(0.039)	(0.049)
ROA	-0.032***	-0.017**	-0.016***	-0.013***	-0.015***	-0.015***	-0.011***	-0.009***	-0.009***
	(0.011)	(0.007)	(0.006)	(0.004)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)
ICR	0.002	-0.001	-0.002	-0.003	-0.003	-0.004	-0.006*	-0.005*	-0.004
	(0.004)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
LEV	0.011***	0.009***	0.008***	0.008***	0.009***	0.009***	0.008***	0.008***	0.007***
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
GROWTH	-0.001	-0.001	0.000	-0.001	-0.0004	0.0009	0.0004	-0.0001	-0.00001
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
MATURITY	0.029***	0.029***	0.026***	0.023***	0.023***	0.021***	0.019***	0.019***	0.017***
	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Constant	2.998***	3.625***	4.340***	4.603***	4.690***	4.739***	4.915***	4.810***	5.262***
	(0.903)	(0.761)	(0.719)	(0.607)	(0.517)	(0.444)	(0.417)	(0.491)	(0.659)
t2	0.379***	0.364***	0.421***	0.452***	0.472**	0.423***	0.380***	0.425***	0.489***
	(0.088)	(0.072)	(0.076)	(0.068)	(0.066)	(0.058)	(0.053)	(0.052)	(0.053)
t3	0.183**	0.103	0.119*	0.140**	0.131	0.100	0.040	0.031	0.060
	(0.088)	(0.071)	(0.061)	(0.056)	(0.060)	(0.062)	(0.053)	(0.042)	(0.043)
t4	-0.071	-0.020	0.034	0.047	0.009	-0.014	-0.047	-0.031	0.051
	(0.097)	(0.080)	(0.071)	(0.071)	(0.077)	(0.078)	(0.065)	(0.054)	(0.063)
t5	0.093	0.106*	0.090	0.118**	0.101	0.031	-0.044	-0.022	-0.013
	(0.076)	(0.062)	(0.061)	(0.059)	(0.062)	(0.069)	(0.061)	(0.052)	(0.050)
t6	-0.037	0.117	0.088	0.139**	0.111*	0.028	-0.038	-0.008	0.047
	(0.206)	(0.078)	(0.069)	(0.063)	(0.065)	(0.071)	(0.058)	(0.050)	(0.046)
Bond FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents the regression results based on Equation 1 and results of panel quantile fixed effects model after split-panel jackknife bias correction based on panel quantile fixed effects regression technique proposed by Koenker (2004). The dependent variable (DV) is the natural logarithm of one-month-ahead bond spreads. The explanatory variables are Environmental, Social, and Governance ratings provided by Bloomberg (ESG), Return on Assets (ROA), Interest Coverage Ratio (ICR), Sales growth (GROWTH), Total debt to total assets (LEV), the natural logarithm of market capitalization (ln(MKTCAP)), natural logarithm of the size of issue (lnISSUESIZE), credit rating provided by Moody's (RATING), maturity in years (MATURITY), and dummy variables for each year t2-t6. The sample includes 66 US corporate bonds from year 2017 to 2022. All the variables are described in Table 3. The standard errors are reported in parentheses. All model specifications include fixed -effects at the bond level.
*,**,*** signify the significance levels at 10, 5 and 1% thresholds, respectively.

7 Conclusion

ESG is increasingly becoming the most crucial indicator of corporate sustainability. Many credit rating agencies now provide their own ESG ratings. Fitch developed its Sustainable Fitch platform, while Moody's and S&P acquired support for similar capabilities. The growing interest of credit rating agencies in acquiring ESG data providers also illustrates the importance of sustainability in credit markets. This evolution in the role of ESG in credit markets poses the question - of how the credit markets reflect the ESG ratings (a proxy for sustainability practices adopted by firms) assigned to companies. This paper addresses this question and brings forward three novel insights about the relationship between ESG and credit risk (proxied by bond spreads). First, the ESG-bond spreads relationship is compared between the heavily polluting sample (comprising of bonds belonging to heavily emitting companies) and the lightly polluting sample (comprising of bonds belonging to lightly emitting companies). Then, the relationship between the weighted E, S, and G pillar with the bond spreads is studied to gauge the importance of each pillar in determining the spreads for different samples. The paper uses weighted pillars as the weighted pillars are comparable across industries and companies. This is one of the few studies highlighting the importance of and accounting for weighted ESG pillar scores instead of unweighted scores. Lastly, the paper investigates if the ESG-bond spread relationship varies across quantiles (distribution of bond spreads).

The findings reveal that the relationship between ESG and bond spreads is negative for the brown sample while positive for the green sample. This implies that for the brown sample, improvements in ESG lead to a risk mitigation effect (manifested in the form of a decrease in the bond spreads). On the other hand, upgrades in the ESG ratings are penalized in the bond markets (in the form of higher spreads) in the case of the green sample (reflected in the positive coefficients of ESG). This finding implies that investors demand higher returns on bonds of lightly emitting companies improving their ESG performance. Though there is scant work in the literature to

back this finding, the paper by Li and Adriaens (2024) finds that the impact of ESG on bond spreads is positive for a sample of companies in lightly polluting sectors. And, Palmieri et al. (2023)'s findings suggest that belonging to a low-emitting industry has no significant impact on a company's probability of default. These findings in the recent literature substantiate the results of this paper by providing evidence that green companies are deemed safe by investors and that any efforts towards improving ESG performance may be considered wasteful and therefore, penalized.

Next, the findings highlight that the weighted E pillar is the most important in determining the bond spreads for heavily emitting companies. This is because the weighted E pillar is the only pillar with a significant mean impact on bond spreads. Moreover, the panel quantile regression results reveal that the coefficient of the weighted E pillar is negative and decreases steeply (becomes more negative). It is also significant for values of bond spreads above the 50th quantile. This result implies that improvements in the weighted E pillar, reduce the credit risk associated with bonds of heavily emitting firms, specifically for higher bond spreads.

For the lightly emitting sample, all three pillars are positive across the distribution of the bond spreads. All three pillars have a significant and positive impact on bond spreads indicating that credit risk associated with bonds of lightly emitting firms increases with improvements in weighted pillar scores. The coefficients of the weighted E and S pillars across the quantiles are decreasing while the coefficients of the weighted G pillar are increasing. While an improvement in the weighted G pillar has the maximum mean impact on the bond spreads, if quantile regression results are considered, it can be noted that the effect of the G pillar is only prominent in the mid-quantiles. This result underscores the advantage of using quantile regression vis-a-vis OLS.

The effect of ESG on bond spreads is studied for heavily polluting and lightly polluting companies. The contrasting results for the two sub-samples bring to light that the ESG-credit risk relationship is heterogeneous across industries. The disentangling

of the impact of ESG (in its pillars) on bond spreads, this paper reduces information asymmetry by highlighting the importance of each pillar (especially using weighted pillars) in determining the bond spreads. Finally, the ESG-credit risk relationship varies across the spectrum of bond spreads.

The results reported in this paper are of use to investors, policymakers, and businesses. As investors become more knowledgeable about the nuances of ESG impacts, they are better able to diversify their portfolios, mitigating the risk of overexposure to sectors whose ESG issues are highly sensitive. Moreover, in industries that adapt to ESG concerns, investors may see growth opportunities and competitive advantages. By gaining an understanding of which sectors benefit from improvements in ESG, investors can advocate a push towards higher sustainability standards. The insights from this analysis can enable policymakers to formulate policies to drive desirable investor behavior. Finally, if businesses understand how investors react to their ESG practices, they can attract more capital at lower costs by formulating policies that are best suited to their industry type.

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Measuring the relationship between ESG factors and firm's credit risk in Europe*
(Preliminary version)

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Abstract

In this paper, we investigate how ESG factors affect the perceived creditworthiness of firms in the European financial market. We model the CDS spread of a firm by considering the usual drivers that reflect specific firm characteristics such as the firm's financial, auditing, and management factors. Along with these variables, we include the ESG dimensions such as the ESG ratings, overall and for each pillar (E, S, and G). Furthermore, we consider specific drivers for a given pillar (i.e., CO2 emissions) or a firm's specific policies (i.e, commitment to human rights). The considered period in the empirical analysis is from September 2010 to July 2016. Our findings show that Social and Governance dimensions have a positive impact on the firm's perceived creditworthiness while we find the opposite for the Environmental dimension. Prior to the Paris Agreement in December 2015, environmental efforts were most likely seen as a sunk cost for a firm during rather than part of a transition strategy to carbon neutrality.

Keywords: Environment Social Governance (ESG), Credit risk, Credit Default Swap, European firms
JEL Classification: G14

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1 Introduction

Within the last decades, growing awareness of Environmental, Social, and Governance factors (ESG) has influenced public opinion, and it has urged firms to integrate these aspects in their strategies. At the same time, governance and social issues also became more pressing after several negative corporate disclosures and the global financial crisis. All these elements have highlighted the negative effects of extreme climate events, poor environmental engagements, and lacking transparency and accountability on companies' financial credibility and stability (Chavagnon et al., 2017). As a consequence, Socially Responsible Investment (SRI) is acquiring further importance for most firms. It is not seen any longer just as a tool to improve their competitiveness within the framework of globalization and the rush towards reduced production costs. During the last decade, a growing number of firms have started targeting ESG objectives to enhance their corporate sustainability. At the same time, investors were facing a considerable need for precise information about companies' involvement, which led to the creation of sustainability indices and the ESG rating agencies. As result, a new specialized market has soared and traditional rating agencies such as Standards and Poor, Moody's, and Fitch started incorporating these aspects in their analyses, while financial data and information providers such as Thomson Reuters and Bloomberg started proposing their own ESG ratings. Besides, these different components (environmental, social, and governance efforts) present their own features, and modeling non-financial ESG risks might be burdensome. For instance, social characteristics are those that are naturally more difficult to quantify, even though they are more easily understood and integrated into a credit risk framework (education levels, labor market structure, etc.). Furthermore, the importance of each component in investors' decisions varies considerably. Namely, governance issues are perceived as influencing more considerably the creditworthiness of a company and its sustainability (Chavagnon et al., 2019).

While several studies have focused on the relationship between ESG factors and the firm's performance over time, there are few investigations in the literature about ESG factors and

a firm's creditworthiness. Some studies have analyzed the impact of ESG and Corporate Social Responsibility (CSR) factors on a firm's cost of capital. The results of these studies provide mixed evidence. El Ghoul et al. (2011) found that higher CSR scores experience a significantly lower cost of equity capital. Menz (2010) have shown that CSR has not been incorporated into the pricing of corporate bonds and that in some cases the risk premium for socially responsible firms is even higher. Goss and Roberts (2011) found that firms with lower CSR pay between 7 and 18 basis points more with respect to the others. Sharfman and Fernando (2008) have reported that firms with better environmental risk management have a lower cost of equity but a higher cost of debt capital. Weber et al. (2010) found that combining traditional and sustainability criteria improve the prediction of SME defaults. The authors demonstrate the relation between firms' sustainability and their financial ratings. They assert that firms with important environmental and sustainability performances are benefitting from higher credit rating scores. Furthermore, their findings confirm that companies' sustainability influences their financial performances and their creditworthiness. They also stress the utility of integrating sustainability criteria in financial performance predictions, as they allow for improved consistency of credit ratings. Polbennikov et al. (2016) also focuses on the historical relationship between ESG ratings and corporate bond spreads and performances. They find that companies with higher ESG ratings show slightly lower bond spreads, and their bonds have been slightly more performant comparatively to less ESG-engaged firms when controlling for various sources of risk exposures. The transition to sustainable finance is crucial to scale up the massive investments needed to foster a transition to a low-carbon economy that keeps temperature rises below 2 degrees Celsius (High-Level Expert Group on Sustainable Finance, 2018), in order to prevent permanent environmental damages (Pachauri et al., 2014). Many central bank governors have recently started considering increasing regulatory oversight to address climate-related risks to financial stability, including carbon stress tests for banks and other relevant financial institutions, to assess the effects of an abrupt transition to a low-carbon economy in response to irreversible climatic

catastrophes (Battiston et al., 2017; Gros et al., 2016).

In this paper, we aim at contributing to the literature by investigating how ESG factors affect the perceived creditworthiness of European firms in the financial markets. We model the CDS spread of a firm by considering the usual drivers that reflect specific firm characteristics such as the firm's financial, auditing, and management factors. Along with these variables, we include the ESG dimensions such as the ESG ratings, overall and for each pillar (E, S, and G). Furthermore, we consider specific drivers for a given pillar (i.e., Co2 emissions) or a firm's specific policies (i.e, commitment to human rights). The considered period in the empirical analysis is from September 2010 to July 2016. Our findings show that Social and Governance dimensions have a positive impact on the firm's perceived creditworthiness. The better the firm's performance on these pillars, the lower is the CDS spreads. On the other hand, we find that the Environmental pillar is significant and positively related to the CDS spreads. It's worth mentioning that in December 2015, the Paris Agreement, a legally binding international accord on global emissions to prevent climate change, was signed. Considering our sample ends in July 2016, the influence of the Agreement is likely not yet discernible in the estimations, given that our sample is just 7 months longer. Those environmental efforts were most likely seen as a sunk cost for a firm during the time period under consideration, rather than as part of a transition strategy to carbon neutrality.

The remainder of the chapter is structured as follows. Section 2 presents the empirical strategy and illustrates the model and data. Section 3 illustrates the empirical analysis and our major results. Finally, Section 3 concludes.

2 Empirical strategy

In this section, we present the model and the data used in the analysis of the determinants of CDS spreads. Specifically, we consider the usual firm's characteristics (i.e., market and fundamental data) augmented with the ESG factors.

2.1 The Model

In the following section, we describe the model used to measure the impact of ESG factors on a firm's creditworthiness proxied by CDS at a given tenor. The credit default swap (CDS) is a derivative instrument where the buyer pays to the seller a periodic amount over the tenor of the contract to ensure against the event of default. It is a measure of the firm's creditworthiness: the higher the spread for the CDS, the higher the perceived credit risk. In this study, we model the CDS spread of a firm by considering three specific groups of determinants and other fixed controls that reflect some specific firm's characteristics. The groups as defined as follows and will be detailed in the Sample section:

1. *Environmental, Social and Governance factors (ESG).* This group involves the ESG factors such as the scores attributed by a given rating agency overall and for each pillar (E, S, and G). Furthermore, we consider specific drivers for a given pillar (i.e., Co2 emissions) or firm's specific policies (i.e, commitment on human rights).

2. *Financial factors (Fin).* This group involves firm's financial market data and balancesheet data that are the usual drivers of the firm's credit risk.

3. *Auditing and Management factors (AdtMng).* This group involves those factors that describe the firm's board and management characteristics such as compensation, remuneration and external auditing.

4. *Firmographics and other fixed effects (FirmFE).* This group involves the usual fixed effects controls related to firmographics such as industry and country of residence. Furthermore, we control also for other fixed effects such time fixed effect.

Let $i = 1, \ldots, N$ be the firm i and N the total number of firms, and $t = 1, \ldots, T$ the time dimension. We can define the model as:

$$\begin{aligned} \log CDS_{it}(tenure) =& \omega + \boldsymbol{\beta}_i \cdot ESG_i + \boldsymbol{\gamma}_i \cdot Fin_i + \boldsymbol{\theta}_i \cdot AdtMng_i + \\ & \boldsymbol{\phi}_i \cdot FirmFE_i + \tau \cdot TimeFE_t + \varepsilon_{it} \end{aligned} \tag{1}$$

where $\log CDS_{it}(tenure)$ is the logarithm of the CDS at a given tenure, $\boldsymbol{\beta}_i$, $\boldsymbol{\gamma}_i$, $\boldsymbol{\theta}_i$, and $\boldsymbol{\phi}_i$ are vectors of coefficients associated to a given group of variables as previously defined. We aim at investigating if the ESG group provides statistically significant results after controlling for the other usual determinants.

2.2 Sample

In this section, we present the database implemented in the empirical analyses. Data have been downloaded on April 2021 at the monthly frequency by Thomson Reuters Eikon and Bloomberg. The CDS spreads time series were available at 5-year tenure in Thomson Reuters Eikon till 2016 and consequently, the sample starts in September 2010 and is limited to July 2016. Figure 1 shows the evolution of the spread over time. We consider only the firms where all the variables of interest are available in the whole period. The resulting database involves 56 European firms (Table 1) that belong to different sectors according to the Global Industry Classification Standards (GICS) and 9 European Countries (Table 2).

The sample includes 59 ESG variables according to the previously defined groups. In particular, we consider alternative specifications of Model 1 according to the type of the ESG information involved.

- *ESG-scores.* The scores are provided by Thomson Reuters Eikon and involve: ESG, Environmental, Social, Governance, ESG combined, Environmental Pillar (Resource use and Emissions), Social Pillar (Workforce and Community, Human rights, Product Responsibility), and Governance (Management, Shareholders and CSR strategy). The scale ranges from 0 (bottom score) to 100 (top score).

  We aim at identifying if the best scorers on a given ESG variable exhibit a decrease on the CDS spreads. In this respect, we compute the quartile for each variable to classify a firm according to four groups: top quartile (Q4), medium quartile (Q3), medium-low quartile (Q2) and bottom quartile (Q1). We create a dummy variable that equals one

Table 1: List of the 52 European firms considered in the analysis.

Accor	Electricite De France	Naturgy Energy Group Sa
Aegon N.V.	Enbw Energie Baden-Wurttemberg Ag	Neles Oyj
Akzo Nobel N.V.	Enel Spa	Orange Sa
Allianz Se	Engie Sa	Royal Dutch Shell Plc
Assicurazioni Generali Spa	Eni - Ente Nazionale Idrocarburi	Siemens Ag
Atlantia Spa	Fortum Oyj	Telecom Italia Spa
Atlas Copco Ab	Fresenius Se & Co Kgaa	Telefonaktiebolaget Lm Ericsson
Axa Sa	Gecina	Telefonica Sa
Basf Se	Heineken Nv	Telia Company Ab
Bertelsmann Se & Co Kgaa	Hellenic Telecommunications Organisatio	Thyssenkrupp Ag
Bouygues Sa	Iberdrola S.A.	Total Sa
Brisa-Auto Estradas De Portugal, S.A.	Ing Groep N.V.	Unibail-Rodamco-Westfield Se
Compagnie De Saint Gobain Sa	Investor Ab	Unilever N.V.
Daimler Ag	Kering Sa	Valeo Sa
Danone Sa	Klepierre Sa	Volkswagen Ag
Deutsche Lufthansa Ag	Koninklijke Dsm N.V.	Wolters Kluwer Nv
Deutsche Post Ag	Koninklijke Kpn Nv	
Deutsche Telekom Ag	L'Air Liquide Societe Anonyme Pour L'Et	
E.On Se	Leonardo Spa	
Edp - Energias De Portugal S.A.	Linde Aktiengesellschaft	

Figure 1: Time series of the natural logarithm of 5-year CDS.

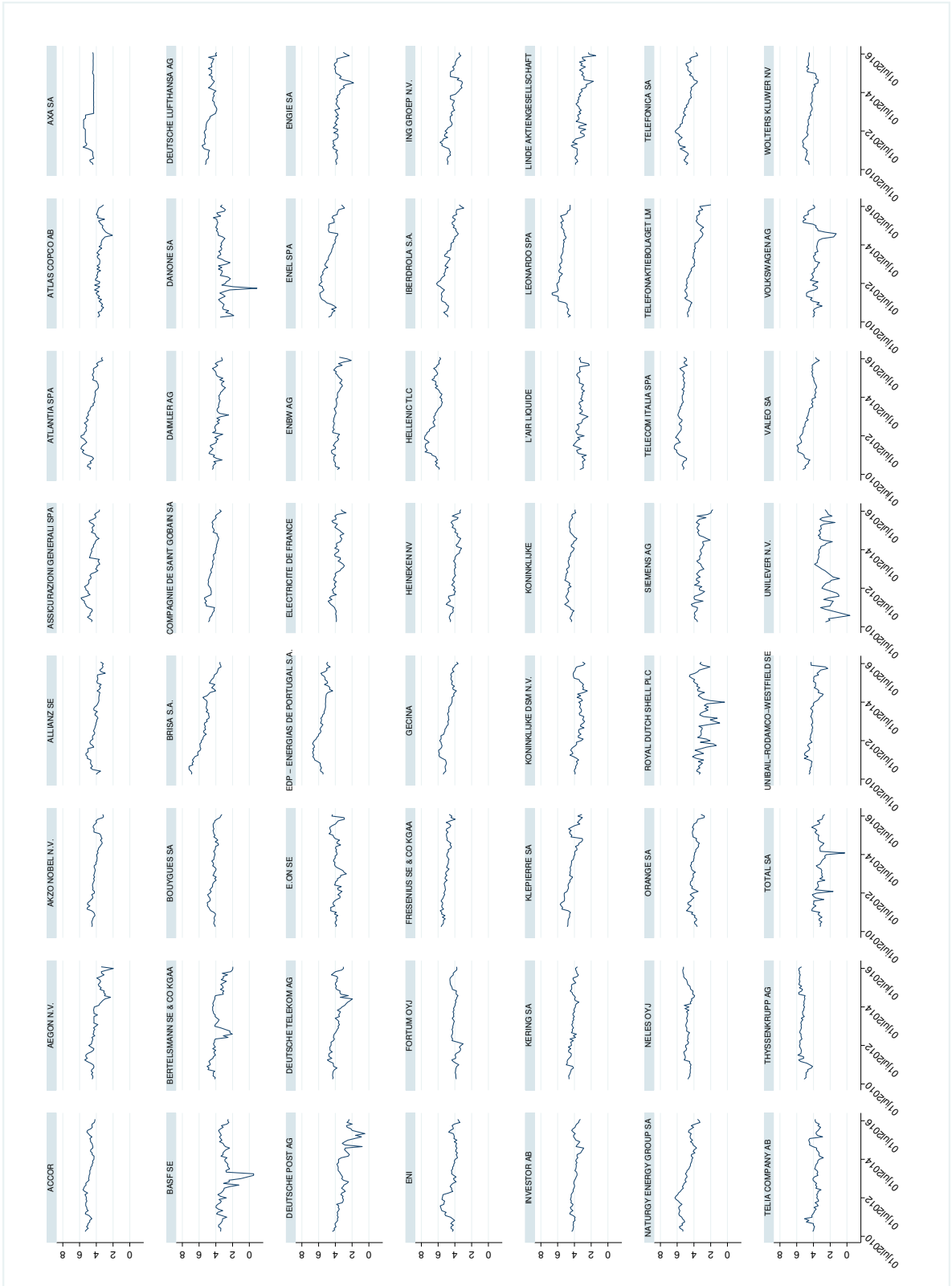

Table 2: Sample composition by sector and country.

Sector (GICS)	Percentage
Communication Services	14.81
Consumer Discretionary	9.26
Consumer Staples	5.56
Energy	5.56
Financials	11.11
Health Care	1.85
Industrials	18.52
Information Technology	1.85
Materials	9.26
Real Estate	5.56
Utilities	16.67
Total	100

Country	Percentage
Finland	3.57
France	26.79
Germany	25.00
Greece	1.79
Italy	10.71
Netherlands	16.07
Portugal	3.57
Spain	5.36
Sweden	7.14
Total	100

if a given firm belongs to the top quartile Q4 or not:

$$\begin{aligned}\log CDS_{it}(tenure) =& \omega + \boldsymbol{\beta}_i \cdot \mathbb{1}(ESG\ scores_i \in Q4) + \boldsymbol{\gamma}_i \cdot Fin_i + \boldsymbol{\theta}_i \cdot AdtMng_i + \\ & \boldsymbol{\phi}_i \cdot FirmFE_i + \tau \cdot TimeFE_t + \varepsilon_{it}.\end{aligned} \tag{M_1}$$

- *ESG-Policy.* These variables identify if a particular ESG policy is implemented or not in a given firm. The (dummy) variables included are based on:
  - Environmental policies (Policy Emissions, Policy Energy Efficiency, Resource Reduction Policy, Efficiency Policy and Environmental Supply Chain Management).
  - Social policies (Ethics Policy, Policy Community Involvement, Policy Diversity and Opportunity, Policy Skills Training, Policy Career Development, Policy Employee Health Safety, Health Safety Policy, Training and Development Policy).
  - Governance policies (Board Structure Policy, Executive Compensation Policy, Policy Bribery and Corruption, Training Policy, Energy, and CSR Sustainability Committee).

The third specification is defined as follows:

$$\begin{aligned}\log CDS_{it}(tenure) =&\omega + \boldsymbol{\beta}_i \cdot \mathbb{1}(ESG\text{-}Policy_i) + \boldsymbol{\gamma}_i \cdot Fin_i + \boldsymbol{\theta}_i \cdot AdtMng_i + \\ &\boldsymbol{\phi}_i \cdot FirmFE_i + \tau \cdot TimeFE_t + \varepsilon_{it}.\end{aligned} \tag{M_2}$$

- *ESG-Factors.* These are factors that measure particular drivers of each pillar. Following the standard approach, we apply the logarithm transformation to reduce the skewness of the data expressed in dollars or in terms of emission. The variables are the following:
  - Environmental factors (Water use to revenues, CO2 emission, Total energy use to revenues).
  - Social factors (Percentage women employees, Turnover of employees, Full time employees).

  The last specification is the following:

$$\begin{aligned}\log CDS_{it}(tenure) =&\omega + \boldsymbol{\beta}_i \cdot ESG\text{-}Factors_i + \boldsymbol{\gamma}_i \cdot Fin_i + \boldsymbol{\theta}_i \cdot AdtMng_i + \\ &\boldsymbol{\phi}_i \cdot FirmFE_i + \tau \cdot TimeFE_t + \varepsilon_{it}\end{aligned} \tag{M_3}$$

Finally, we list the other potential determinants of the CDS spreads according to the groups previously defined.

- *Financial factors.*

  Volatility, Size, Cashflow, Enterprise Value to Sales, Financial Leverage, Total Revenue, Operating Income, EBITDA, Intangibles Net, Effective Tax Rate, Capital Expenditures, Sale of Fixed Assets, Long Term Investments.

- *Auditing and Management factors.*

  Total Senior Executives, Board Member Compensation, Board Size, Auditor Tenure,

Audit Committee Independence, Highest Remuneration Package, Number of board meetings.

3 Results

In this section, we present the results according to the three models discussed above. For the sake of clarity, we do not include the estimates for the control groups (i.e., Financial, Auditing, and Management controls, Industry, Country and Year fixed effects).[1] Model M_1 includes the dummy variables that identify the top scorers for the group *ESG-score*. Results are reported in Table 3 for the full model (column 1) and for the subgroups (columns 2-5). It is worth noting that the top ESG scorers do not show any statistically significant difference from their counterparts. The result is confirmed also in the disjoint specification of $M_1^{(2)}$. Interestingly, the top scorers in *ESGcombined* exhibit a significant and negative coefficient, in the full and the disjoint model $M_1^{(3)}$, implying a lower level of credit risk with respect to their counterparts. The ESG combined is a score that includes also a penalization for those firms involved in major controversies (e.g., conflict on international norms). Surprisingly, the Environmental score (E) is significant and positively related to the CDS spreads. The results are confirmed also when the ESG score is taken on at the time in specification $M_1^{(4)}$. An analogous result is provided by the variable *Emissions* that measures the ability and commitment of a firm in reducing CO2 emission in the production processes. Another variable that shows a significant and negative relationship with the CDS spreads is *ResourceUse* (Environmental) that indicates the top scorer in the percentage of raw materials used from recycled sources. It is worth noting that the Paris Agreement, a legally binding international treaty on global emissions to mitigate climate change, took place in December 2015. Our sample stops in July 2016 and probably the effect of the Agreement are not visible yet in the estimates given that our sample end after 7 months. In the considered period, probably those environmental strategies were perceived as a sunk cost for a firm and not as part of

[1] The full estimates are available upon request to the authors.

the transition plan to carbon neutrality. On the other hand, these indicators involve several environmental metrics that could mask on average the greenhouse gas emissions. The top scorers in *CSRstrategy* (Governance) also show a significant and negative coefficient with respect to the CDS spreads. This variable measures the ability of the firm to disclose its implemented practice on the integration of financial, social, and environmental pillars in the decision-making process. Similarly, the *HumanRights* (Social) top scorers are perceived as less risky. The variable measures the firm's effectiveness in respecting the fundamental human rights conventions. The *ProductResponsibility* (Social) describes the capacity of a firm to provide goods and services by considering customers' health and safety and data privacy. Also, in this case, the top scorer firms are perceived as less risky with respect to their counterparts. Finally, top firm scorers on other social and governance factors such as *Workforce* (job satisfaction, healthy and safe workplace, diversity and equal opportunities), *Community* (good citizenship, protecting public health and business ethics), *Management* (the best practice of corporate governance) and *ShareHolders* (equal treatment of shareholders and the use of anti-takeover devices) are not perceived less risky with respect to the lowest counterparts.

The second model (M_2) includes the (dummy) variables that identify the ESG implemented policies as described in the group *ESG-policies*. Estimates are shown in Table 4. Also in this case the environmental dimension does not improve the perceived creditworthiness of a firm but on the contrary, the implementation of environmental policies seems to be perceived by the market as an additional cost. For instance, *PolicyEmissions* detects whether a firm has the policy to improve emission reduction and is positively related to the CDS spreads. An analogous result is found with *PolicyEnergyEfficiency* which identifies those firms that have a policy for energy efficiency improvements. Results are different for the social and governance policies. *PolicyBriberyAndCorruption* involves a code of conduct that aims at avoiding bribery and corruption in the governance and business processes. *PolicyCommunityInvolvement* identifies the policies on social responsibility (e.g., community

donations, volunteering, philanthropic activities, and community investments in education). *PolicyDiversityAndOpportunity* concerns commitment to diversity and equal opportunity (e.g., policies on equal treatment of women, minorities, disabled employees, age, ethnicity, race, nationality, and religion). *PolicySkillsTraining* signals whether a firm implements policies to improve the skills and the training of its employees (e.g., job-specific training). All these policies are significant and negatively related to CDS spreads. The only case involves the policy on a balanced membership of the board (*BoardStructurePolicy*) which is significant and positively related to the CDS spreads. All the other examined ESG policies do not provide any significant results with respect to the counterpart.

The last considered model is M_3 which includes the variables of the *ESG-factors* group. Results are presented in Table 5. The majority of these factors relate to the Environmental dimension and do not provide any significant result. A notable exception concerns the variable *WaterUseToRevenues* which is significant and positively related to the CDS spreads. The factor measures the total water withdrawal in cubic meters divided by net sales. Regarding the social factors, we have an interesting result on employees. Firms with a higher turnover of employees due to voluntary or involuntary reasons are perceived as riskier while firms with a higher percentage of full-time employees are perceived as less risky. Once again, findings on the Social dimension provide evidence of a negative relationship between the perceived credit risk of a firm.

Conclusion

The increasing awareness of ESG criteria on investors' choice explains the need to analyze how ESG factors contribute to the firms' creditworthiness. According to a recent survey of (Amel-Zadeh and Serafeim, 2018), 82% of respondent investors make use of ESG information since they consider it as financially crucial to a firm's performance. Generally, the availability of ESG ratings, which are assigned at a firm level, allows us to exploit cross-sectionally the

relationship between the ESG ratings and credit risk. Given that ESG factors measure a firm's sustainability and attitude towards positive or negative externalities, we investigate in this study how these factors affect the firm's creditworthiness after controlling for the usual determinants. Specifically, we consider the CDS spread for a sample of European firms from September 2010 to July 2016. Results show that a good performance on Social and Governance dimensions is negatively related to the CDS spread level. Conversely, results show that positive achievements on the Environmental pillar are negatively related to the CDS spreads. This clearly requires further investigations. For instance, our considered sample ends in July 2016, 7 months after the Paris Agreement that has represented the first legally binding international agreement to limit global emissions. The Agreement's influence, if any, is not yet discernible in the estimates. Those environmental efforts were most likely viewed as a sunk cost for a company during the time period under analysis, rather than as part of a carbon-neutral transition plan.

Table 3: Determinants of the natural logarithm of CDS spread using the specifications discussed in M_1. Statistical significance is denoted by ***, **, and * at the 1%, 5%, and 10% level, respectively. Robust standard errors in parentheses.

$\log CDS(5y)$	$M_1^{(1)}$	$M_1^{(2)}$	$M_1^{(3)}$	$M_1^{(4)}$	$M_1^{(5)}$
ESG(Top)	0.0354	-0.0174			
	[0.0476]	[0.0403]			
ESGcombined(Top)	-0.0865*		-0.1510***		
	[0.0475]		[0.0478]		
E(Top)	0.3449***			0.3363***	
	[0.0487]			[0.0437]	
S(Top)	-0.0477			-0.2177***	
	[0.0425]			[0.0340]	
G(Top)	-0.0449			-0.0808**	
	[0.0495]			[0.0363]	
ResourceUse(Top)	-0.2371***				-0.2743***
	[0.0365]				[0.0368]
Emissions(Top)	0.0911*				0.1848***
	[0.0500]				[0.0459]
Workforce(Top)	-0.0693				-0.0493
	[0.0488]				[0.0481]
Community(Top)	0.0014				0.0121
	[0.0354]				[0.0321]
Management(Top)	-0.0249				-0.0447
	[0.0463]				[0.0348]
Shareholders(Top)	0.0373				0.0692**
	[0.0305]				[0.0299]
CSRstrategy(Top)	-0.1088***				-0.0828**
	[0.0408]				[0.0407]
HumanRights(Top)	-0.1896***				-0.1995***
	[0.0298]				[0.0318]
ProductResponsibility(Top)	-0.2791***				-0.2778***
	[0.0401]				[0.0400]
Financial Ctrls	Yes	Yes	Yes	Yes	Yes
Auditing and Management Ctrls	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
SE	Rob.	Rob.	Rob.	Rob.	Rob.
Observations	2,072	2,072	2,072	2,072	2,072
R-squared	0.6781	0.6380	0.6407	0.6537	0.6660

Table 4: Determinants of the natural logarithm of CDS spread using the specifications discussed in M_2. Statistical significance is denoted by ***, **, and * at the 1%, 5%, and 10% level, respectively. Robust standard errors in parentheses.

$\log CDS(5y)$	M_2
PolicyEmissions	0.5932*
	[0.3319]
EthicsPolicy	-0.1258
	[0.1137]
PolicyEnergyEfficiency	0.6564***
	[0.0801]
BoardStructurePolicy	0.1586**
	[0.0734]
ExecutiveCompensationPolicy	-0.0571
	[0.1564]
PolicyExecutiveCompensationPerformance	0.0951
	[0.1452]
PolicyBriberyAndCorruption	-0.2082**
	[0.0831]
PolicyCommunityInvolvement	-0.9988***
	[0.1489]
PolicyDiversityAndOpportunity	-0.2207***
	[0.0803]
PolicySkillsTraining	-0.4806***
	[0.0970]
PolicyCareerDevelopment	-0.0819
	[0.1689]
PolicyEmployeeHealthSafety	0.1399
	[0.1001]
CSRSustainabilityCommittee	0.0981
	[0.1134]
EnvironmentalSupplyChainManagement	0.0926
	[0.0792]
Financial Controls	Yes
Auditing and Management Controls	Yes
Industry FE	Yes
Country FE	Yes
Year FE	Yes
SE	Rob.
Observations	2,072
R-squared	0.6581

Table 5: Determinants of the natural logarithm of CDS spread using the specifications discussed in M_3. Statistical significance is denoted by ***, **, and * at the 1%, 5%, and 10% level, respectively. Robust standard errors in parentheses.

$\log CDS(5y)$	M_2
CO2 Emission	-0.0044
	[0.0325]
WaterUseToRevenues	0.1409***
	[0.0173]
TotalEnergyUseToRevenues	-0.0006
	[0.0307]
Perc.WomenEmployees	-0.0015
	[0.0029]
TurnoverOfEmployees	0.0058***
	[0.0015]
FullTimeEmployees	-0.2111***
	[0.0510]
Financial Controls	Yes
Auditing and Management Controls	Yes
Industry FE	Yes
Country FE	Yes
Year FE	Yes
SE	Rob.
Observations	1,530
R-squared	0.6839

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HOW IS CREDIT RISK AFFECTED BY ESG FACTORS?

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CONTENTS

This paper is based on the work of a technical committee of AIFIRM (Italian Association of Financial Industry Risk Managers), coordinated by Paolo Di Biasi and Andrea Resti with the technical-organizational support of CRIF.

The original paper (in Italian) and the list of the committee members can be found at: https://www.aifirm.it/wp-content/uploads/2016/03/2021-Position-Paper-29-ESG-e-rischio-credito.pdf

CRIF would like to thank all the participants in the working group and AIFIRM for agreeing to this publication.

1. FOREWORD[1]

There is growing interest among banks in production systems compatible with environmental protection, greater social balance, and sound governance practices. Lenders are being encouraged to pursue similar objectives by increasingly widespread regulations and the growing awareness of investors and customers. Openness toward environmental, social, and corporate governance (ESG) requirements is all the more important in a trust-based business such as financial intermediation, and the ability to respond to changing public attitudes and sensibilities can become a powerful driver of success, as confirmed by the high growth rates seen by "sustainable" mutual funds and other forms of responsible investments.

While the banking system is aware of the strategic importance of ESG issues, their practical introduction into the lending processes (and in the monitoring tools that guide management actions) is still extremely heterogeneous and fragmented. This is also true of those aspects of the ESG paradigm, such as climate risk, where the pressure from supervisory authorities has become stronger and more focused in recent years. A recent report by the European Banking Authority (EBA)[2] highlighted the limited ability of banks to classify their borrowers based on their level of vulnerability to physical risk and to regulatory, technological, and market changes driven by the climate emergency. The methodologies used to quantify the effects of this vulnerability are still based on qualitative and subjective criteria, given the lack of a reference set of indicators, the absence of adequate historical empirical data, and the difficulty of constructing models capable of managing long-term forecasts with an acceptable confidence margin.

As a result, environmental and, to an even greater extent, social and governance risks are still recorded in a very imprecise and unclear way by individual banks. While this is true within lenders, it is even more striking for external parties – like policymakers or investors – which must observe the exposure of individual institutions to ESG factors through a frosted glass. Because of this lack of information, it becomes more difficult to subject intermediaries to an effective "market discipline", rewarding best practices and penalizing undesirable behaviors driven by the quest for short-term profit.

[1] This paper is based on the work of a technical committee of AIFIRM (Italian Association of Financial Industry Risk Managers), coordinated by Paolo Di Biasi and Andrea Resti with the technical-organizational support of CRIF. CRIF would like to thank all the participants in the working group and AIFIRM for agreeing to this publication.

[2] European Banking Authority, "Mapping climate risk: Main findings from the EU-wide pilot exercise", EBA/Rep/2021/11, May 21, 2021, European Banking Authority, Paris.

Indeed, the increasing attention paid by the public opinion to sustainable intermediation models may fall prey to flawed or opportunistic practices such as greenwashing. This can lead to behaviors that are geared mainly toward marketing purposes, in search of an effective "storytelling" for a customer base that is increasingly sensitive to ESG issues.

Against this background, our paper explores the relationship between ESG factors and credit risk. Is there a link between compliance with ESG values and the reliability of a borrower? Does the availability of collateral that is more in line with ESG criteria (e.g., buildings with energy certification, financial instruments issued by more "sustainable" companies) significantly reduce the Loss Given Default (LGD)? Some studies, although still preliminary, seem to point this kind of relationship.

Of course, such an outcome would be highly desirable. The ability to reduce risk, and therefore increase financial leverage and return on capital, would be a powerful driver to accelerate the banking system's transition toward "green" portfolios that also respect human rights and promote good governance practices. The shift toward sustainable investments could be "rewarded" with a discount on mandatory capital requirements, and banks could pass on some of the lower funding costs to ESG-compliant firms.

Are we sure, though, that these factors are not already indirectly present in risk measurement models? E.g., if an environmental certification increases the value of a property used as collateral, a correct appraisal should be enough to recalibrate the loan-to-value ratio and therefore the expected LGD… These objections are conceptually correct, but not always justified. Indeed, environmental certification may not only affect the current value of a property, but also its ability to maintain or increase its value in the future, an aspect that a traditional appraisal may not capture.

As one can see, this is a wide-ranging and highly relevant topic: for banks, which are rightly eager to improve credit risk management and extract value – including in terms of lower capital requirements - from the shift toward "sustainable" finance; and for supervisors, who are formally requested to investigate this subject[3].

[3] E.g., article 501(c) of the amended Capital Requirements Regulation (CRR) asks the EBA to assess whether a specific prudential treatment of exposures related to assets associated with environmental and/or social objectives would be justified.

This paper looks at the banks' risk management processes and, after defining ESG factors and how they interact with traditional banking risks, discusses how risk governance can be enhanced to incorporate ESG metrics, starting with those dealing with climate-related and environmental risks. It also focuses on loan origination and monitoring processes, showing how ESG factors can be incorporated into lending strategies, loan pricing, and collateral selection.

Finally, we examine the possible relationship between ESG variables and credit risk. One case study is presented concerning the introduction of ESG variables (mostly environmental) into bank rating processes. The results are incomplete and preliminary, but suggest that there is a potentially positive and statistically significant impact of ESG factors on the creditworthiness of bank borrowers.

2. THE EVOLUTION OF THE RISK GOVERNANCE FRAMEWORK IN LIGHT OF THE ESG FACTORS

ESG factors can have negative impacts (e.g., reputational damage, credit losses, etc.) but also positive ones (cost reductions and diversification benefits). For this reason, they should become part of a bank's risk governance and credit risk management infrastructure.

In this chapter, after defining ESG risks and how they interact with traditional banking risks, we look at how risk governance can be enhanced (from the choice of a business model to the risk appetite framework, ICAAP and ILAAP) to incorporate these types of factors, starting with climate-related and environmental risks. We finally focus on loan origination and monitoring processes, showing how ESG factors can be incorporated into lending strategies, loan pricing, and collateral selection.

2.1 DEFINING ESG RISKS AND THEIR INTERACTION WITH "TRADITIONAL" BANKING RISKS

ESG risk can be defined as the risk of a negative financial impact arising directly or indirectly from the effect that environmental ("E"), social ("S"), and corporate governance ("G") issues can have on the bank and its stakeholders, including customers, employees, savers, and suppliers. This can also happen indirectly, e.g. when ESG factors have a negative impact on the performance or solvency of a bank's counterparties (EBA, 2020, *Sustainable Finance: Market Practices*)[4]. More generally, ESG risks can be defined as "environmental, social or governance events or conditions, which if they occur have or may potentially have significant negative impacts on the assets, financial and earnings situation, or reputation of a supervised entity" (see BaFin, 2019, "Consultation - *Guidance Notice on Dealing with Sustainability Risks*").

ESG factors materialize through different transmission channels (see Table 1):

- **Physical risk -** this is the risk caused by the bank's interaction with counterparties that may suffer a negative physical impact linked to ESG factors;

- **Transition risk -** this refers to the uncertainty surrounding the time and speed of transition to a more sustainable economy, including:

[4] In other words, the impact of ESG factors on banks is both direct (as for any other business) and indirect (through losses suffered by their borrowers).

- changes to ESG policies (e.g., energy efficiency policies, taxes on fossil fuels leading to a price increase, environmental policies that encourage the use of environmentally sustainable resources, etc.);

- technological changes making old, polluting technologies obsolete ;

- behavioral changes (e.g., consumers and investors moving toward more sustainable products or assets);

- **Legal risk -** risks arising from losses or damage caused to natural persons or businesses due to ESG factors (e.g., damage due to non-compliance with ESG regulations).

	Physical risk	Transition risk	Legal risk
Environmental	X	X	X
Social		X	X
Governance			X

ESG risk can be seen as an extension of the risks already known by banks, supervisors and experts. Indeed, while ESG risks could be treated in a stand-alone way, it often becomes difficult to separate them from traditional credit, market, liquidity, and operational risks. ESG risks apply across all business processes, and therefore require an integrated risk governance.

While ESG risks materialize through already-known risk categories – such as credit, market, and operational risk – it is important for institutions and regulators to gain a holistic view of their overall relevance for financial performance. Their impact depends not only on the institution's business (e.g., types of assets, sector, size, geographical location, life-cycle stage, and types of liabilities), but also on governance and management strategies.

Having said that, let us discuss how ESG factors affect the main "traditional" bank risks.

First, with regard to **credit and counterparty risk**, ESG risks are challenging at all stages of the loan origination and monitoring process. The EBA guidelines (EBA/GL/2020/06, 2020) explain the role of environmental factors in the loan origination and monitoring process, providing a guide to assess ESG risks. In particular, the EBA suggests that banks include ESG factors – as well as all risks and opportunities associated with them – in their risk management policies, particularly for credit risk, and in their procedures.

The impact of ESG factors on the customers' creditworthiness is currently being studied by the banking system at an international level and will be further discussed in §4. Harmful environmental events are increasingly causing financial damage to corporate borrowers, leading to the need to reconsider their probability of default. When assessing the customers' creditworthiness, banks increasingly need to supplement the overall internal rating with scoring/ratings that also explicitly take into account environmental compliance.

The impact of ESG risks on credit risk parameters can be measured as follows:

- Probability of Default (PD) may change, for example, due to new regulations in the area of sustainability (which could reduce demand for some products and cause a fall in turnover), adverse climatic conditions (such as floods that could cause a crisis in some sectors, such as agriculture), and exposures to corporates that violate human rights;
- Exposure At Default (EAD) could be adversely affected by unforeseen shocks to the borrower caused by environmental disasters;
- Loss Given Default (LGD) could be negatively impacted by a drop in the value of assets used to secure loans, leading to losses when non-performing exposures are collected.

With regard to **market risk**, ESG factors can affect the fair value of a portfolio of financial instruments in several ways:

- accentuating the left tail of the distribution of market risk returns, given the presence of financial instruments issued by companies that do not meet environmental and social sustainability criteria;

- an increase in the volatility of the returns on financial instruments issued by companies in sectors perceived as unsustainable; the price of these instruments may be more significantly influenced by a tighter ESG regulations. The same holds for the value of portfolios that only include a low share percentage of ESG-compliant instruments.

The inclusion of ESG risks in market risk management is not enough. In fact, an organizational framework must be adopted that defines the responsibilities for decision-making, implementation, monitoring, and reporting of the impact of ESG risks on the bank's securities portfolio.

ESG factors also affect **operational risk**, mainly through the reputational/ legal risks that may arise from the activities of the bank and its counterparties. For example, the financing of companies extracting fossil fuels could be the subject of public controversy with a negative impact on the reputation of the financing bank; exposures to companies that do not adopt appropriate standards in relation to workers' rights (or more generally, human rights) may also increase future compliance costs, with potential negative impacts on the financial position, and/ or reputational risks, leading to a loss of customers. In addition, climate-related physical risks can cause a direct negative impact on the bank due to material damage caused by adverse climate events.

ESG factors may also have an effect on a bank's **liquidity and refinancing risk,** affecting its ability to refinance on the market and on the degree of liquidity of its financial assets. From this perspective, the banking system is called upon to include ESG factors in the liquidity and refinancing risk management process, taking into account normal and stressed market conditions. Namely, on the assets side, ESG factors can influence the value of financial assets by increasing their illiquidity. Liquidity risk may also ensue from bank runs caused by unforeseen environmental shocks and/or social unrest. On the liabilities side, ESG factors may affect the availability and/or stability of funding sources due, for example, to higher costs of market access and/or higher funding uncertainty due to shifts in the savers' preferences. Conversely, greater attention to ESG factors can lead to easier access to liquidity and the capital market, as evidenced by the widespread success enjoyed in recent years by "sustainable" investment vehicles, which captured a significant share of the new savings[5].

2.2 ESG RISK MEASUREMENT: POTENTIAL DIFFICULTIES AND APPROACHES

The analysis of ESG factors and the assessment of ESG risks[6] should translate into a bank's whole risk governance process and, as requested by the EBA, into the loan origination/monitoring policies and creditworthiness assessment tools. As many banks still in the early stages of this effort, a number of challenges emerge:

- *Uncertainty:* the impact of environmental risks is very uncertain in terms of timing, as well as of the impact of the various policies and regulatory actions aimed at reducing emissions. For each measure adopted, various scenarios should be envisaged, each with different economic and social implications;

[5] In December 2020, ESG open-ended funds in Europe (including ETFs) accounted for around 11% of the total and managed resources of more than €1,100 billion (with annual growth of 52%, compared to a market average of 3%). There were around 500 new funds of this type in 2020 (42 of which were specifically related to climate change), while a further 253 funds were "repurposed", changing their name and investment policy in order to intercept the growing demand for sustainable investment. Source: Morningstar. "European Sustainable Funds Landscape: 2020 in Review - A Year of Broken Records Heralding a New Era for Sustainable Investing in Europe", Morningstar Manager Research. Chicago, 2021.

[6] From this point, reference will be made mainly to the lending business.

- *Lack of data:* data on ESG factors may not be meaningful, or may be unreliable and difficult to use. Even when information is available (such as for carbon dioxide emissions), is may be difficult to translate it into forecasts of the counterparties' financial performance;

- *Methodological constraints*, the risk management models used by banks are based on historical information, which is then used to estimate current and future risks. However, when it comes to environmental factors, such models are likely to be inadequate. It can therefore be very difficult to include ESG risks in the calculation of standard risk parameters such as PD or LGD;

- *Timescale mismatch:* while the strategic planning of intermediaries typically looks at "short" periods, ESG factors can materialize over decades.

In other words, the integration of ESG factors into risk management processes (including the management of credit risk) is hampered by the lack of data on the counterparties' ESG characteristics and by methodological issues: e.g., when assessing the financial risks associated with climate change, traditional retrospective analysis cannot be relied on and longer time windows are needed than those usually adopted.

However, data availability on ESG aspects will benefit from a number of initiatives. Indeed, as part of the EU's "action plan on sustainable finance", several activities related to ESG disclosure have been entrusted to the EBA and other bodies, as summarized in Figure 1.

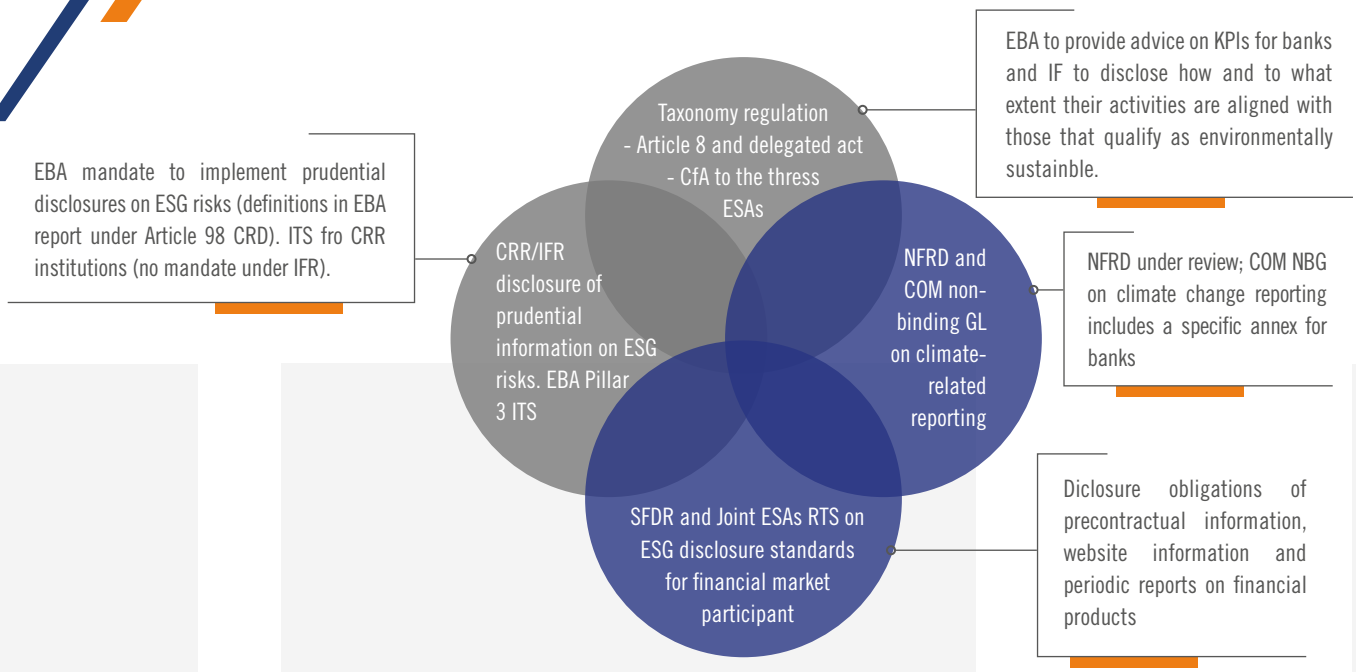

Figure 1 - ESG Disclosure: initiatives by European authorities

In any case, ESG indicators will play a key role in both the lending and the investment process, with a significant impact on the banks' operating functions. Credit institutions will have to implement a structured approach to data collection as well as a well-defined operational workflow within their organization. In this regard:

- the departments responsible for products should typically be responsible for data collection, preliminary information analysis and the assessment of ESG trends, identifying potential problems and strengths by industry and geographical area, or even by individual counterparty. Data should be acquired either directly from the customer or, hopefully to increasing extent, indirectly, from databases focused on ESG data[7];

- based on this new information, the Risk Management department should incorporate ESG factors into the bank's Risk Appetite Framework ("RAF"), as well as into the setting of risk limits and other risk governance tools.

[7] With regard to public databases, work is under way to define the European Single Access Point (ESAP) promoted by the European Commission, which will contain both financial and "non-financial" data (or rather, sustainability or "pre-financial" information, using the two terms now considered more appropriate). Therefore, the ESAP should contain ESG data both on counterparties within the scope of the Non-Financial Reporting Directive ("NFRD"), and on smaller counterparties not subject to these regulations (an ESG Template is being developed for SMEs, excluding those of very small size).

In this context, the implementation of structured automated processes that enable timely data collection and proactive data analysis will also prove expensive from an IT perspective. On the one hand, data collection requires the development of specialized software to preserve data integrity; on the other hand, the standardization of formats is necessary to allow precise cataloging and an initial assessment of the ESG factor metrics. Without an adequate IT structure and highly automated processes, the data received would be hard to manage. In a number of Commission consultations (NFRD, new sustainable finance strategy, ESAP), the European Banking Federation (EBF) has stressed the importance of some form of centralized information hub at an EU level, collecting ESG data in a standardized and potentially machine-readable format.

It seems likely that the actual assessment of ESG risks will have to be preceded by a so-called "tagging" according to the EU Taxonomy (as well as other ESG taxonomies used by individual banks). "Tagging" means checking (and monitoring) whether a given economic activity fits the screening criteria provided for by a given classification (e.g., those provided by the EU Taxonomy according to a science-based approach that includes the so-called "do no significantly harm" principle).

For EU banks at least, such tagging may also be necessary for prudential reporting purposes (especially if the EBA confirms the introduction of the so-called Green Asset Ratio, a ratio indicating the incidence of ESG investments on the total investments financed by a bank), as well as for non-financial reporting (assuming that the indicators presented in the Guidance issued by the Commission in June 2019, which refers to the Taxonomy, will translate into the new NFRD).

Tagging counterparties on the basis of the EU Taxonomy may not be enough to evaluate ESG-related financial risks, and in particular credit risk. According to the evidence available today, not all economic activities[8] aligned with the EU Taxonomy (e.g., relating to climate change mitigation) also lead to a reduction in credit risk[9].

[8] For example, green mortgages, products related to the development of the circular economy, and some forms of project financing.

[9] The economic activities with these characteristics are those defined as eligible for a specific form of prudential treatment which would be recognized by virtue of their reduced risk.

As a result, one of the main challenges for risk managers is to identify the additional information, besides tagging, required to assess the financial risks associated with ESG factors[10]. As noted by several rating agencies, defining ESG risks is essential to fully assess the creditworthiness of a counterparty, but is a complex process that involves a forward-looking perspective, especially for long-term factors. A typical example of forward-looking studies are scenario analyses and stress tests for climate-related risks, such as those that the ECB will conduct in 2022.

As noted above, data availability plays a major role, given the lack of transparency and the difficulty of obtaining relevant, reliable, and comparable information. One example are ESG ratings, whose production – by specialized agencies – follows different approaches and leads to results that are difficult to reconcile with each other (to the extent that ESMA has suggested that ESG ratings be subjected to forms of supervision and regulation similar to those already in place for credit ratings).

Another key aspect of ESG risks is the time horizon on which they must be assessed. Historical indicators must be available for each sector, but should always be accompanied by suitable forward-looking metrics. For example, measuring a company's CO2 emissions today does not take into account the benefits expected from energy saving projects that are planned for the future. For this reason, the Taxonomy Expert Group (TEG) suggests[11] that a forward-looking assessment should be obtained by analyzing investments in sustainability or other ventures, to estimate the alignment of activities with performance improvement programs (as already identified for some macro sectors[12]). While quantitative indicators are certainly beneficial to forward-looking assessments, a number of subjective appraisals are required to understand in detail the dynamics of a sector, including how different counterparties are preparing to deal with the risks and opportunities, and what their specific points of vulnerability and strength are.

[10] In the medium to long term, considering the transition risk, it still seems plausible to assume, once tagging is complete, that there will be a greater risk for a portfolio that is heavily unbalanced toward activities tagged as environmentally non-sustainable according to the EU Taxonomy. In that sense, tagging may also result in some "high-level" considerations in terms of financial risk.

[11] https://ec.europa.eu/info/sites/info/files/business_economy_euro/banking_and_finance/documents/190618-sustainable-finance-teg-report-taxonomy_en.pdf

[12] https://2degrees-investing.org/wp-content/uploads/2020/09/Katowice-Banks-2020-Credit-Portfolio-Alignment.pdf

2.3. INTEGRATION OF ESG FACTORS INTO THE RISK GOVERNANCE PROCESS

2.3.1 STRATEGIC PLANNING AND DISCLOSURE

Due to the special nature of ESG risks, a preliminary analysis should be conducted aimed at identifying factors, topics, and criteria that each bank considers relevant to its profile, business model, size, and reference market (with regard to geographical areas and sectors served).

As suggested by the relevant international standards (such as those drawn up by the Global Reporting Initiative[13]), a materiality analysis should be performed to identify the most significant sustainability issues, to which one or more ESG risk categories are associated. Examples of such risks are waste and pollution management, climate change, respect for human rights, the workers' employment and health and safety conditions, and anti-bribery and anti-corruption practices.

Each bank should then assess the impact that these risks could have with respect to three different levels:

- general, considering the negative effects that might ensue if they are not properly monitored;
- specific, based on the impact they could have on traditional risk categories, in particular on reputational risk;
- focused on emerging risks.

Climate change and environmental risks ("CER") are currently considered a priority in terms of the correct assessment and integration into risk management and strategic planning models. In 2020, the scientific community, governmental institutions and national regulatory bodies focused on mitigating these risks, including through initiatives such as the European Green Deal and the Taxonomy Regulation.

[13] See note "*Global Reporting Initiative, The global standards for sustainability reporting*", available on *https://www.globalreporting.org/standards/.*

Organizations, including banks, will therefore increasingly have to rethink their strategies, identifying the actions needed to turn climate-related risks into new business opportunities. To do this, they must:

- assess, report, and integrate into business strategies the (financial) risks arising from climate change;
- improve disclosure to investors on the basis of the TCFD recommendations, 11 recommendations (see Table 2) which focus on four thematic areas (governance, strategy, risk management, and metrics and targets) and indicate how climate risk information should be passed on to investors and other stakeholders to help them understand how organizations assess climate risks and opportunities.

Governance	Strategy	Risk management	Metrics and targets
Disclose the organization's governance around climate-related risks and opportunities.	Disclose the actual and potential impacts of climate-related risks and opportunities on the organization's businesses, strategy, and financial planning where such information is material.	Disclose how the organization identifies, assesses, and manages climate-related risks.	Disclose the metrics and targets used to assess and manage relevant climate-related risks and opportunities where such information is material.
Recommended Disclosures	**Recommended Disclosures**	**Recommended Disclosures**	**Recommended Disclosures**
Describe the board's oversight of climate-related risks and opportunities.	Describe the climate-related risks and opportunities the organization has identified over the short, medium, and long term.	Describe the organization's processes for identifying and assessing climate-related risks.	Disclose the metrics used by the organization to assess climate-related risks and opportunities in line with its strategy and risk management process.
Describe management's role in assessing and managing climate-related risks and opportunities.	Describe the impact of climate-related risks and opportunities on the organization's businesses, strategy, and financial planning.	Describe the organization's processes for managing climate-related risks.	Disclose Scope 1, Scope 2, and, if appropriate, Scope 3 greenhouse gas (GHG) emissions, and the related risks.
	Describe the resilience of the organization's strategy, taking into consideration different climate-related scenarios, including a 2°C or lower scenario.	Describe how processes for identifying, assessing, and managing climate-related risks are integrated into the organization's overall risk management.	Describe the targets used by the organization to manage climate-related risks and opportunities and performance against targets.

Table 2 - TCFD recommendations on disclosures

2.3.2. THE RISK APPETITE FRAMEWORK (RAF) AS A STARTING POINT FOR INCORPORATING ESG RISKS

The Risk Appetite Framework ("RAF") defines the level of risk an institution is willing to assume within its risk capacity, in line with its business model, to achieve its strategic objectives (EBA, 2017[14]). The definition of the risk appetite, risk tolerance and risk capacity, which make up the RAF, is the first step in the process through which the bank identifies the relevant risks and decides how to measure them by reference to capital adequacy, liquidity, operational risks, equity risk, and so on.

Over the coming years, the RAF is expected to also include ESG risks, or at least climate-related risks, as suggested from the guidelines and consultations on climate-related risks that have been issued in recent years (TCFD, 2018; ECB, *Guide on climate-related and environmental risks,* 2020; EBA, Discussion Paper, 2020).

For each risk category identified, the RAF defines the risk capacity, risk appetite, risk tolerance, and risk limits. The incorporation of ESG factors therefore requires careful evaluation. The risk tolerance and risk appetite for climate-related and environmental risks should be reported (e.g. in terms of concentration of climate-sensitive sectors in the overall portfolio, capital needed to cover risks, etc.). The ECB expects banks to incorporate the identification of environmental risks into their RAF and that the appropriate Key Performance Indicators (KPIs) are cascaded down to the relevant business lines (e.g., retail banking, private banking, commercial banking, and corporate banking) and portfolios. Examples of such indicators are carbon emissions from borrowers' activities, the average energy class of mortgage portfolios, and the number of real estate properties where loans were used to improve energy savings. The analysis should be adapted to the bank's business model and risk profile, taking into account the vulnerabilities of different economic sectors, transactions, and the physical locations of the bank and its counterparties.

[14] EBA (2017), Guidelines on Internal Governance, November.

In addition, to comply with article 79 of the CRD and with the EBA guidelines[15], institutions should adopt a holistic approach to account for climate risks and related environmental factors in their lending procedures and policies.

As for physical risks, banks should set limits to assess the potential impact of climate events (such as floods and droughts) on the customers' properties, infrastructures, and production activities. Similarly, from a social and governance point of view, banks should take strict measures to blacklist companies that exploit child labor or do not provide adequate levels of social protection to workers (EBA, 2020).

The integration of climate-related and environmental risks into the RAF increases the resilience of the banks' business models and improves their ability to manage risks (e.g., by setting credit caps on exposures to vulnerable sectors and areas). Since climate change risk is associated mainly with credit risk, its identification involves an approach that takes into account the measurement, monitoring, and reporting of exposures[16]. However, supervisors and regulators are aware that the relevant definitions and taxonomies are still under development.

The integration of climate-related risk into the RAF can occur through appropriate adjustments to the indicators relating to pre-existing risk areas (credit, market, liquidity, and operational). In both cases, intermediaries should:

- document/map in detail the climate-related and environmental risks relevant to their business model, in particular their transmission channels and the impact on the risk profile;
- develop appropriate risk indicators and set suitable limits for the effective management of climate-related and environmental risks in line with their regular monitoring processes;
- define the reference time periods (including long-term horizons) for the measurement and monitoring of the CER metrics integrated into the RAF;

[15] See also Principle 2 (ii) and (iii) of the ECB Guide. Guide to the internal capital adequacy assessment process (ICAAP); see paragraphs 57, 126, 127, 146, 149 and 188 of the Guidelines on loan origination and monitoring (EBA/GL/2020/06).

[16] According to ECB expectations, banks should allocate quantitative metrics to such risks, particularly physical and transition risks.

- develop indicators that strengthen the bank's ability to respond to a sudden shift to a low-carbon economy (e.g., due to an environmental event that has a strong impact on the business model and/or loan portfolio). Simplified indicators (green asset ratio, green collateral ratio, green sector concentration, ad-hoc division of risk metrics for green lending and sustainable finance, etc.) should also be considered as a way to set things in motion and improve internal practices;

- Prepare a remediation plan setting out all the mitigation measures to be promptly taken if alert thresholds are exceeded.

2.3.3. ICAAP, ILAAP AND EARLY WARNING SYSTEMS

The inclusion of climate-related and environmental risks requires not only to update a bank's RAF, but also all other to review all other risk governance documents (including ICAAP and ILAAP), early warning systems and remuneration policies (TCFD, 2018; ECB, 2020). Risk planning, including for climate-related risks, together with capital planning, is seen by regulators as a fundamental component of risk management, along with the related documentation.

The integration of ESG factors should involve the bank's strategy, the policies relating to the main risks, the abovementioned risk governance infrastructure, the contingency funding plan, the internal stress test framework, measurement tools, internal reporting and, market disclosure (see Figure 2).

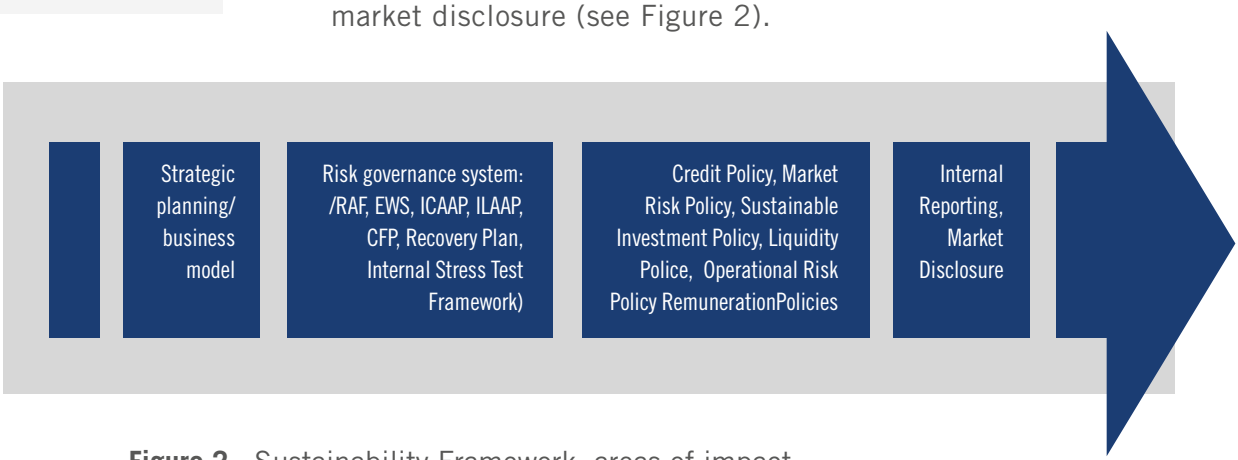

Figure 2 - Sustainability Framework: areas of impact

At present, banks seem to have only partially achieved these objectives. Difficulties arise mainly from the lack of data and the misalignment between the Taxonomy and the RAF, as well as from the cross-cutting nature of climate-related and environmental risks. Furthermore, the ECB Guide on climate-related and environmental risks and the EBA consultation of November 2020 do not clearly indicate to what extent, and with what level of detail, climate-related risk and other environmental risks should be included in the RAF, as their importance can vary significantly depending on each bank's size and business model. In short, the integration of ESG risks into the risk management framework is still in the development phase and requires collaborative interaction between regulators, supervisors, and banks.

According to the ECB, the integration of ESG issues into strategic planning requires intermediaries to:

- promote of an internal sustainability risk culture;
- analyze the impact of climate-related and environmental risks in the bank's market context from a short- and long-term perspective, in order to take decisions that are consistent with the strategic plan and the business model;
- conduct longer-term assessments (beyond the usual 3 to 5-year time horizon typical of planning activities) focusing on the resilience of the current business model against plausible and relevant future scenarios that embed public policy commitments to transitioning to a more sustainable economy;
- define strategic objectives linked to climate-related and environmental risks for the different lending and trading portfolios;
- define measurable and quantifiable KPIs for each climate-related or environmental risk (where possible). Depending on the nature of the activities carried out by each bank, the KPIs should cascade down to the relevant business lines and portfolios;

- integrate significant climate-related and environmental risks into all relevant levels of the organization, assigning specific tasks (including an ad-hoc organizational role dedicated to sustainability management), ensuring ongoing communication between the various functions, monitoring progress, taking timely corrective action, and keeping track of all costs;

- integrate climate-related and environmental risks into the bank's risk governance infrastructure, consistent with its strategic objectives, associating quantitative metrics with those risks (particularly to physical and transition risks).

Box 1 – Restructuring the ICAAP to include ESG factors

ICAAP restructuring must cover all phases and therefore include:

- the incorporation of the definition of climate-related risks, other environmental risks, and other ESG risks among the **"mapped" risks;**
- The definition of the roles and responsibilities of the bodies and functions involved in the ESG framework within the **ICAAP governance framework** (e.g., by assigning new tasks to the Risk Committee, the Management Planning and Control function, the CRO, the Board of Directors, the Internal Auditors, the Sustainability Manager, or the Sustainability Committee);
- The incorporation of the strategic lines relating to climate-related risk and other ESG risks into the **business model description**, also referring to the potential impacts of environmental disasters and other climate-related risks on the long-term validity of the current business model. For this evaluation, it is useful to use stress testing;
- **The integration of climate-related risk and other ESG risks into the assessment of current and future capital adequacy,** from both an economic and regulatory perspective. The former perspective considers the potential risks to the economic value of the bank and the level of the so-called "internal capital". The latter assesses the potential impact on regulatory capital ratios, taking this into account a baseline scenario and one or more adverse ones.

The ECB expects the results of this assessment to be taken into account in the definition of risk appetite and the business strategy and, more generally, in all strategic and managerial decision-making;

- **Periodic reviews** of the ICAAP in order to verify if the internal methodologies and processes have led to strong results and whether they continue to be adequate in light of the current situation and future developments. Given the rapid evolution of data availability and methodologies for the identification and measurement of climate-related and environmental risks, the ECB expects banks to regularly assess their adequacy and quality.

In order to test capital adequacy under stressed conditions, adverse scenarios should include all risks relevant to internal capital and regulatory ratios. In carrying out these scenario analyses and stress tests in relation to climate-related and environmental risks, the following aspects should be taken into account:

- how the institution could be affected by physical risk and transition risk;
- how climate-related and environmental risks could evolve within the various scenarios, bearing in mind that they may not be fully reflected in the historical data;
- how climate-related and environmental risks could materialize in the short, medium, and long term, depending on the scenarios considered.

The ECB expects institutions to define their own risk profile and individual characteristics and to consider various scenarios based on different combinations of assumptions. Adverse scenarios should assume unusual but plausible situations with an appropriate degree of severity in terms of impact on regulatory capital adequacy ratios. In accordance with the ECB ICAAP guide, the forward-looking simulation should cover at least three years. For material risk types, however, institutions should take into account trends beyond this minimum time horizon in a proportionate manner, including in the context of strategic planning. Intermediaries must have a forward-looking view of climate-related and environmental risks, given the significant impact they have in terms of potential losses and a reduction in the economic value of the bank's assets.

In order to establish an effective ESG risk management system, additions to the RAF, ICAAP and ILAAP must be supported by appropriate changes to the early warning system (including through the calibration of all relevant limits).

Box 2 – Restructuring the ILAAP to include ESG factors

In parallel with the ICAAP, banks must also review their liquidity governance system, assessing whether climate-related and environmental risks could have a reputational impact that would reduce their ability to raise funds on the market, affect the net stable funding ratio, impact the survival period and produce net cash outflows that would have a tangible effect on the supply of High-Quality Liquid Assets (HQLA) and the asset encumbrance level.

Based on the results of these analyses, it may be necessary to realign the bank's funding plan and the contingency funding plan. The ECB therefore expects intermediaries to assess whether environmental risks can significantly change net cash outflows and liquidity reserves, taking them into account when managing liquidity risk and calibrating reserves, including for specific geographical areas where significant climate-related or environmental risks materialize.

Finally, within the framework of liquidity management, banks should plan the development of green funding instruments in line with the principles developed by the International Capital Market Association ("Green Bond Principles") and the Technical Expert Group ("Climate Bond Standard" and "EU Green Bond Standard").

2.4. ESG FACTORS IN LOAN ORIGINATION AND MONITORING MODELS

2.4.1. PORTFOLIO-LEVEL AND SINGLE-NAME ASSESSMENTS

As far as credit risk is concerned, a bank must be able to assess the creditworthiness of a customer or a loan by taking into account all risk factors, including ESG risks if relevant. Furthermore, once a loan has been originated, its risk profile must be monitored, on a single-counterparty basis and/or looking at homogeneous portfolios.

In its discussion paper on the management and supervision of ESG risks (EBA/DP/2020/03), the EBA argues that banks need to combine risk identification with quantitative methodologies to assess the degree of alignment of their credit portfolios with sustainability objectives. In particular, three possible approaches exist:

- the *Portfolio Alignment Method*, which assesses the changes necessary to align the bank's portfolio with its sustainability targets;
- the *Risk Framework Method*, which assesses the sensitivity of the bank's portfolio – in terms of risk – to potential changes linked to ESG factors;
- the *Exposure Method*, which assesses the performance of individual exposures in relation to ESG factors, producing a score/rating.

The supervisor leaves it to the banks to decide what methodologies to apply and is aware that, given the increasing awareness about ESG issues and the rapid evolution of available data, the effectiveness of the approaches initially chosen could change over time, including due to changes in business strategies. Therefore, banks should carry out regular assessments of the adequacy of the methodologies and approaches adopted for the assessment and mitigation of ESG risks (as expressly stated by the ECB regarding climate-related risks)[17].

In this context, there are several possible approaches to incorporating ESG factors into loan origination and monitoring phases (either from a portfolio-wide or a single-name perspective), which are discussed below.

[17] See Expectation 7.7 – ECB Guide on climate-related and environmental risks

2.4.1.1. THE LOAN ORIGINATION STEP

The origination and the renewal of a loan should be guided by well-defined risk objectives and clear policies. The various departments involved should have appropriate tools (in terms of procedures and information) to carry out a credit assessment taking into account all relevant risk factors.

Today's customer segmentation criteria (legal status, size, characteristics of the requested facility, type of collateral, and sector of economic activity) should be expanded to consider ESG risks, in line with the identification and definition of the significant factors and with the business strategies.

As already mentioned, the European Union has established a taxonomy as consistent as possible with the sustainability goals (in terms of low emissions) contained in the Sustainable Finance Action Plan and the Paris Agreement. It identifies industries and economic activities that can help achieve the objective of reducing net CO2 emissions to zero by 2050. Based on these guidelines, credit institutions should be able to update the breakdown by industry of their loan portfolios.

A portfolio segmentation based on the EU taxonomy could help the bank when assessing its business model or when choosing investment strategies or the choice to disinvest from certain asset classes (according to the portfolio alignment approach identified by the EBA and described above). For example, an institution may decide to increase loan supply to "zero-emission" firms or to the so-called "transitional" sectors (whose activity requires substantial investments to update their energy consumption model). Also, with reference to the Risk Framework Method, the bank could identify which sectors would be most at risk from climate-related changes and fine-tune its investment strategies for some asset types. In order to identify those customers that are most exposed to ESG risks, either directly or indirectly, banks could also consider using heat maps and scores which highlight, for example, the climate-related and environmental risks of individual economic sectors and sub-sectors, as suggested by the Exposure Method.

These portfolio-wide approaches must certainly be combined, at least initially, with an assessment of individual customers and loans. In fact, belonging to a sector and/or segment characterized by high ESG risk does not necessarily imply a similar risk for each individual customer. The bank should therefore carry out an in-depth analysis of large borrowers, including an examination of current and projected greenhouse gas emissions, their market context, ESG supervisory requirements, and the likely impact of ESG regulations on the customer's financial position[18].

In assessing the creditworthiness of borrowers, a key role is played by the valuation of collateral, especially for real estate. With regard to climate-related risk, a bank could supplement the traditional valuation of real estate assets with indexes of vulnerability to physical events (such as landslides, floods, or earthquakes); this could be made by examining the geographical location of the property on one or more risk maps that indicate the likelihood of such extreme climate events. In the case of collaterals or counterparties with a high environmental risk, banks could charge higher rates in order to ensure that higher risks are paid for by the customers.

With regard to other ESG risks, i.e., social and governance risks, there are currently no agreed taxonomies at a European level. Expert discussions are at a much earlier stage than for climate-related/environmental risks, in part due to the broad and heterogeneous nature of the "S" and "G" factors. Some initiatives led by trade associations aim to raise awareness about the general Sustainable Development Goals contained in the United Nations Agenda 2030, to highlight the benefits of disclosing non-financial information and to spread best practices on how that disclosure should occur.

The origination stage provides a great opportunity to acquire missing ESG-related information from the customer. Such information, if collected systematically and consistently[19], will allow banks to experiment with new credit risk assessment algorithms. One example is the data relating to the energy efficiency classification of the property, which appears to be related to the borrower's risk[20]. Banks do not currently file that piece of information on a systematic basis, and must therefore acquire it when the loan is granted or when the property valuation is renewed. This aspect is also important in view of the creation of adequate time series for the development of internal scoring models.

[18] EBA Guidelines – Loan Origination and Monitoring, §127.

[19] See Expectation 6.2 – ECB Guide on climate-related and environmental risks: "As climate-related and environmental risks have distinctive characteristics, institutions are expected to consider adapting their IT systems to systematically collect and aggregate the necessary data in order to assess their exposures to these risks".

[20] Refer to the study promoted by the EedaPP (Energy efficiency Data Protocol and Portal, Final report on econonometric assessment and results, 2020, available at https://eemap.energyefficientmortgages.eu/.).

2.4.1.2. THE RISK MANAGEMENT/MONITORING STEP

According to Expectation 8.4 of the ECB Guide on climate-related and environmental risks, banks should "monitor and manage credit risks in their portfolios, in particular through sectoral/geographic/single-name concentration analysis, including credit risk concentrations stemming from climate-related and environmental risks, and using exposure limits or deleveraging strategies". The same authority advises institutions "to develop their monitoring capabilities in conjunction with the metrics and limits developed for the purposes of their risk appetite and data governance framework".

To monitor the solvency status of borrowers, institutions use early warning indicators, internal ratings, or other anomaly detection systems to intercept adverse developments as soon as possible. Based on these indicators and other characteristics, a bank, where appropriate, initiates its collection strategies, which depend on the type of loan and customer. The assessment of the initial anomalies experienced by a customer is usually delegated to the branch network.

The integration of ESG factors into credit monitoring could certainly improve the understanding of the borrower's difficulties and provide additional criteria for effective segmentation of non-performing loans. As with the risk assumption stage, the bank should have the appropriate level of information in its internal systems to conduct a comprehensive assessment.

ESG indicators and metrics could therefore be integrated into the banks' monitoring tools (performance ratings, early warning systems, Level 2 controls...), highlighting those positions that are most sensitive to them and providing information on their deterioration, including in relation to environmental risk. When assessing any signs of decline, the branch network could also use ad hoc ESG ratings assigned by external providers or a qualitative ESG risk assessment drawn up internally (possibly on the basis of the counterparties' sector of activity and the presence of specific risks).

[14] EBA (2017), Guidelines on Internal Governance, November.

The EBA guidelines on loan origination and monitoring also suggest assessing the inclusion of such risks within internal rating models, considering the development of ad-hoc modules in order to streamline the validation process. These modules do not necessarily have to be statistical, but can be based on qualitative questionnaires and expert opinions.

In the monitoring phase, the following factors could be used:

- *Geographical:* examining the portfolio concentration in areas linked to special phenomena: climate (floods, earthquakes, hydrological instability), environmental (CO2 emissions), social (companies with lower levels of occupational health and safety, with low levels of inclusion, etc.), or governance (companies without an effective code of conduct and/or appropriate remuneration policies);

- *Sector-based:* examining the concentration in sectors identified in the EU taxonomy (or other taxonomies), with particular regard to those associated with transition risk;

- *Energy:* examining the distribution by energy efficiency class of the properties used as collateral.

ESG vulnerabilities could also affect non-performing loan management. In fact, a bank could choose to carry out massive actions on its non-performing portfolio (or to target individual positions) in light of the forecasts published by specialized external providers.

Finally, the introduction of segmentation criteria and risk metrics driven by ESG factors would also enrich the information set available to the risk management department to perform Level 2 checks, e.g., when verifying whether impaired exposures have been correctly identified and provisioned.

3.THE LINK BETWEEN ESG FACTORS AND CREDIT RISK

We now look at the potential relationship between ESG variables and credit risk. The introduction of an ESG component into internal rating systems has long been debated by analysts, banks and regulators. This was made, e.g., by the ECB Guide on climate-related and environmental risks (see Box 3) as well as by the EBA Guidelines on loan origination and monitoring (2020), which also require credit institutions to incorporate sustainability factors into their lending policies.

Box 3 – Relationship between ESG and credit ratings in the ECB guidelines

The introduction of ESG factors into rating systems responds to the following regulatory requirements in the ECB Guide on climate-related and environmental risks:

- **Loan origination and monitoring processes:** climate-related and environmental risks are expected to be included in all relevant stages of the credit-granting process and credit processing. Institutions are expected to monitor and manage credit risks in their portfolios, in particular through sectoral/geographic/single-name concentration analysis, including credit risk concentrations stemming from climate-related and environmental risks, and using exposure limits or deleveraging strategies
- **Risk classification procedures:** institutions are expected to adjust risk classification procedures in order to identify and evaluate, at least qualitatively, climate-related and environmental risks. Critical exposures to such risks should be highlighted and, where applicable, considered under various scenarios with the aim of ensuring the ability to assess and introduce in a timely manner any appropriate risk mitigation measures, including pricing
- **Collateral valuation:** Institutions are expected to consider climate-related and environmental risks in their collateral valuations
- **Pricing:** institutions' loan pricing is expected to reflect the different costs driven by climate-related and environmental risks
- **Risk appetite and business strategy:** Institutions' loan pricing frameworks are expected to reflect their credit risk appetite and business strategy with regard to climate-related and environmental risks.

ESG phenomena can affect the financial performance of enterprises. This suggests that this should be taken into account in creditworthiness assessments, including through the use of a rating system that incorporates these factors qualitatively or quantitatively.

Generally speaking, it would be desirable for financial institutions to grant credit to counterparties that are more virtuous in relation to ESG issues, giving them easier access to lower-cost loans. To this end, it makes sense to ask whether mandatory capital requirements could be adjusted – if necessary by introducing a special "ESG Supporting Factor", as it was proposed by the EBF – by giving a "discount" on loans granted to more "sustainable" counterparties.

However, the introduction of any "discounts" associated with the ESG profile would become much easier, both conceptually and in terms of consensus among policymakers, if a positive ESG profile can be shown to statistically associated with a lower credit risk.

In the following pages we present a case study, carried out by CRIF, on the introduction of some ESG variables into a bank's rating process. The results are incomplete and preliminary, but suggest that there is a potentially positive and statistically significant impact of ESG factors on the creditworthiness of borrowers.

3.1. ESG FACTORS AND CREDIT RISK: A STRUCTURED APPROACH

3.1.1. ESG RISK AND CREDIT RISK

A borrower's exposure to ESG factors can be captured through an ad-hoc rating system (sometimes called an "environmental rating", as social and governance factors are not always measured on a systematic basis). This system, which can be developed in-house, is based on a predominantly qualitative approach, coming from questionnaires, on-site visits, information gathering, and a direct assessment of the counterparty's "environmental behavior".

ESG factors can affect the performance of a company, as well as of an industry/area. In the first instance, ESG risks affect a single borrower, not the entire market, and are due to specific factors such as the company's governance, regulatory compliance, and brand reputation. In the second case, however, there are wider issues that concern a whole industry or area, and can be linked e.g. to legislation, technological changes, or upstream/downstream markets.

Given the intangible nature of many ESG factors, building a quantitative score can be complex. It is even more difficult to establish whether there is a link between environmental ratings and credit risk: the relative novelty of the topic means that less good-quality data is available and that risk measurement models are still under development. Nevertheless, integrating ESG factors into credit risk analysis is crucial, as it enables banks to capture latent vulnerabilities that may emerge over time and indirectly affect creditworthiness (since their materialization would trigger significant financial effects). An enterprise's ESG performance can affect the probability of default, as a stronger ESG awareness means a lower risk of experiencing events that can negatively affect the orderly operation of the company, its ability to produce income, and therefore ultimately its reliability towards creditors.

3.1.2. DATA CONTRAINTS

Data availability is a key constraint when assessing the exposure of a credit portfolio to ESG risks. These include quantitative metrics (e.g., the customer's carbon emissions), qualitative information about the borrower's organizational structure and activities (e.g., the presence of task forces and policies focused on ESG risks, plans to achieve net zero greenhouse gas emissions, adequate procurement practices), as well as broader macroeconomic, social, and environmental information (e.g., shared socio-economic scenarios).

Most banks currently use a mix of internal customer data and external data from third-party providers. External data is used both to validate existing information and to collect more granular data for specific portfolios.

However, many banks have raised concerns about the procedures followed by data providers and have expressed a preference for developing their own methodologies. This points to a need for standardization in ESG factor measurement methods, to reduce the risk of distortion and strengthen the credibility of the metrics obtained. Some banks also acquire scenarios from specialist environmental agencies (such as the Intergovernmental Panel on Climate Change), in order to use them for their what-if analyses. Although there are many data providers, they typically do not offer full coverage of all asset classes, geographical areas, and counterparty types. As a result, banks need to combine multiple sources and enrich external information with internal data.

Many institutions collect customer data when granting credit, through specific questionnaires. The information required often depends on the industry and size of the customer, with a view to proportionality and cost/benefit optimization. The "G" component appears to be the area with the best information coverage, thanks to the data collected by banks (in particular, by significant ones) in accordance with "Know Your Customer" regulations. On the other hand, the "E" component, especially when it comes to climate change, seems to be affected by the most severe information gaps. There are also discrepancies in the data across portfolios, as well as between listed and unlisted counterparties; this often leads banks to rely on mean values and to use proxies, which are not always seen as fully reliable.

In a study by BlackRock (see Figure 3), the banks surveyed mentioned three main areas of concern regarding ESG data: data availability and coverage, data reliability and verifiability, and data comparability and standardization.

Commonly mentioned data concerns

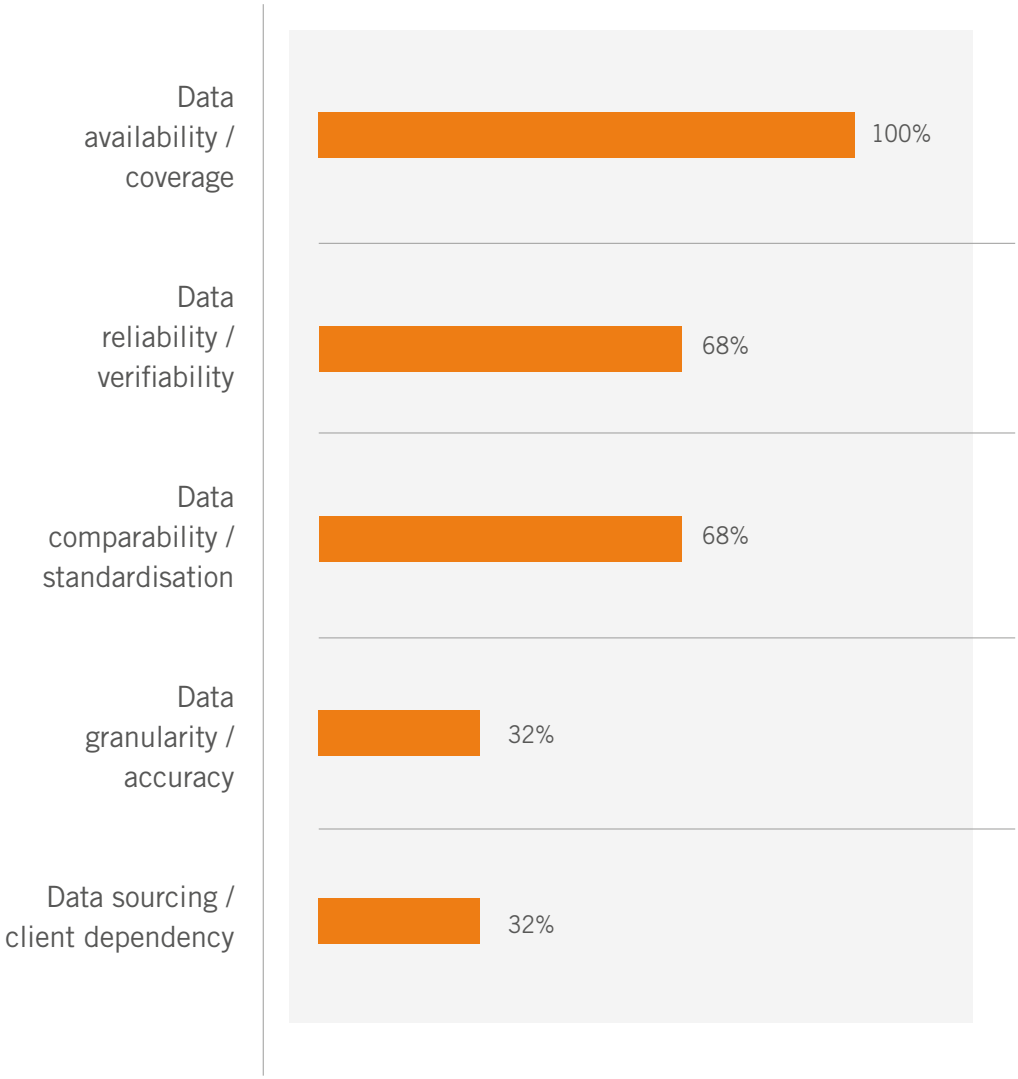

Figure 3 - The most commonly mentioned data concerns – Source: BlackRock FMA analysis

Concerns about data availability and coverage usually relate to non-listed counterparties, but also to some geographical areas, especially emerging markets.

Data collection from customers can be done in a reasonably standardized way (e.g., through specific questionnaires). However, banks have not yet invested enough to check the accuracy and reliability of the data received. Therefore, external data is often used, thus shifting the burden of accuracy checks onto third-party information providers. Finally, poor data comparability and standardization is also seen as a major issue, since the quality and relevance of the information provided by issuers can vary considerably.

These challenges can be addressed through the use of emerging technologies, for example, through the adoption of new methods for using spatial data infrastructures within the financial sector. In order to fill the data gaps, especially for non-listed counterparties, many banks intend to work with non-financial companies to develop and standardize information. Some banks expect the new NFRD to provide an incentive to act in this way. Indeed, the likely increase of the range of entities to which the NFRD will apply, which is currently under discussion, could extend reporting requirements to non-listed companies.

3.1.3. A POSSIBLE "QUANTITATIVE" APPROACH

The lack of uniform and structured data makes it difficult to carry out an ESG risk assessment using a bottom-up approach, i.e., based on the specific characteristics of each counterparty. This approach would produce more robust ESG risk assessments, but it is difficult to apply, especially for small businesses. Even for larger counterparties, the situation is complex. While there are large international firms (such as Morgan Stanley CI, Refinitiv, Bloomberg) that offer ESG ratings for major listed companies, several studies have shown that such ratings can diverge substantially for the same company, due to the lack of a standardized, shared, and universally accepted methodology. There are also no real standards for certifying ESG data, meaning that different scores often originate from different indicators, which are analyzed and weighted arbitrarily by each rating agency.

Many banks are preparing for the collection of data on ESG factors through questionnaires to be submitted to companies upon loan origination and monitoring. This approach allows them to obtain detailed information at the single counterparty level, but it may take time to create a robust database that can be used for statistical analysis. An alternative route is to use external data from public sources, but these sources only exist at a macro level (industries or geographical areas), and hence can only be used for top-down assessments. By way of example one can look at the situation in Italy (other European countries enjoy similar data sources), where information can be obtained from:

- ISTAT (Italian Institute of Statistics), which collects information related to the environment, such as electricity consumption per capita, or to the social context, such as salaries by gender and age;
- ACCREDIA, which provides data on company certifications following a compliance assessment (voluntary and not voluntary);
- ISPRA (Italian National Institute for Environmental Protection and Research), which provides data on the management and consumption of natural resources, biodiversity, waste management, and climate events by geographical area.

Additional data items are also available, which can be used to cover other ESG factors, such as those generated by INAIL (Italy's National Institute for Insurance against Accidents at Work) and some ad-hoc proxies built by CRIF using its wide-ranging database (see Table 6).

Table 6 - CRIF and INAIL indicators by main subject area

Main subject area	Area	Indicator	Granularity	Source
Social factors	Community/society	Local offices in socially underdeveloped areas	VAT No.	CRIF
Social factors	Employee relations / employment standards	Accidents at work	ATECO/Region	INAIL
Social factors	Employee relations / employment standards	Occupational diseases	Region	INAIL

Additional information can be extracted from company websites through web scraping and web crawling. This can be done through some open source libraries (like the "Selenium" and "Beautiful Soup" packages available in Python, and the "Rvest" library for the "R" programming language) that can manage the large amounts of unstructured data present on web pages and in HTML code; such tools can recover the content of interest and translate it into a structured format to be used for further analysis. The procedure is illustrated in Figure 4, which shows how the information contained in the html code of a set of selected websites can be extracted and saved in structured .csv, Excel or .xml files.

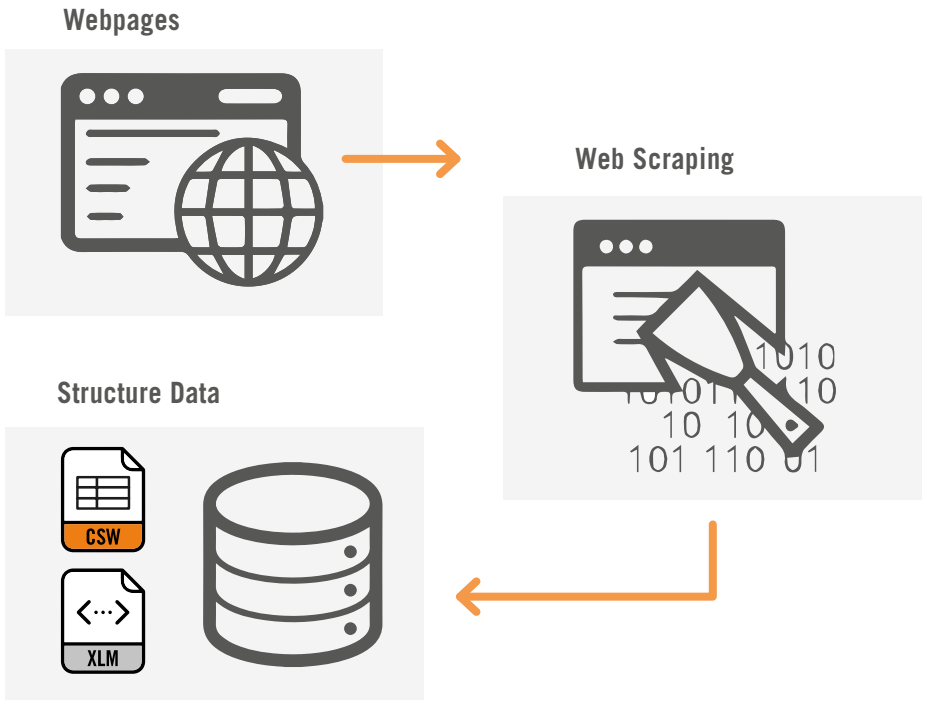

Figure 4 - How web scraping works

Another method used to obtain information from the web is web crawling, which can prove very useful to check whether a certain company has released specific information on its website regarding socially-oriented initiatives, specific certifications or environmental commitments. This technique is used, among others, by search engines like Google in order to extract URLs by analyzing the text of each individual site. In short, a search is performed for all the links connected to each desired search key by accessing all relevant sites, extracting the text, analyzing it according to certain rules (the "build list"), and indexing the web addresses associated with the relevant page. The information is then stored in a database on which future queries can be quickly performed (see Figure 5).

Web Crawler

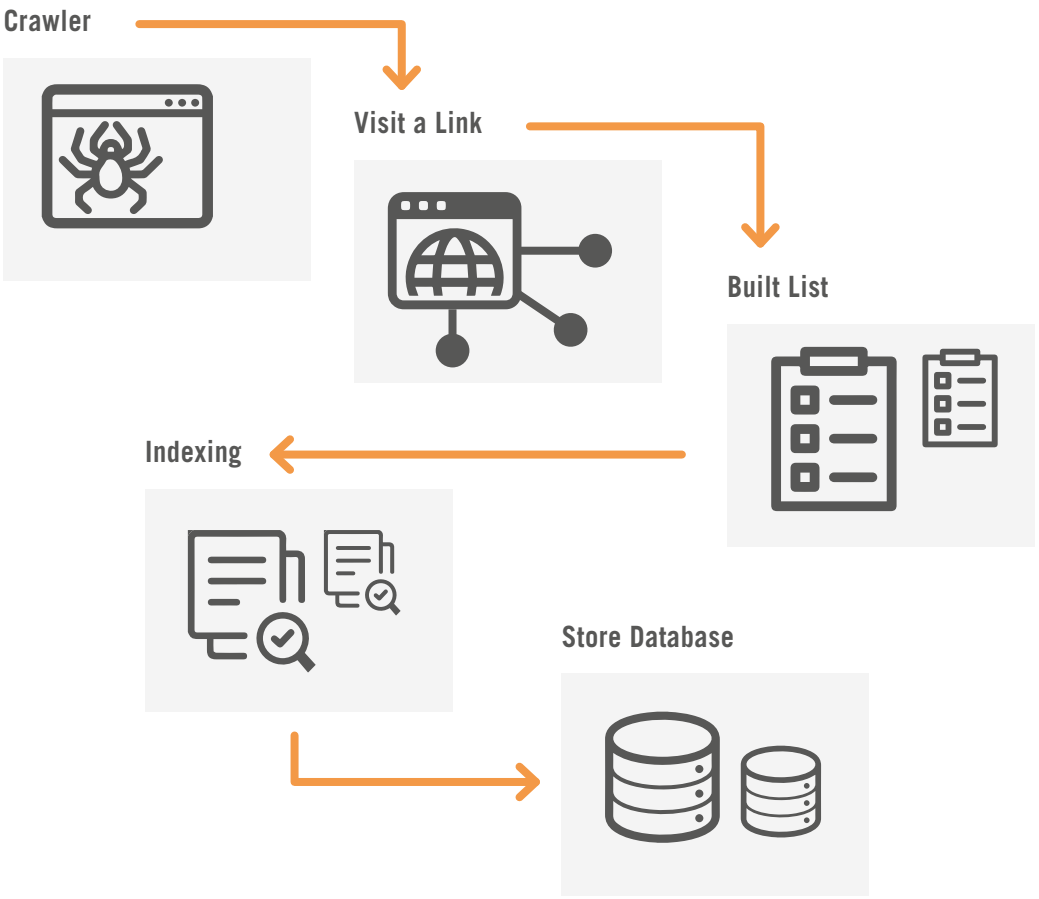

Figure 5 - How web crawling works

To conclude, let us recall that using data that is available only at an industry/area level has some disadvantages. In particular, this top-down approach does not allow an assessment of the actual management of ESG risks by a specific counterparty, since all companies in a given cluster are assigned the same average level.

This could penalize some companies which, although they belong to high-risk sectors or geographical areas, are trying to reduce their negative impact on the environment, the economy, or the community. In addition, the estimate of the average risk for a certain aggregation of counterparties is typically carried out on a sample of observations for which detailed data and assessments are available; if such sample is not representative of the reference population, the evaluation can be biased.

3.1.4. THE IMPACT OF SOME ESG FACTORS AND CREDIT RISK

Due to the lack of widely-available quantitative ESG data (both at a single-name and industry/area level), ESG risks can be incorporated into rating models through a series of specific questions, added to the questionnaire used for the qualitative assessment of borrowers. A large Eurozone bank (whose name cannot be disclosed for confidentiality reasons) adopted this approach in order to incorporate ESG risk factors into the "qualitative" component of its PD estimation models. In the remainder of this section, we look at that data to verify the existence of a correlation with credit risk.

The qualitative questionnaire was filled by credit analysts during the rating process, based on their expert judgment and specific guidelines. The latter were aimed at making the responses consistent across different borrowers (i.e., leading to identical values in the case of counterparties with the same characteristics). All responses provided by analysts were saved to build a time series of ESG factor assessments, with enough of information depth to be used for statistical analysis.

It should be noted that such a qualitative approach has its own weaknesses. Old data show some counterintuitive values, especially before the signing of the Paris Agreement and the creation of the TCFD in 2015, which provided a significant stimulus to recent regulatory developments in climate change and standardized industry practices. The absence of a clear, universally recognized taxonomy introduced further uncertainty in the identification of enterprises that can be defined as "green" or "brown". Additionally, the level at which exposure to ESG risks should be assessed may also differ (e.g., for a counterparty rather than a business branch or product), sometimes leading to conflicting results. Finally, some ESG risks relate to large companies with a more sophisticated business structure, extending across many economic sectors and industries.

Therefore, the same counterparty could be considered "green" or "brown", depending on the business segment being assessed.

Even with these caveats, the historical data collected through the qualitative questionnaire enables an analysis of the historical default rates broken down by different ESG characteristics. The latter are measured at time "*T*" and linked to the default rates observed in the following 12 months (*"T+1"*).

As shown in Figure 1, exposure to socio-environmental risks (emissions of harmful substances, negative environmental impacts, occupational health and safety issues, human rights issues, etc.) is associated with a higher default rate, meaning that such borrowers pose a greater credit risk.

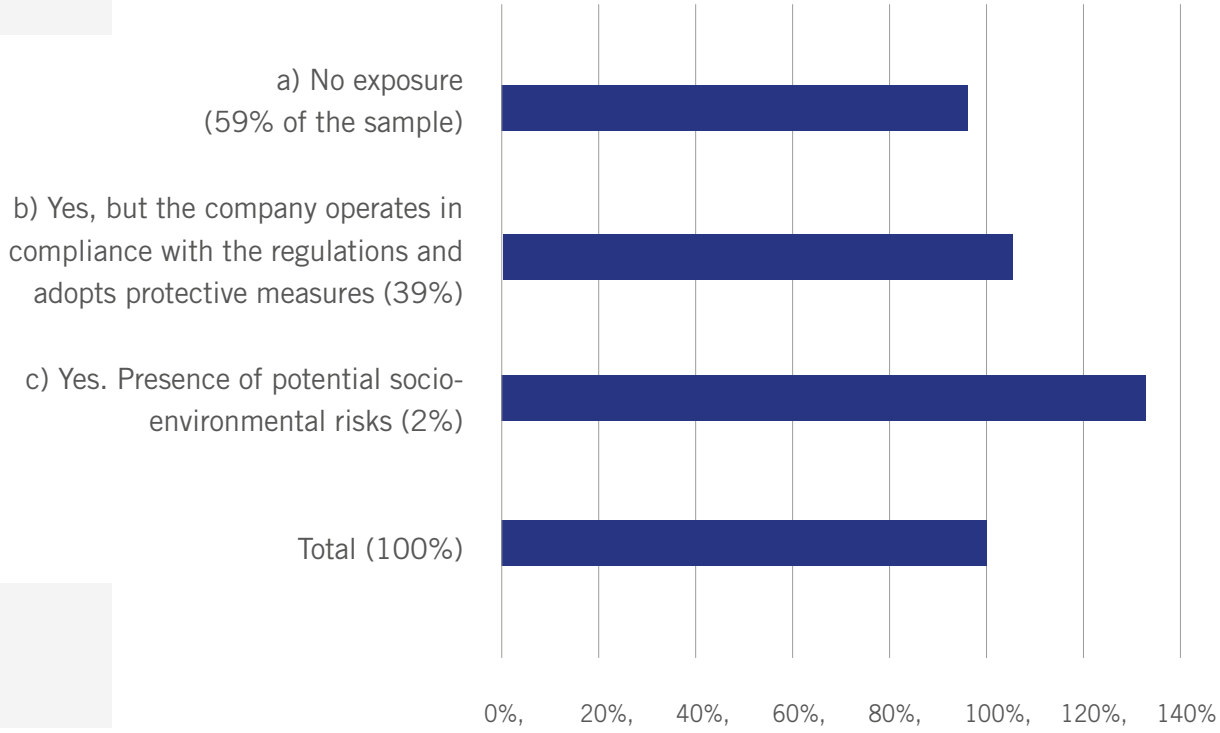

Figure 6 - Exposure to socio-environmental risks and impact on a credit risk index[21]

[11] This is an index number, where 100% denotes the average default rate of the sample.

This kind of evidence was confirmed by more sophisticated statistical analysis, showing a satisfactory predictive capacity of ESG risk factors included in credit rating models. Indeed, the bank chose to retain all ESG-related questions in its qualitative questionnaire, as they proved statistically significant with respect to default risk. Also, some further ESG-related questions were added to the questionnaire and the analysis of social and environmental information was eventually included in the quantitative section of the bank's PD model.

As regards new questions, the questionnaire was enriched with items covering governance risks, the presence of insurance against the interruption of activities/payments caused by environmental catastrophes (fires, earthquakes, floods, etc.), the availability of certain ESG certificates (quality, environmental, occupational health and safety, or information security certifications, etc.) which was captured through a binary variable. Figure 2 shows how default rates in the sample change when different types of ESG certifications are available.

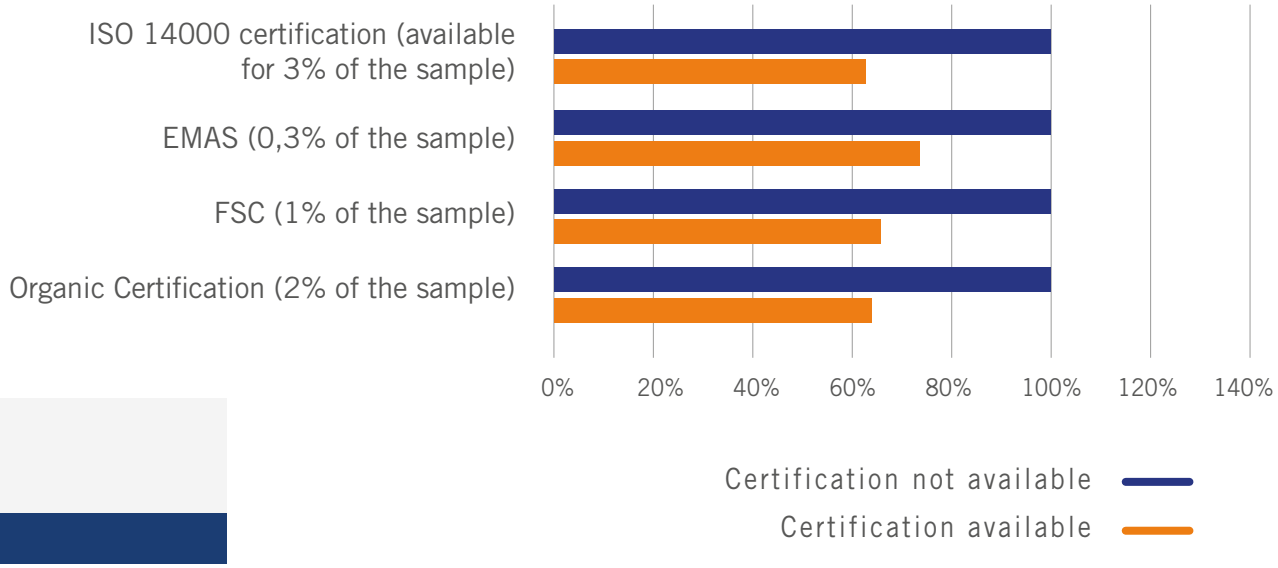

Figure 7 - Environmental certifications[22] and impact on our credit risk index

[22] ISO 14001 certification: a technical standard of the International Organization for Standardization (ISO) on Environmental Management Systems (EMS) to help organizations minimize the negative effects of their activities on the environment (energy efficiency, material and water efficiency, proper waste management, emissions, etc.). EMAS (Eco-Management and Audit Scheme - environmental efficiency): this is a tool created by the European Community consisting of an environmental management system based on the ISO 14001:2004 standard, referring to all the requirements, while open dialog with the public is pursued by requiring organizations to publish (and keep up to date) an Environmental Statement containing key information and data from the organization on its environmental aspects and impacts. FSC (Forest Stewardship Council): an internationally recognized forestry certification system. The purpose of the certification is to ensure correct forest management and the traceability of product derivatives. The FSC logo guarantees that the product has been made from raw materials from properly managed forests according to the principles of the two main standards: forest management and chain of custody. Organic certification: specific certifications on agricultural methods (in the case of farms) or on the origin of raw materials (in the case of food producers).

One can see that environmentally certified firms have a lower default rate. This applies to all types of certifications analyzed. The incorporation of certifications into the rating model through a quantitative approach, i.e., based on statistical analysis, allows the bank to allocate a relative weight to all new data items, that is consistent with their statistical significance and discriminating power. Factors that are materially linked to default are therefore excluded or assigned very low weights (something that cannot be taken for granted when one adopts an expert-based approach). However, a quantitative approach is only possible when a representative data sample is available. Moreover, a qualitative approach can be used as a data collection tool, making it easier to transition to a quantitative approach at a later stage. The structured storage of historical data allows *ex-post* validation of the weight attributed to *ex-ante* risk factors, calibrating the assumptions that were initially adopted using an expert-based approach.

3.1.5. AN ALTERNATIVE APPROACH TO ASSESSING THE IMPACT ESG FACTORS ON CREDIT RISK

When limited, unstructured data are available, one could use machine learning ("ML") techniques to process available information and generate a score that highlights the extent of the ESG risks associated with each borrower. The use of ML models can support a data-driven approach, without committing to an overly rigid set-up (expert-based or model-based). The output of this analysis, a summary assessment of ESG risks, can then be used to verify whether ESG scores show a significant correlation with credit risk.

Academic literature shows a wide array of ML approaches, with different levels of sophistication. As far as ESG is concerned, a widespread solution uses a combination of models in an approach known as ensemble modeling, i.e., multiple models working together to produce forecasts. Algorithms which, taken individually, would perform poorly, are grouped together and often provide better results than advanced, complex models.

The decision tree is the basis of many ensemble model solutions. The most important qualities of this approach are:

- automatic management of characteristics (with very limited need for pre-processing the data) and mixed-type predictors (meaning that, e.g., missing variables are managed automatically);
- the selection of relevant features at the expense of redundant features;
- excellent performance without the need to modify the so-called "hyperparameters"[23];
- a forecasting process that is a summary of a set of cascading rules.

A very well-known variant of ensemble models based on decision trees involves replicating the tree building process many times (including over 1000 times) using only a subset of the available variables. This approach is called "random forest", and is based on a regression and classification algorithm that uses a large number of decision trees built on different datasets, generated through a so-called bootstrap (random sampling) methodology. If the problem to be resolved is classification, the most frequent response is used as output. If, on the other hand, the problem is predictive in nature, the average of all the regressions calculated within the trees is used.

CRIF has developed an ESG score based on ML techniques, covering all companies included in its credit bureau and enriching data by means of web scraping techniques and direct access to web sites (both internal and external to the company to be assessed). This score is a statistical, quantitative assessment of the level of compliance of companies to ESG factors, and can be related to credit ratings (including those produced by CRIF itself through its proprietary "CBDI" model) through a cross tabulation like the one shown in Figure 6 (green represents low risk and red means high risk).

[23] In ML, a hyperparameter is a parameter whose value is used to control the learning process (from which the values of the remaining parameters derive).

Figure 8 - Matrix for CRIF CBDI rating classes and ESG score classes

By combining the CRIF credit rating (CBDI) with the ESG score, it is possible to obtain a more granular assessment of borrowers. For any level of the CBDI rating, the ESG score allows the borrowers to be sorted into three subsets characterized by different ESG risk. It is interesting to note that these three subsets are normally characterized by a default risk that increases as the ESG score worsens, indicating the presence of a (statistically significant) correlation between ESG assessments and credit risk.

The ESG risk assessment therefore looks capable of improving the discriminating power of traditional credit risk assessment models, even when the information is scarce and unstructured. Needless to say, such results need to be extended to include additional ESG risk factors (as dictating by a growing academic literature and by continuously-improving industry practices) and to additional segments (e.g., small enterprises and structured finance projects), building public data hubs that can be used for ESG assessments by all interested stakeholders.

4. CONCLUDING REMARKS

To conclude, we would like to recall some of our findings and highlight some challenges for the future. Let's start from the basics: the case study examined in Chapter 3 suggests – with all the caveats due to a limited data sample – that there is a link between ESG indicators and credit risk that deserves further investigation, extending the analysis to other types of counterparties and portfolios. Further work is still needed, however, not in terms of statistical techniques, but as concerns the day-to-day operations of banks. Before fine tuning the models, it is necessary to update the processes, so that ESG profiles are adequately captured during loan origination, monitoring and collection, both in quantitative terms (by recording as objectively as possible the existence of certain requirements) and at a qualitative level (through expert analysis that highlights additional sensitive profiles, and allows banks to refrain from "shortcuts", such as SIC codes, which are as useful as they are potentially untrustworthy).

Bringing ESG approaches into processes is necessary to respond to the requirements set out by the EBA in its guidelines on loan origination and monitoring[24], as well as to accelerate the transition to more "sustainable" portfolios. But it also is a prerequisite for developing quality databases, which can be used to verify how strong the inverse link is, that seems to emerge between ESG ratings and credit risk. While such a link would be a strong incentive to develop asset allocation policies that are more open to ESG criteria, it is also true that – unless operating processes are made more sensitive to such metrics – the lower risk associated with "responsible" investments may not be properly recognized. Indeed, a recent publication of the NGFS[25], which does *not* find significant evidence of a risk differential between "green" and "brown" activities (based on a sample of nine large banks), argues that it is still impossible to carry out robust analyses, as only a few countries have clear criteria in place to distinguish between those two types of investments.

The difficulties still present in the tagging phase (where loans and borrowers are "labeled" according to whether they meet ESG criteria) were also highlighted in the recent EBA "pilot" on climate-related risks. It is worth recalling that the EBA exercise deliberately excluded SMEs (small and medium-sized enterprises) and focused on larger counterparties, which were deemed easier to label: what would have happened if smaller companies had also been taken into account?

[24] See EBA "Guidelines on loan origination and monitoring", EBA/GL/2020/06, European Banking Authority, Paris. See, for example, §56, which states that "institutions should incorporate ESG factors and associated risks in their credit risk appetite and risk management policies, credit risk policies and procedures, adopting a holistic approach".

[25] Network for Greening the Financial System, "A Status Report on Financial Institutions' Experiences from working with green, non green and brown financial assets and a potential risk differential", May 2020, Banque de France, Paris.

How can tagging be effectively addressed in many European countries where SMEs are an essential component of the production system? This looks as a huge challenge and one wonders whether the banking system should be equipped with a common infrastructure that, similar to a central credit register, allows banks to share the burden of an unprecedented investment, while helping them to align to best practices. Such an "ESG data register", which would provide individual institutions with a "semi-finished product" that they can individually enrich without harming competition, is certainly an ambitious objective whose practical feasibility should be carefully examined. It would bring significant cost savings, improve performance and – last but not least – it would cut operating expenses for enterprises, which would have to deal with a single questionnaire rather than face multiple requests from different banks (leading to a less careful attitude towards filling in the required information).

It should be noted, however, that measuring how close a borrower lies to the ESG paradigm is inherently difficult for a very straightforward reason: while traditional credit risk scores can be assessed on the basis of their ability to predict default or to estimated LGDs (something that is relatively easy to define and measure on an ex post basis), an ESG score is not directly related to a simple target variable against which its predictive ability can be assessed. The lack of an objective benchmark against which ESG classifications can be back-tested adds an additional layer of uncertainty to the analysis, and requires banks (as well as supervisors and academics) to think out of the box in order to identify appropriate validation methods.

Finally, the measurement of ESG factors raises two potential dangers that periodically re-emerge in the regulatory and supervisory practices of bank risks.

The former is the temptation to entrust the banking system with a task (redirecting individual behaviors toward socially-desirable goals) that is primarily a policy issue, and therefore should be pursued through taxation, consumer education, information campaigns on the long-term consequences of certain lifestyles and consumption habits. The latter is the risk that the "rules of the game" keep changing while the race is already in progress, rather than being defined from the start providing everyone with a clear and common way forward (ultimately penalizing early spenders who are willing to commit to substantial investments and process to align with the ESG new paradigm). Banks – and their risk managers – must play their part (and the more coherent the principles and rules, the more they can do so); but they cannot be the ultimate driver of a societal and economic change that calls for strong and clear policy actions.

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Research Memorandum 04/2022

4 August 2022

DOES BETTER ESG PERFORMANCE LOWER CREDIT RISK? A SOVEREIGN CREDIT PERSPECTIVE

Key Points:

- *Environmental, social and governance (ESG) factors have become increasingly important in investment and financial valuation in recent years. Public sectors in many economies have launched or planned to launch ESG bonds to demonstrate their commitment to sustainable development and combat the challenges of climate change. Against this backdrop, this study examines how ESG factors have affected sovereign credit risk over time and across economies.*

- *We find that investors have generally factored in ESG performance and the development of ESG debt market in pricing sovereign credit risk since the mid-2010s. On comparing emerging market economies (EMEs) with advanced economies (AEs), the still shallow ESG debt market in EMEs has yet to exert material effect on their sovereign credit risks, and investors tend to disregard environmental factors when pricing EMEs' sovereign credit risk, probably as a sacrifice to economic development.*

- *As such, policymakers need to continue to support the ESG-related developments especially in EMEs, for example, by growing the awareness of the linkage between environmental well-being and financial investment return, and strengthening international cooperation to improve the environmental performance of EMEs, e.g. fostering technology transfer.*

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1. INTRODUCTION

Environmental, Social and Governance (ESG) investing has evolved to become a mainstream investment strategy since the mid-2010s. Following the establishment of the Doha Amendment in 2012 and the Paris Agreement in 2015[1], institutions started to create framework and guidelines to manage and disclose climate risks in accordance with the Task Force on Climate-Related Financial Disclosures (TCFD) under the Financial Stability Board (FSB). Investors also increased their appetites on incorporating ESG principles into their portfolio decisions after the COVID-19 outbreak in early 2020.[2] Accordingly, the number of economies with available ESG debt information has grown steadily since early 2000s, and the amount of ESG debt issuance skyrocketed after 2014 (Chart 1).

Alongside the expansion in the global ESG debt market, more studies have examined the linkage between corporate ESG performance and financial performance (Buallay, 2019; Giese et al., 2019; and Taliento et al., 2019), and generally pointed to two channels through which ESG performance would affect corporate financial performance: (1) the *cash-flow channel*, through which higher ESG-rated firms might have better competitive advantage (e.g. more efficient use of resources and better innovation management) to generate abnormal returns (Gregory et al., 2014); (2) the *risk control channel*, through which firms with better ESG performance are typically more devoted to maintaining high quality risk control and compliance standards, and hence can reduce the potential exposures to downside risks, such as corruption and fraud (Godfrey et al., 2009; Jo et al., 2012; and Oikonomou et al., 2012). The literature also suggested that investors have increasingly been willing to pay a premium for firms' good ESG performance.

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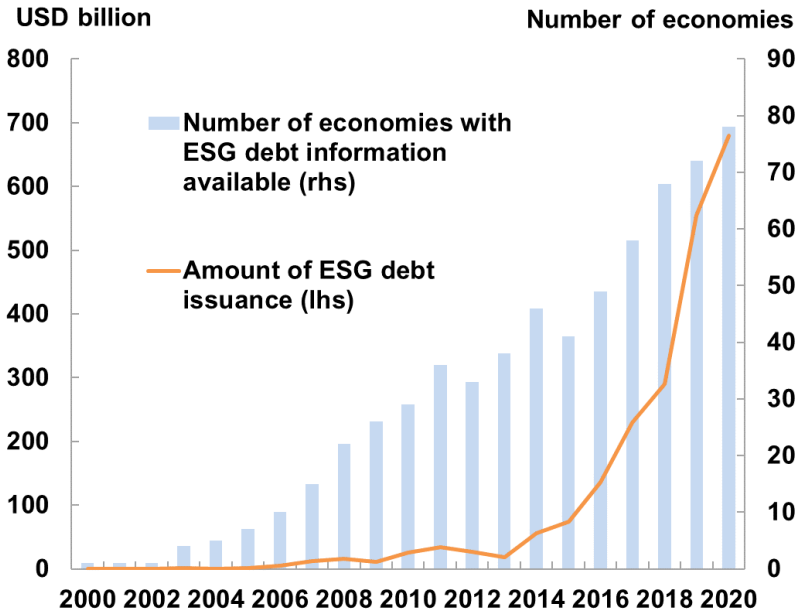
[1] The 26th UN Climate Change Conference of the Parties (COP26) summit in 2021 called for accelerating global actions to achieve the goals of the Paris Agreement.

[2] See "Why COVID-19 Could Prove to Be a Major Turning Point for ESG Investing", J. P. Morgan, July 2020 (URL: https://www.jpmorgan.com/insights/research/covid-19-esg-investing).

Chart 1. Global ESG Debt Issuance



Note: Supranational ESG debt excluded.

Source: Bloomberg.

Meanwhile, there are comparatively few studies on the effect of economy-wide ESG performance on sovereign credit risk, even though many economies have launched or planned to launch ESG bonds to demonstrate their commitment to sustainable development and combat the challenges of climate change. **To fill this blank, our study aims to examine *the influence of* the ESG factors on sovereign credit risk.** Specifically, the study addresses four key questions: (1) Could better national ESG performances reduce sovereign credit risk (i.e. in practice, reduce the CDS spread)? (2) Could a faster ESG debt market development reduce sovereign credit risk? (3) When did investors start including ESG factors in their investment decision making? (4) Whether the ESG effect on sovereign credit risk is homogeneous across advanced economies (AEs) and emerging market economies (EMEs)? The answers to these questions could provide important insights for ESG-related policymaking in the medium- to long-term.

The rest of the paper is organised as follows. Section 2 reviews the literature. Section 3 and Section 4 discuss the methodology and data respectively. Section 5 elaborates on the empirical results and the corresponding robustness check is reported in Section 6. Section 7 discusses the policy implications and concludes

the study.

2. LITERATURE REVIEW

According to the literature, sovereign credit risk is determined by three major factors, namely: (1) *sovereign credibility* – which is determined by an economy's fiscal and macroeconomic position, including the level of government debt, fiscal space, GDP growth, inflation, etc.; (2) *liquidity risks* – which reflects the size and the depth of financial market; and (3) *global risk aversion* – which reflects international investors' attitude towards different types of risk factors.[3]

Some studies suggest that the linkages between macroeconomic fundamentals and sovereign credit risk might have weakened after the GFC (De Grauwe and Ji, 2013; Poghosyan, 2012; Di Cesare et al., 2012). A possible reason is the distortion caused by the unprecedentedly accommodative monetary conditions and excessive global liquidity. Other than the macroeconomic fundamentals, non-financial factors, such as concerns over the governance issue – which was cited as a key cause of the GFC – as well as the increase in environment awareness, are also considered to have played a role. At this time, studies began to investigate the impact of the ESG elements on sovereign credit risk (Ciocchini et al., 2003; Baldacci et al., 2011; Drut, 2010).

Margaretic and Pouget (2018) establish a framework that explicitly links up the ESG factors and sovereign credibility. Their study hypothesises that sovereign bond returns can be affected by the "extra-financial performance", i.e. the ESG factors, through four economic channels. First, an economy with good ESG performance implies its commitment to sustainable development and therefore the default risk of its debt obligations is lower than those economies with poor ESG performance. Second, a better public communication on ESG issues could reduce information asymmetries and strengthen the trust between investors and the economy.

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[3] For details, please refer to Afonso et al.(2015), Aizenman et al. (2013), Alichi (2008), Baldacci et al.(2011), D'Agostino and Ehrmann (2014), and Garcia-Herrero et al. (2006).

Third, in specific cases, the preservation of important natural resources is conducive to the long-term sustainable development in some economies (e.g. the habitat of the Amazon rainforest). Fourth, natural and social resources can be treated as the extra-buffer against unexpected shocks.

Capelle-Blancard et al. (2019) introduces several new findings based on Margaretic and Pouget (2018)'s framework. First, the study verifies the strong negative relationship between ESG performance and sovereign bond yield spread, i.e. a better national ESG performance is associated with narrower sovereign bond yield spread. Nonetheless, similar to the findings in Margaretic and Pouget (2018), the correlation is primarily contributed by the governance factor (G) and social factor (S), while the environmental factor (E) has an insignificant effect on sovereign bond yield spread. Second, the relationship between ESG performance and sovereign bond yield spread is more significant after the GFC, and this may imply that more investors included ESG factors in their investment decision after the GFC.[4]

Hübel (2020) proposes two distinct aspects to quantitatively explain the linkages between ESG factors and sovereign credit risk. First, the "level effect of ESG" indicates that a better ESG performance leads to a lower level of CDS spread, as better ESG performance can be viewed as a buffer to stabilise tax income and mitigate the impact of negative shocks. Second, the "slope effect of ESG" suggests that the negative relationship between ESG performance and sovereign credit risks should be more significant in the long-term than in the short-term horizons (measured by the differences between the 10-year CDS spreads and the 1-year CDS spreads).

3. METHODOLOGY AND DATA

To study the effects of ESG performance on sovereign credit risk, we

[4] Nevertheless, Crifo et al. (2017) argue that the effect of financial ratings (measured by S&P ratings) on sovereign borrowing cost is about three times stronger than the effect of ESG ratings, suggesting that any investment decisions still mainly depend on the financial performance of securities, and the ESG ratings are typically treated as the supplementary information.

estimate a fixed-effect model with the sovereign credit risk of an economy i in year t, $SCR_{i,t}$, as the dependent variable:

$$SCR_{i,t} = \alpha_i + \beta ESG_{\mathrm{i,t-1}} + \gamma Control_{i,t} + e_{i,t} \quad (1)$$

Where α_i is the fixed effect, $ESG_{i,t-1}$ are the ESG-related variables lagged by one year to circumvent the issue of reverse causality (see Hübel (2020)), $Control_{i,t}$ are the control variables and $e_{i,t}$ is the error term. The coefficient β captures the impact of ESG-related factors on the sovereign credit risk, which is the key estimate in this study. Our sample covers 44 economies (25 AEs and 19 EMEs)[5] with the time period covering 2005 to 2020. Details are listed in Tables A2 and A3.

i. Dependent Variable: Sovereign credit risk

The CDS spread is used as the dependent variable in the baseline model. Unlike Hübel (2020) which uses the year-end CDS spread in the estimation, we use the logarithm of the yearly-averaged CDS spread to capture the sovereign credit risk over the entire year (Our finding is robust to the use of the year-end CDS spread). We use the 10-year US dollar sovereign CDS spread as the long-term baseline dependent variable. The 5-year and 1-year CDS spreads are used in the robustness check to verify the heterogeneous impact of ESG factors on the medium- and short-term sovereign credit risk. The 10-year generic government bond yield spread over the US Treasury yield will also be used for the robustness check.

ii. Key Explanatory Variables:

a. ESG Indices

The **Environmental Index (E-Index)** is based on the index published by the Yale University.[6] The index covers 32 performance indicators across 11 issues,

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[5] Please see Table 7.

[6] Wendling, Z.A., Emerson, J.W., de Sherbinin, A., Esty, D.C., et al. (2020). 2020 Environmental Performance Index. New Haven, CT: Yale Center for Environmental Law & Policy. epi.yale.edu

including human health, ecosystem vitality and environmental health.

The **Social Index (S-Index)** is retrieved from the World Bank's World Development Indicators (WDI). There are several sub-indicators in the WDI that fit the definition of social performance. We narrow down the list to a set of four sub-indicators due to practical considerations, such as data availability across the economies in our sample and the length of the available time series. The four selected social indicators are: (1) share of individuals using the internet, (2) life expectancy at birth, (3) share of wage and salaried workers in total employment, and (4) share of vulnerable employment in total population. Similar to Capelle-Blancard et al. (2019), we use the principal component analysis (PCA) to construct the S- Index. [7]

The **Governance Index (G-Index)** is based on the World Bank's Worldwide Governance Indicators (WGI). To construct the G-Index by the PCA, we use all six governance indicators from the WGI, including (1) voice and accountability, (2) political stability and absence of violence, (3) government effectiveness, (4) regulatory quality, (5) rule of law, and (6) control of corruption.[8]

We then aggregate the above three indicators by repeating the PCA procedures. The resulting **ESG Index** summarises an economy's overall ESG performance (See Table A4c). Chart 2 depicts the ESG performance rankings of our sample economies with reference to their GDP per capita levels in 2017. It shows that AEs in general have better ESG performance than EMEs.

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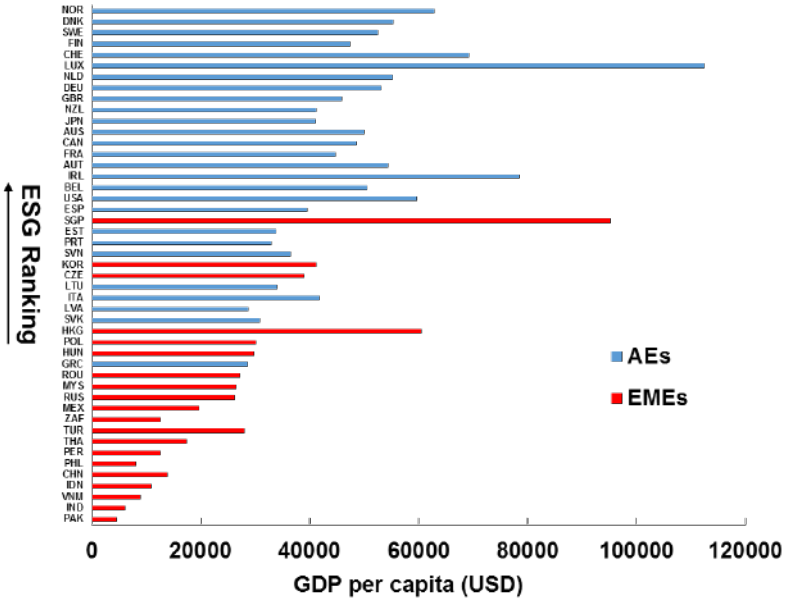
[7] According to Jolliffe and Cadima (2016), PCA is a technique to reduce the dimensionality of datasets by creating new uncorrelated variables to maximize the variance. Thus, it can increase the interpretability of those datasets while minimize the information loss. Following Kaiser's criterion, only components with the eigenvalue larger than 1 are extracted (See Table A4a). Thus, the first principal component is extracted as the Social Index, which accounts for more than 70% of total variance.

[8] Similar to the construction of S- Index, the first principal component (the only component with eigenvalue higher than 1) is extracted as the G- index (See Table A4b).

Chart 2. Ranking of ESG Index and GDP per capita in 2017



Note: GDP per capita in PPP exchange rate, nominal USD.

Sources: Oxford Economics, World Bank, Yale University and authors' estimation.

b. ESG Debt Issuance

Another key variable is the ESG debt issuance-to-GDP ratio which captures the development of ESG financial markets of the economies. The data on ESG debt issuance is collected from the Bloomberg Intelligence, which contains debt issuance data of 124 economies from 2000.

c. Control Variables

A list of conventional financial and macroeconomic factors is included in the regression as control variables. Financial factors include the US treasury yield (corresponding to the tenor of the CDS) and the VIX index. Macroeconomic factors include GDP growth, CPI inflation, government debt-to-GDP ratio and foreign exchange reserves (excluding gold) as a share of GDP. Variables are transformed to yearly frequency (by taking average) to align with the yearly ESG-related variables.

4. KEY FINDINGS

i. ESG factors have become more influential to the sovereign credit risk in recent years

Table 1 shows the baseline estimation results of Equation (1). Columns (1) and (2) respectively show the results using the ESG Index and ESG debt issuance as the key independent variables. **The significantly negative estimated coefficients in both cases indicate that a better ESG performance and a more established ESG financial market could narrow the sovereign credit risk**.

To examine the impact of the ESG concept since the mid-2010s, we divide the data into subsamples using year 2014 as the dividing point, as 2014 is the year when the ESG debt market began to thrive (see Chart 1). Columns (3) and (4) in Table 1 show the estimation results of the "pre-2014" subsample; and columns (5) and (6) show the results of the "post- 2014" subsample. The estimated coefficients of the ESG Index and ESG debt issuance are insignificant in the "pre-2014" period, but become significantly negative in the "post-2014" sample. **This implies the ESG factors have become influential in the sovereign bond market only since the mid-2010s.** To ascertain the robustness of this finding, we further perform a set of rolling window regressions. The estimations further confirm that the impact of ESG performance gradually increased over the period of 2008 to 2020.[9]

[9] Estimation details are reported in Section 6i.

Table 1. Panel fixed effect regression on Equation (1) by sample period

Sample period	(1) Full	(2) Full	(3) Pre-2014	(4) Pre-2014	(5) Since 2014	(6) Since 2014
ESG Index (lagged)	-0.347^		0.657		-1.200***	
	[-1.85]		[1.34]		[-5.69]	
ESG Debt Issuance (% GDP, lagged)		-0.385**		1.021		-0.353***
		[-3.19]		[1.56]		[-4.73]
10-y UST Yield (%)	-0.564***	-0.710***	-0.461***	-0.695***	-0.185***	-0.161***
	[-8.91]	[-8.72]	[-6.08]	[-6.64]	[-5.42]	[-3.87]
VIX (%)	0.051***	0.054***	0.054***	0.059***	0.003	-0.001
	[8.63]	[7.24]	[8.63]	[7.26]	[0.62]	[-0.07]
GDP Growth (%)	-0.043***	-0.033*	-0.030*	-0.002	0.002	0.006
	[-4.91]	[-2.52]	[-2.62]	[-0.10]	[0.26]	[1.15]
Inflation (%)	0.043**	0.072***	0.039*	0.062^	0.026*	0.048***
	[3.52]	[3.79]	[2.31]	[1.74]	[2.24]	[3.71]
Gov. Debt (% GDP)	0.025***	0.018***	0.040***	0.037***	0.024***	0.016*
	[5.21]	[3.90]	[7.31]	[7.10]	[4.07]	[2.31]
FX Reserve (% GDP)	-0.003	-0.004	-0.005	0.001	0.002	0.017
	[-1.09]	[-1.58]	[-1.19]	[0.68]	[0.72]	[1.33]
Constant	3.703***	4.031***	2.605***	2.322**	3.567***	3.294***
	[9.21]	[7.92]	[5.40]	[3.36]	[7.37]	[5.50]
No. of observations	621	294	373	126	248	168
No. of economies	44	41	42	33	44	40
R-squared	0.723	0.665	0.806	0.860	0.387	0.360
Economy FE	Yes	Yes	Yes	Yes	Yes	Yes
Robust SE	Yes	Yes	Yes	Yes	Yes	Yes

Note: The dependent variable is the logarithm of 10-year CDS spreads. All regressions are estimated in yearly frequency with economy fixed effect using Huber-White robust standard error. T-values are in parentheses. ***, **, * and ^ denote significance at the 0.1%, 1%, 5% and 10% levels respectively.

Source: authors' estimation.

ii. ESG debt markets in EMEs might still be too small to exert significant impact on EMEs' sovereign credit risks

To examine the difference in the sensitivity of sovereign credit risk to ESG-related factors across economies, we further divide the "post-2014" subsample into two groups, AEs and EMEs, and repeat the estimations. Table 2 shows the estimation results of Equation (1) using (i) all economies, (ii) AEs only and (iii) EMEs only. As shown, the estimated coefficients of ESG Index are significantly negative in both AEs and EMEs subsample estimations, but that of the ESG debt issuance with the EMEs subsample is insignificant (Column 6 of Table 2). **The results suggest that the relatively shallow ESG markets in EMEs has yet to exert material effect on EME sovereign credit risk** (See Chart 3).

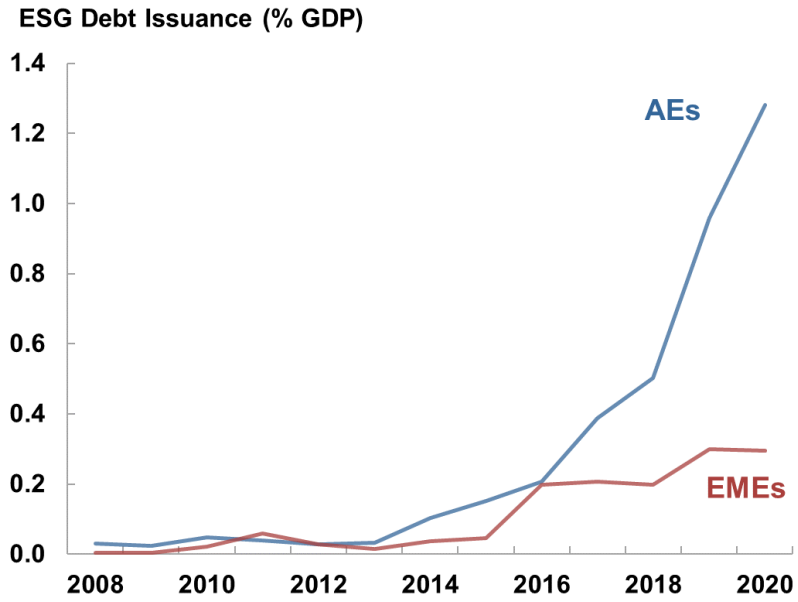
Table 2. Panel fixed effect regression on Equation (1) by economy group

	(1)	(2)	(3)	(4)	(5)	(6)
Sample economy	All	All	AEs	AEs	EMEs	EMEs
ESG Index (lagged)	-1.200*** [-5.69]		-1.389** [-3.13]		-1.138*** [-4.22]	
ESG Debt Issuance (% GDP, lagged)		-0.353*** [-4.73]		-0.336** [-3.38]		-0.201 [-1.54]
No. of observations	248	168	141	103	107	65
No. of economies	44	40	25	23	19	17
R-squared	0.387	0.36	0.399	0.446	0.493	0.253
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Economy FE	Yes	Yes	Yes	Yes	Yes	Yes
Robust SE	Yes	Yes	Yes	Yes	Yes	Yes

Note: The dependent variable is the logarithm of 10-year CDS spreads. Control variables are not reported for simplicity. Sample period is from 2014 to 2020. All regressions are estimated in yearly frequency with economy fixed effect using Huber-White robust standard error. T-values are in parentheses. ***, **, * and ^ denote significance at the 0.1%, 1%, 5% and 10% levels respectively.

Source: authors' estimation.

Chart 3. ESG Debt Issuance by Economy Group



Note: See Table A1 for economy classification.

Source: Bloomberg, World Bank and authors' calculation.

iii. Environmental factor is still out of investors' mind in EMEs

To study the impacts of the E-, S- and G-performances separately, the ESG Index is disaggregated into E-Index, S-Index and G-Index. The disaggregated indices are then put into Equation (1) as the explanatory variables in separated estimations. Table 3 summarises the signs of their coefficients[10].

Table 3: The signs of coefficients of ESG-related factors: AEs vs. EMEs

Factor	AEs	EMEs
E-Index	-ve	0
S-Index	-ve	-ve
G-Index	0	-ve
ESG Index	-ve	-ve
ESG Debt Issuance	-ve	0

Note: "-ve" refers to a negative coefficient that is significant under 5% confidence level. "0" refers to an insignificant coefficient under 5% confidence level.

Source: authors' estimation.

[10] Estimation results of each pillar are reported in Table A5.

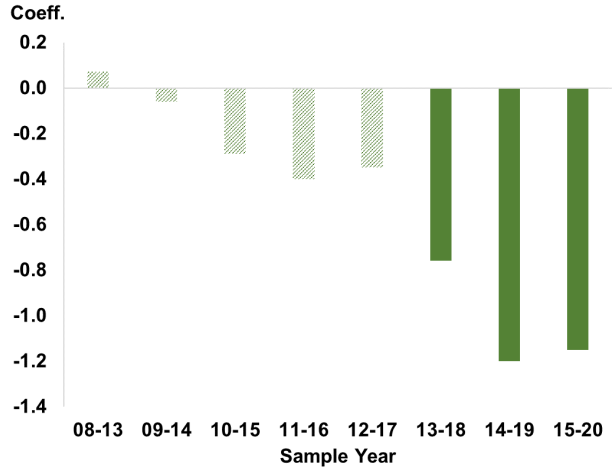
There are two interesting observations in Table 3. First, the impact of governance performance on the sovereign credit risk within AEs is not statistically substantial, possibly because governance performance of an economy would matter less once the economy has developed beyond a certain stage. Second, investors tend to have concern about the effectiveness of governance among EMEs but not the environmental risk when pricing their sovereign credit risk. The latter possibly indicates the conflict between economic development and environmental protection in developing economies due to their industrial structures and technology levels (Guo and Ma, 2008).

5. ROBUSTNESS CHECK[11]

i. Change in the impact of ESG performance over time

To further demonstrate the impact of the ESG performance on sovereign credit risk pricing, we additionally perform a set of rolling regression, with each window spanning six years. Chart 4 depicts the rolling coefficients of the ESG Index using Equation (1) in different windows.

Chart 4. Rolling Coefficient of ESG Index



Note: Rolling coefficient of ESG Index estimated by Equation (1) with a 6-year window. Shaded bar indicates insignificant coefficient and solid bar represents significant coefficient under 5% confidence level.
Source: authors' estimation.

[11] Detail estimation results in this Section are not reported for simplicity.

The chart verifies that the ESG performance had a negligible impact on sovereign credit risk in the early years, but its influence strengthened in recent years alongside the growing awareness of the ESG concept in global financial markets.

ii. Choice of CDS tenor

To ascertain the robustness of the results in Section 5 against the choice of CDS tenors, all estimations are repeated by substituting the dependent variables with 5-year and 1-year CDS respectively to measure the medium- and short-term sovereign credit risk. The results using the 5-year CDS spread are largely consistent with the estimation in Section 5, whereas most of the coefficients are insignificant when using 1-year CDS spreads as the dependent variable. The findings probably highlight the long-term nature of ESG risk, and ESG framework might be less prominent in pricing the short-term sovereign credit risk.

iii. Measure of sovereign credit risk

In addition to CDS spreads, we also proxy the sovereign credit risk by government bond yield spreads. The estimations in Section 5 are repeated by (i) substituting the dependent variable with nominal government bond yield spreads, which is defined by 10-year generic government bond yield of each economy over the 10-year US Treasury yield; and (ii) replacing the US Treasury yield in the list of control variables by FX return. The results are largely consistent with the estimation in Section 5, indicating that the results are robust to the measure of sovereign credit risk.[12]

[12] Although both CDS and government yield spreads generate similar results, the latter is less desirable in this study since the US would inevitably be removed from the sample, which has been one of the key stakeholders in the ESG development.

6. CONCLUSION AND POLICY DISCUSSION

Our empirical results show that investors have generally factored in ESG performance and the development of the ESG debt market when pricing sovereign credit risk in recent years. Such "ESG impact" is significant in both AEs and EMEs in general, but the EMEs' sovereign credit risk appeared to be less sensitive to the ESG debt market size, probably due to the still-underdeveloped ESG market in EMEs.

The study also shows some differences in the sensitivity of sovereign credit risk to the individual E-, S- and G- factors, depending on the stage of economic development. We found that (i) the sovereign credit risk of AEs is insensitive to their governance performance, and (ii) the sovereign credit risk of EMEs is insensitive to their environmental performance. The former suggests that the governance performance of an economy would matter less once the economy has developed beyond a certain stage. The latter might be more alarming: when pricing the sovereign credit risk of EMEs, investors tend to disregard environmental risk probably as a trade-off for economic development. This can be a source of concern given that EMEs are also the major stakeholders of environmental risk in the world. For example, among the top 20 economies of carbon dioxide emission in 2019, 11 were EMEs which were responsible for 49% of carbon dioxide emission of the world (See Table A6 for details).

Our findings have important policy implications. To better sovereign credit risk, policymakers need to continue to support ESG-related developments. For EMEs in particular, more education is needed to increase the awareness of the environmental well-being, as otherwise, sacrificing the environment for near-term economic development will result in irreversible damage to the economy in the long-term and could cause negative spillovers to other parts of the world. Stronger international corporation is also needed to improve environmental performance in EMEs, e.g. technology transfer via FDI to mitigate carbon emission (Williams et al., 2015).

APPENDIX

Table A1: Classification of economies

Group	Economies
Advanced economies (AEs)	Australia, Austria, Belgium, Canada, Denmark, Estonia, France, Germany, Greece, Ireland, Italy, Japan, Latvia, Lithuania, Netherlands, New Zealand, Norway, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom, United States
Emerging market economies (EMEs)	Mainland China, Czech Republic, Hong Kong SAR, Hungary, India, Malaysia, Mexico, Pakistan, Peru, Philippines, Poland, Romania, Russia, Singapore, South Africa, South Korea, Thailand, Turkey, Vietnam

Source: BIS.

Table A2. Data description and source

Variable	Description	Source
Sovereign Credit Risk		
CDS Spreads	Spread on CDS spreads (10-year, 5-year and 1-year). In logarithm of basis point.	S&P Capital IQ
Yield Spreads	Generic 10-year government yield spreads over US Treasury yield. In percentage point.	Bloomberg
ESG-related Variables		
E-Index	Environmental Performance Index (EPI) published by Yale University. Larger values indicate better environment performances. In index point.	Yale University and authors' estimation
S-Index	The first principal component of four social indicators from World Development Indicators (WDI). Larger values indicate better social performances. In index point.	World Bank and authors' estimation
G-Index	The first principal component of all six aspects of governance indicators from the Worldwide Governance Indicators (WGI). Larger values indicate better governance performances. In index point.	World Bank and authors' estimation
ESG Index	The first principal component of E-Index, S-Index and G-Index. Larger values indicate better broad-based ESG performances. In index point	Authors' estimation
ESG Debt Issuance	The amount of ESG-related debt issuance (in US dollar) to GDP ratio. In percentage.	Bloomberg
Control Variables		
US Treasury Yield	Generic US Treasury yield (10-year, 5-year and 1-year). In percentage.	Bloomberg
VIX	Chicago Board Options Exchange Volatility Index. In percentage.	Bloomberg
GDP Growth	Annual growth rate of GDP. In percentage.	World Bank
CPI Inflation	Annual growth rate in consumer price index. In percentage.	World Bank
Government Debt	Government debt-to-GDP ratio. In percentage.	World Bank
FX Reserve	Foreign exchange reserve (exclude gold)-to-GDP ratio. In percentage.	World Bank

Table A3. Descriptive Statistics

Variable	N	Mean	SD	Min	P25	Median	P75	Max
10-y CDS Spreads (bps)	621	135.94	148.87	0.67	45.05	90.55	184.60	1788.50
5-y CDS Spreads (bps)	621	112.73	154.65	0.38	27.98	66.06	145.46	1994.06
1-y CDS Spreads (bps)	621	64.24	157.57	0.10	7.97	21.76	56.73	2554.80
10-y Yield Spread (ppt)	521	1.11	2.95	-3.05	-0.71	0.33	1.70	21.47
E-Index	621	58.33	15.61	24.45	44.11	62.55	71.31	82.51
S-Index	606	0.37	1.57	-4.90	-0.34	0.96	1.55	2.29
G-Index	621	-0.13	2.18	-5.36	-1.87	0.23	1.82	3.11
ESG Index	606	0.11	1.54	-3.71	-1.14	0.47	1.43	2.23
ESG Debt Issuance (% GDP)	316	0.27	0.52	0.00	0.03	0.10	0.27	4.55
10-y UST Yield (%)	621	2.96	0.94	1.79	2.14	2.76	3.64	4.79
5-y UST Yield (%)	621	2.27	1.14	0.75	1.50	1.92	2.79	4.74
1-y UST Yield (%)	621	1.31	1.25	0.11	0.16	0.60	2.35	3.30
VIX (%)	621	18.49	6.28	11.09	14.23	16.64	22.55	32.70
Inflation (%)	621	2.99	3.10	-4.48	1.11	2.29	3.87	23.12
GDP Growth (%)	621	2.90	3.51	-14.84	1.38	2.69	4.81	25.16
Government Debt (% GDP)	621	60.55	44.47	0.05	32.46	47.11	78.66	222.87
FX Reserve (% GDP)	621	17.00	20.65	0.00	2.45	11.82	23.01	126.44

Source: Authors' estimation.

Table A4a. Principal Component Analysis of S- Index

Component	Eigenvalue	Difference	Proportion	Cumulative
1	2.87	2.06	0.72	0.72
2	0.80	0.47	0.20	0.92
3	0.33	0.33	0.08	1.00
4	0.00	.	0.00	1.00

Table A4b: Principal Component Analysis of G- Index

Component	Eigenvalue	Difference	Proportion	Cumulative
1	5.28	4.97	0.88	0.88
2	0.31	0.05	0.05	0.93
3	0.26	0.17	0.04	0.97
4	0.09	0.05	0.01	0.99
5	0.04	0.01	0.01	1.00
6	0.03	.	0.00	1.00

Table A4c: Principal Component Analysis of ESG Index

Component	Eigenvalue	Difference	Proportion	Cumulative
1	2.52	2.23	0.84	0.84
2	0.29	0.11	0.10	0.94
3	0.19	.	0.06	1.00

Notes: The eigenvalue for each principal component show the percentage of variation (explanatory power) in the dataset. We adopt Kaiser's criterion or the eigenvalue rule. The components with eigenvalue higher than 1 are selected. The results above indicate that the first component accounts for at least 70% of total variance for each case.

Source: authors' estimation.

Table A5: Regression on Equation (1) by ESG pillar and economy group

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Sample economy	All	All	All	AEs	AEs	AEs	EMEs	EMEs	EMEs
E- Index	-0.067**			-0.096***			-0.026		
(lagged)	[-3.46]			[-3.87]			[-0.87]		
S- Index		-0.745***			-1.151**			-0.617***	
(lagged)		[-5.43]			[-3.10]			[-4.33]	
G- Index			-0.131			0.258			-0.275*
(lagged)			[-1.06]			[1.31]			[-2.45]
No. of observations	258	248	258	147	141	147	111	107	111
No. of economies	44	44	44	25	25	25	19	19	19
R-squared	0.265	0.409	0.197	0.404	0.437	0.322	0.172	0.514	0.213
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Economy FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Robust SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: The dependent variable is the logarithm of 10-year CDS spreads. Control variables are not reported for simplicity. Sample period is from 2014 to 2020. All regressions are estimated in yearly frequency with economy fixed effect using Huber-White robust standard error. T-values are in parentheses. ***, **, * and ^ denote significance at the 0.1%, 1%, 5% and 10% levels respectively.

Source: Authors' estimation.

Table A6: The 20 largest carbon dioxide emission economies in 2019

Economy	Share of global CO_2 emission (%)
Mainland China	27.9
United States	14.5
India	7.2
Russia	4.6
Japan	3.0
Germany	1.9
Indonesia	1.7
South Korea	1.7
Canada	1.6
South Africa	1.3
Mexico	1.2
Australia	1.1
Turkey	1.1
United Kingdom	1.0
Italy	0.9
France	0.9
Poland	0.9
Thailand	0.8
Spain	0.7
Malaysia	0.7
Sum	74.8
of which: EMEs	49.1 (65.5%)

Note: Red represents EMEs.

Source: Our World in Data.

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ESG Relevance in Credit Risk of Development Banks

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ESG Relevance in Credit Risk of Development Banks

Abstract:

This paper investigates relevance of Environmental, Social, and Governance (ESG) risks in the context of banks' credit risk. Focusing on a global sample of 567 banks, including 40 development banks, we aim to discern nuances in ESG relevance scores between different bank types. Our findings highlight distinct differences between national and multilateral development banks, with ESG risk significantly influencing credit risk in the latter. Notably, social and governance factors play pivotal roles in shaping credit profiles. Development banks, at the forefront of promoting good ESG practices, face heightened exposure and risks. This paper contributes to the understanding of the evolving dynamics of ESG impact on creditworthiness.

Key words: development banking, socio-economic development, ESG relevance, credit risk, sustainable finance

JEL codes: G21, G28, O19, Q56

1. Introduction

Development banks act as important promotors of Environmental, Social, and Governance (ESG) considerations in finance. Their mandates specifically focus on market failures in areas, which are prone to sustainability risks, such as agriculture, infrastructure, small enterprises, social housing or financial inclusiveness (Xu et al., 2021; Luna-Martínez and Vicente, 2012; González-Vega, 1990; Lyne et al., 2009). On the one hand, this can make them more exposed to ESG risks than other banks, whereas on the other hand, it serves as a platform for promoting robust ESG practices with a positive impact on sustainability factors. Each side of ESG considerations (ESG relevance from a risk perspective and ESG impact perspective) can be studied separately, using different types of ESG scores and ratings (risk-based and impact-based).

In this paper, we aim to explore and explain the differences in risk-based ESG scores (which measure how relevant external ESG risks are to credit risk) between development banks and compare them with conventional banks. Whereas ESG risk in banking has been the topic of several studies (Tashtamirov; 2023, Galletta, Mazzù, and Naciti, 2022; Mariia 2022; Kalfaoglou, 2021), variation in ESG risk between different bank types has not been explored in the literature. In particular, we inquire how bank-specific and country-specific factors explain variations in observed risk-based ESG scores, focusing on the differences between development and conventional banks. Additionally, we examine whether risk-based ESG scores of national or multilateral development banks behave differently compared to conventional banks. Finally, we break down the overall ESG scores into constituent E, S and G components and study the impact of bank-specific factors (including bank type) and country-specific factors on each component.

Our adopted measure of ESG risk reflects the relevance of external ESG risk for bank credit risk (Fitch Ratings, 2020b). Several studies show that ESG risks are becoming increasingly relevant for credit risk. Physical and transition climate risks as well as other environmental factors can impact bank loan quality. For example, Dietz et al. (2016) estimate that up to 30% of global assets under management are at risk from climate change, while Battiston et al. (2017) find significant exposure to climate-policy sectors in investors' equity and banks' loan portfolios. Social dynamics, including labor practices, legal concerns, and reputational integrity, coupled with external pressures such as community resistance and social unrest, collectively contribute to the credit risk landscape. Furthermore, governance factors, both internal such as board independence and ethical practices

and external such as the rule of law, institutional robustness, and regulatory quality also exert influence on the credit risks faced by banks.

To analyze the factors that may affect ESG risks' relevance for credit risk, we construct a comprehensive database integrating risk-based ESG relevance scores and bank financials from Fitch Ratings, along with country-level data from multiple sources. Our dataset spans 567 banks globally, with 40 of them categorized as development banks. Our findings reveal substantial differences between national and multilateral development banks. While the relevance of ESG risk for credit risk does not significantly differ between national development banks and conventional banks, it emerges as an important component of credit risk in multilateral development banks. A detailed breakdown underscores that E risk does not significantly impact credit risk across different bank types, whereas S risk and, notably, G importantly contribute to credit risk.

The rest of this paper is structured as follows. Section two offers the literature review. Section three describes the methodology employed in this paper and offers a detailed data description. In section four we present and discuss the results. Section five concludes.

2. Literature review

Risk stemming from ESG factors is increasingly relevant for financial institutions, including banks. Tashtamirov (2023) notes that sustainability has evolved beyond its ethical dimension and has attained economic and existential dimensions. Galletta, Mazzù, and Naciti (2022) note the growing need to integrate ESG factors into strategies, processes, and financial instruments to generate medium and long-term value in the banking sector. Consequently, integrating ESG risk into banks' risk management frameworks is necessary, as it can amplify existing financial and non-financial risks. Ziolo (2021) supports this argument, highlighting that ESG risk can exert a discernible influence on a bank's financial performance, prompting several institutions to incorporate ESG considerations into their decision-making processes. Although addressing ESG concerns presents opportunities[1], La Torre, Leo, and Panetta (2021) observe that regulatory bodies have primarily focused on ESG risks to encourage banks to adopt new ESG business models.

[1] Izcan and Bektas (2022) found a significant negative relationship between banks' ESG impact and idiosyncratic risk, indicating that sustainable practices lower risk. Azmi et al. (2022) found that ESG activity positively affects bank value (with environmental activities having the strongest impact), and reduces the cost of equity but not debt. Buallay (2019) also found a positive relationship between environmental disclosure and financial performance in European banks.

Kalfaoglou (2021) notes that ESG issues introduce a new risk dimension in the banking sector, encompassing both direct and indirect components. Direct exposure pertains to a bank's operational risk, while indirect exposure arises from its lending and investment activities. Banks investing in sectors vulnerable to environmental hazards, such as fossil fuels, mining, or agriculture, face asset valuation fluctuations due to climate events, regulatory changes, and consumer preference[2] shifts, thereby amplifying "E" risk. Financing entities with poor labor practices, human rights violations, or inadequate supply chain oversight can lead to reputational damage, legal liabilities, and financial sanctions, increasing "S" risk. Weak governance practices, such as poor risk management, lack of board diversity, or unethical conduct, can cause financial instability and regulatory penalties, heightening "G" risk. Additionally, investments in questionable enterprises or facilitating fraudulent activities elevate "G" risk. Therefore, all three ESG pillars can increase credit risk by affecting a bank's reputational integrity.

Banks rely heavily on public trust and confidence. ESG-related controversies or negative news can damage a bank's reputation, leading to customer attrition, loss of business, and declining share prices. Mariia (2022) observes that ESG controversies negatively impact a bank's value and share prices, as investors often react strongly to negative ESG news related to community and workforce issues. Galletta, Mazzù, and Naciti (2022) note that banks with fewer ESG controversies generally assume less risk.

Kalfaoglou (2021) notes that ESG risk transmits into financial or credit risk through microeconomic and macroeconomic channels. The microeconomic channel impacts a bank's credit risk through its borrowers, while macroeconomic factors, such as economic growth and inflation, have indirect effects. These channels can lead to liquidity risk, creating a negative feedback loop and increasing cyclicality in the banking sector.

However, acquiring comprehensive data on ESG factors remains a challenge in the financial domain. Zaytseva and Maksimov (2022) highlight the lack of a unified methodology for evaluating banks' ESG engagement and the inadequate regulatory framework for analyzing such projects.

[2] Consumers are increasingly interested in electric vehicles, renewable energy, organic foods, and eco-friendly goods. This shift in demand can impact a bank's environmental risk, as it may lower the creditworthiness and profitability of businesses in fossil fuel or mining sectors. Consequently, banks financing these sectors could face higher risk.

Nonetheless, the privileged status of banks in financial intermediation does not absolve them from involvement in ESG initiatives.

The European Union has pioneered ESG regulation in the financial sector. Bruno and Lagasio (2021) note that European policymakers have intensified efforts to create a regulatory framework for enhancing sustainability in finance. The EU has implemented the Non-Financial Reporting Directive (2014/95/EU) and the Sustainable Finance Disclosures Regulation (2019/2088), known as NFRD and SFDR, respectively.

The NFRD requires large EU companies, including financial institutions, to disclose non-financial information in their annual reports, covering various ESG aspects such as impacts, governance, diversity initiatives, and due diligence practices. Korca, Costa, and Farneti (2021) note that, following the NFRD's shift from voluntary to mandatory non-financial reporting, the quantity of disclosures by Italian banks increased significantly, though challenges in report quality remain. In 2022, the NFRD has been superseded by the Corporate Sustainability Reporting Directive (2022/2464), abbreviated CSRD, which substantially upgrades ESG reporting with the introduction of mandatory European Sustainability Reporting Standards (from 2024 onwards for first reporting in 2025), and gradually broadens it from the largest companies that were subject to NFRD reporting (with more than 500 employees) to all large companies (with more than 250 employees) and listed small and medium-sized enterprises.

In parallel, SFDR enhances ESG information disclosures for the benefit of investors by introducing specific requirements for financial institutions and other industry actors. Cremasco and Boni (2022) emphasize that the SFDR's primary objective is to compel financial entities to declare their compliance with ESG disclosure and reporting obligations, aiming to curb greenwashing practices. However, despite the SFDR's innovations, persistent ambiguity about ESG issues remains in the European financial market. Additionally, Gyura (2020) anticipates data collection challenges in less developed markets within the EU.

The NFRD, CSRD, and SFDR have been further amended by the Taxonomy Regulation (2020/852), requiring companies, including financial institutions, to disclose environmentally sustainable activities and, for financial companies, investment products. Large financial institutions, including banks, are also subject to sustainability reporting under the Capital Requirements Regulation (EU/2019/876), or CRR II, which emphasizes quantitative reporting on

climate-related risks and investment activities. The EU's stringent sustainability reporting framework aims to facilitate information flow and reduce asymmetries to redirect capital towards sustainable activities. However, it remains to be seen if these complex demands will be implemented without creating an excessive regulatory burden that could hinder competitiveness.

Development banks and ESG

Within the banking landscape, development banks, guided by their institutional mandates, allocate resources to pivotal ESG-oriented projects, distinguishing their role from conventional banks. For example, in 2019, the EIB pledged to become the EU's climate bank. However, this heightened engagement exposes them to elevated ESG-related risks, as their portfolios are intentionally biased toward environmentally and socially significant endeavors.

Rich (1984) recognized development banks' significance in the 1980s, emphasizing their role in promoting underdeveloped regions while managing natural resources effectively. In the 1990s, Mikesell and Williams (1992) highlighted the potential for integrating environmental principles into traditional development policies, advancing sustainable resource development. Handl (1998) noted that development banks' activities and funding contribute to economic, social growth, and environmental protection within sustainable development.

The integration of environmentally friendly policies into development bank activities is ongoing. Grutner (2002) emphasizes the convergence of economic development and environmental protection in projects such as efficient energy facilities, sectoral restructuring, and water supply initiatives. Regional development banks, such as the EIB, have pledged to focus on key environmental issues, particularly climate change (Ebeling, 2022). Humphrey (2016) argues that multilateral development banks even risk losing relevance if they do not align with the economic, social and environmental aspirations of developing countries. In the dynamic financial landscape, reconciling economic progress with environmental responsibility is central for development banks to effectively fulfill their mission.

These specialized financial institutions, dedicated to advancing socio-economic development, prioritize projects aligned with sustainable principles, inherently acknowledging the social pillar in their operations. McIntyre (2015) highlights that development banks' commitment to ESG policies is often aligned with both national and international environmental and human rights legislation.

Lyne et al. (2009) emphasize the role of development banks in social lending, strengthening areas like health, education, and safety nets. Gallagher and Yuan (2017) stress the importance of distributing development financing in a socially inclusive manner, a critical stance for development banks.

Regarding the social pillar of ESG, it is important to note the similarities and differences between the "S" component in ESG and the concept of social capital pursued by multilateral development banks. Both frameworks focus on improving social outcomes, addressing social issues, enhancing social well-being, and supporting sustainable development, but they differ in scope and application. Bebbington et al. (2004) note that the social capital debate within the World Bank aligned with the post-Washington Consensus idea that non-market interventions can resolve market imperfections with social origins. Fox and Gershman (2000) define social capital as the social relationships facilitating collective action in the public interest, while Bebbington (2006) expands this to include networking resources, information, and reputational influence within social groups. Fine (2003) observes that social capital is such a broad concept that it can mean almost anything, granting significant analytical flexibility. While social capital definitions align with aspects of the "S" component in ESG, the two concepts do not entirely overlap. The "S" component in ESG evaluates a wide range of social issues, including labor practices and human rights, across all sectors, assessing both impact and risk. In contrast, the social capital goals of multilateral development banks are more focused on specific social infrastructure and community development in developing regions.

Regional and multilateral development banks, as noted by Scatigna et al. (2021), wield substantial influence in deepening ESG markets. They mobilize public and private capital to bolster ESG assets, significantly contributing to sustainable financing initiatives. Mendez and Houghton (2020) describe development banks as "norm entrepreneurs" in sustainable banking, shaping industry practices and norms. They are crucial for international governmental and civil society organizations aiming to establish comprehensive financial frameworks for sustainable development.

Development banks often face criticism for governance issues, with Gutierrez et al. (2011) noting their susceptibility to political pressures and sometimes "outright corruption." Despite these challenges, governance in development banks tends to improve over time. The authors suggest that private sector participation in ownership, listing on stock exchanges, or similar measures can

enhance corporate governance practices. Luna-Martinez and Vicente (2012) add that, post-global financial crisis, many countries have worked to transform their national development banks into financially self-sustainable organizations with innovative and robust governance arrangements. This reflects a global trend toward strengthening the governance frameworks of development banks for increased stability and effectiveness.

Nevertheless, it is important to recognize that political governance issues are particularly pronounced in multilateral development banks. Authors highlight the significant voting influence of large countries, pointing to a highly political internal governance structure (Stiglitz, 2000; Wade, 2001; Thacker, 1999; Gwin, 1994; Dreher, Lang, and Richert, 2019). These institutions exhibit a dichotomy between their internal and externally projected governance. Woods (2000) notes that, in the last decade of the 20th century, the World Bank and IMF embraced "good governance" principles such as democratization, transparency, and anti-corruption strategies to guide their objectives in member countries. However, these institutions often fell short in applying equal standards of transparency, accountability, and participation to themselves. Woods also emphasizes the need to adapt the voting structures of these institutions to address governance issues effectively.

3. Data and methodology

It is important to acknowledge two distinct paradigms of ESG scores (also ratings), prevalent in contemporary banking. The first one entails a *risk-based* or *outside-in* perspective, where the scores reflect the relevance of *external* ESG risks to the bank. These are known as ESG *relevance* scores. For instance, if a bank finances a project in an earthquake-prone area, the environmental risks may elevate the project's risk profile, impacting the bank's credit risk assessment. Similarly, operating in regions with weak social conditions, inadequate rule of law, and high corruption levels can increase the bank's credit risk, highlighting the relevance of social risk factors. Governance concerns, whether internal or affecting entities financed by the bank, can also heighten credit risk, resulting in higher governance relevance scores. This perspective is the central focus of our paper.

The second paradigm of ESG scores assesses a bank's impact on the broader environment, offering a value judgment of its sustainability-oriented practices. In this paradigm, a higher ESG score indicates a positive influence on environmental, social, and governance conditions. For example, financing a project that harms the environment would result in a lower "E" score, while supporting low-carbon technologies would yield a higher "E" score. This ESG paradigm reflects an *impact* or

inside-out perspective, focusing on how a bank's internal practices impact sustainability factors. This paradigm, while important, is not the focus of this paper.

While both paradigms are interconnected, one does not necessarily imply the other. Moreover, positive developmental impact does not always align with favorable ESG scores from an inside-out perspective. To illustrate, a multilateral development bank might extend loans to poor nations with specific loan conditionality. In such cases, achieving a sustainable energy transition (the "E" in ESG) may be impractical, making it more important to focus on competitive markets and create jobs. This could involve establishing factories with less-than-ideal carbon footprints, resulting in lower environmental scores but higher social scores. Conversely, if the loan conditions emphasize reforms related to the rule of law, anti-corruption measures, and democratic governance, the governance impact would be heightened. Depending on the ESG score provider's weighting scheme, the overall ESG score may increase or decrease, but the developmental impact remains significant.

The relevance of ESG considerations for credit risk assessment may vary. For example, if a factory is not in an earthquake- or flood-prone area, its environmental risk score would likely be low, indicating minimal contribution to the bank's credit risk. Conversely, issues like poor rule of law and corruption in impoverished nations can significantly increase credit risk, resulting in a higher social relevance score. This highlights the distinct and complementary nature of both perspectives, each offering unique insights into the broader implications of ESG factors in banking and development financing.

3.1 Data

This study aims to investigate the differences in risk profiles between development banks and conventional banks concerning ESG issues, specifically from an outside-in (risk-based) perspective. We seek to understand if ESG relevance scores are different for development banks compared to conventional banks. Given that development banks are often mandated to improve environmental, social, and governance conditions, they typically operate in areas where these conditions are deficient. This focus may translate to higher ESG relevance for their credit risk.

We sourced ESG relevance scores from Fitch Ratings which measure how ESG risk affects overall credit risk, rated on both continuous (1 to 5) and discrete (1 to 5) scales. Table 1 describes the employed scale and the meaning of relevance scores.

Table 1: ESG relevance scores measurment scale

Score	ESG Risk Relevance to Bank's Credit Risk	ESG Risk Relevance to Sector
1	Irrelevant to the bank's credit risk.	Irrelevant to the broader sector.
2	Irrelevant to the bank's credit risk.	Relevant to the broader sector.
3	Minimal relevance to the bank's credit risk; negligible impact or actively managed.	Relevant to the broader sector.
4	Relevant to the bank's credit risk, but not a key driver.	Relevant to the broader sector.
5	Highly significant to the bank's credit risk; pivotal and influential factors.	Highly relevant to the broader sector.

Source: Summarized from Fitch Ratings (2020)

Each ESG relevance score comes with a sentiment that can either be positive or negative, implying that ESG risks can either diminish a bank's credit risk (positive sentiment) or increase it (negative sentiment). Importantly, all banks examined in our analysis demonstrate a negative sentiment regarding the relevance of ESG risks to credit risk. This means that ESG risks either have the potential to increase credit risk of banks in our sample or do not exert any influence on it (in the case of low 1-2 ESG relevance scores).

Data limitations must be acknowledged. Due to the relatively novel concept of ESG relevance scores, data is available for only 567 banks globally (40 development banks and 527 conventional banks). This limitation in data availability for ESG relevance scores prevents us from assembling a panel data structure at this point. Notably, ESG relevance scores are at the time of writing this article time-invariant and not tied to annual reporting cycles, setting them apart from traditional financial metrics. Consequently, only one observation of ESG relevance scores is available for each bank. Therefore, we are working with a cross-sectional dataset of 567 banks. We appended balance sheet and income statement information from Fitch Connect Fundamentals dataset. To align the time period of bank financials and country level data with time-invariant ESG relevance scores, we employed an averaging technique for all bank specific financials and country-level variables. Specifically, we calculated average values for financial indicators spanning the three-year period from 2019 to 2021. Similarly, we used three-year averages for country-level controls from the

World Bank's datasets. By averaging data over multiple years, we mitigate the influence of year-to-year fluctuations, ensuring the stability and reliability of our analytical framework.

Although our sample is relatively modest in terms of the number of banks included, it nevertheless serves as a comprehensive representation of the global banking system, collectively accounting for approximately 75% of the total assets within the global banking system. Hence, our sample predominantly represents large banks, thereby exhibiting limited representativeness of smaller and medium-sized banks. Notably, development banks constitute approximately 4.3% of the total assets in our sample, a proportion that is in line with the findings of Porenta and Rant (2024) where the share of development banks was estimated at 4.75% of global banking system assets. Table 2 presents a breakdown of the regional and income group distribution of banks within our sample.

Table 2: Regional and income group distribution of banks and their average ESG relevance scores in the sample

				ESG		E		S		G	
	N	CB	DB	CB	DB	CB	DB	CB	DB	CB	DB
East Asia and Pacific	101	93	8	3.85	4.13	2.00	2.00	3.04	3.20	3.88	4.08
Europe and Central Asia	216	205	11	3.81	3.83	1.99	2.00	2.98	3.09	3.85	3.84
Latin America and Caribbean	100	86	14	3.84	3.90	2.09	2.00	3.04	3.10	3.85	3.89
Middle East and North Africa	54	53	1	3.83	4.20	2.01	2.00	2.99	3.20	3.84	4.20
North America	62	62	/	3.83	/	2.11	/	3.09	/	3.82	/
South Asia	10	9	1	4.00	3.80	2.00	2.00	3.00	3.00	4.17	3.80
Sub-Saharan Africa	24	19	5	3.82	4.20	2.00	2.00	3.00	4.00	3.84	4.00
HIC	326	315	11	3.79	3.89	2.02	2.00	3.00	3.20	3.80	3.84
UMC	174	154	20	3.89	3.92	2.04	2.00	3.04	3.03	3.93	3.93
LMC	63	57	6	3.88	4.17	2.04	2.00	3.01	3.57	3.94	4.07
LIC	4	1	3	3.80	4.20	2.00	2.00	3.00	4.00	3.80	4.00
Total	567	527	40	3.83	3.97	2.03	2.00	3.02	3.23	3.86	3.93

CB = conventional banks, DB = development banks. Average ESG, E, S and G relevance scores are shown.

The distribution of observations from development banks predominantly reflects banks located in the East Asia and Pacific, Europe and Central Asia, and Latin America and Caribbean regions. This pattern aligns with the broader financial sample analyzed in Porenta and Rant (2024). However, a limitation in the data becomes apparent when examining income group distribution. Nearly 90% of observations originate from banks operating in either high-income or upper-middle-income

countries. Consequently, the sample predominantly represents the ESG risk profiles of banking systems in these nations, with limited representation from lower-income countries. This disparity can be attributed to the relatively nascent nature of ESG risk relevance scores, which are more readily available for banks in more developed regions of the world.

Social risk exhibits a higher degree of relevance and exerts a more pronounced influence on credit risk compared to environmental risk. Conventional banks tend to maintain relatively stable ratings, hovering around 3, while development banks, on average, score slightly higher at 3.2. Although social risk holds a marginally greater level of relevance for development banks, the magnitude of the score implies that social risk remains minimally relevant, yet still pertinent, to credit risk assessments. Notably, for the nine development banks operating in lower-middle-income or low-income countries, social risk assumes a moderate level of relevance, with scores of 3.6 and 4, respectively. These banks, with their mandates centered around social housing, healthcare, education, poverty alleviation, and agricultural development, naturally accumulate more social risk. Furthermore, social risk demonstrates a moderate level of relevance to credit risk for development banks operating in Sub-Saharan Africa, with an average score of 4.

Governance risk emerges as the most relevant to the credit risk within the banking landscape, consistently garnering higher relevance scores. Conventional banks exhibit an average score of 3.86, while development banks slightly surpass them with an average of 3.93. This positions governance risk within the moderately relevant category, yet it does not attain the status of a key credit risk driver. Notably, the relevance of governance risk increases for development banks operating in lower-middle-income and low-income countries. In these contexts, governance risk assumes a more significant role in credit risk assessments.

3.2 Methodology

To comprehensively analyze the factors that affect ESG relevance for credit risk, combined ESG and separate E, S, and G relevance scores are used as dependent variables. Two regression models, OLS for continuous scores and ordered logit for discrete scores, were estimated with multiple specifications for robust results. The full regression equation is presented in model (1). To examine disparities in the relevance of ESG factors in credit risk between development banks and conventional banks, our model introduces two dummy variables. Specifically, $Ind_{DBi,j}$ signifies

national development banks, while $Ind_{MDBi,j}$ represents multilateral development banks. These dummy variables account for the substantial differences between these two categories. Multilateral development banks, as larger international financial institutions with greater financial flexibility and liquidity support, often possess a higher capacity to invest in ESG-oriented projects. This predisposition may consequently introduce elevated ESG risk into their portfolios.

$$ESG_{i,j} = \alpha + \beta_{DB} Ind_{DB\,i,j} + \beta_{MDB} Ind_{MDB\,i,j} + \beta_1 Prof_{i,j} + \beta_2 LoanQ_{i,j} + \beta_3 Liq_{i,j} + \beta_4 lnTA_{i,j} + \theta_1 EPI_j + \theta_2 HDI_j + \theta_3 WGI_j + \gamma_1 PrivateCreditGDP_j + \gamma_2 CountryNPL_j + \varepsilon_{i,j} \quad (1)$$

Acknowledging the associations between ESG considerations and financial performance (Azmi et al., 2022; Buallay, 2019; Izcan and Bektas, 2022), we recognize the need to control for fundamental financial performance indicators. While our primary focus is on ESG risk, differences in financial performance can influence risk-taking behavior. We consider three components of financial performance: profitability, loan quality and liquidity.

Profitability can significantly affect a bank's risk tolerance, credit risk, and ESG risk management approach. Cheng et al. (2020) show a positive relationship between credit risk and ROAA, ROAE, and net interest margin (NIM), indicating a risk-taking motive, while Saleh and Abu Afifa (2020) report a negative relationship for banks in emerging markets. To account for potential impact of bank financial performance on its ESG risk profile, we incorporate the *composite profitability index* $Prof_{i,j}$. This index is constructed using principal component analysis (PCA).[3] The index is a composite measure based on three standard bank profitability metrics: ROAA, ROAE and NIM. We employed PCA on this variable set, yielding an index derived from the first principal component (Comp1) scores.

Credit risk is notably higher in institutions with poor *loan quality*. Cai and Zhang (2017) found a positive relationship between non-performing loans (NPLs) and both credit and liquidity risk in Ukrainian banks. Since ESG projects can introduce additional risk, banks may adjust their

[3] PCA is commonly employed to construct composite indices. Jan et al. (2019) use bank-specific KPIs like ROAA, ROAE, and Tobin's Q to measure financial performance from management, shareholders, and market perspectives. They derive PCA scores from these metrics, creating the Islamic Financial Index. Similarly, Shi and Yu (2021) utilize PCA to construct an index for measuring Chinese banks' risk management, avoiding arbitrary weight assignment to individual indicators.

portfolios away from such initiatives. To assess this, we introduce a *composite loan quality index*, $LoanQ_{i,j}$., based on NPL ratios (NPLR), NPLs to total assets ratio (NPLTA), and NPLs to total equity ratio (NPLE). These metrics are condensed into the index with PCA, with results shown in Table 3. All three variables have positive loadings on Comp1, indicating moderate to strong correlations. Higher Comp1 scores originally indicated lower loan quality, so we reversed the scores by multiplying by -1 to ensure higher scores reflect higher loan quality.

Table 3: Composite indices of financial performance – PCA results

	Comp	Eigenvalue λ	Explained %	Variables	Loadings on Comp1	Unexplained %	Observations
Profitability	Comp1	2.27	0.76	ROAA	0.63	0.10	567
	Comp2	0.59	0.29	ROAE	0.59	0.22	
	Comp3	0.14	0.05	NIM	0.51	0.42	
Liquidity	Comp1	2.21	0.55	LATA	0.65	0.06	576
	Comp2	1.46	0.36	LATD	0.34	0.74	
	Comp3	0.29	0.07	LATL	0.66	0.05	
	Comp4	0.05	0.01	FGTA	-0.17	0.93	
Loan Quality	Comp1	2.73	0.91	NPLR	0.58	0.09	576
	Comp2	0.21	0.07	NPLTA	0.59	0.04	
	Comp3	0.06	0.02	NPLE	0.56	0.14	

The KMO measure of sampling adequacy is higher than 0.5 for all groups. The left side of the table includes Comp, Eigenvalue, and Explained columns, detailing results for all components derived from the original KPIs. The Eigenvalue column lists eigenvalues for each component, while Explained indicates the proportion of variance in the original KPIs explained by each principal component. Total variance explained by all components equals the variance in the original KPIs. On the right side of the table, KPI, Loadings on Comp1, Unexplained, and Observations are shown, focusing on the first principal component used to construct the composite financial performance index. Loadings on Comp1 represent weights for the weighted linear combination of standardized original KPIs to calculate scores. The Unexplained column shows the proportion of variation in the original KPIs not explained by the first principal component.

Banks with enhanced *liquidity* are better positioned to select ESG-oriented projects and respond to unforeseen ESG-related shocks, such as extreme weather events, resource scarcity, and infrastructure vulnerabilities. To control for this, we introduce a *composite liquidity index*, $Liq_{i,j}$, comprising four KPIs: liquid assets to total assets ratio (LATA), liquid assets to total deposits ratio (LATD), liquid assets to liabilities ratio (LATL), and the funding gap as a share of total assets (FGTA). PCA results show LATA, LATD, and LATL, which indicate higher liquidity, positively load on Comp1 with moderate to strong correlations, while FGTA, indicating liquidity risks, shows a weak negative correlation. Despite the second component's eigenvalue being slightly above 1, we use scores from the first component only, as it explains 55% of the variation and offers

straightforward interpretation. This composite liquidity index yields higher scores as increased liquidity. Together, these composite variables indicate a bank's financial performance within the model.

Results on index creation and PCA results are presented in Table 3. All three original variables exhibit moderate to strong positive correlations with the first principal component. Consequently, a higher Comp1 value indicates higher overall balanced profitability of a bank.

Bank size can significantly influence ESG risk management within financial institutions. Larger banks, with diversified portfolios, can spread ESG risks across various activities and geographies, reducing overall exposure. Conversely, smaller banks with more concentrated portfolios may be more vulnerable to ESG risks. Additionally, larger banks face increased regulatory and stakeholder scrutiny due to their systemic importance, which may lead to stricter ESG risk management requirements. To control for bank size, we include the log of total assets ($lnTA_{j,t}$) in the model.

Incorporating macro-level factors is central in assessing ESG risk relevance for banks. A bank's exposure to ESG risks is influenced by the broader environmental, social, and governance conditions of its operating environment. Banks in environmentally challenged regions face elevated "E" risk, while those in areas with governance issues accumulate more governance – "G" risk automatically. To address environmental conditions, we use country-level Environmental Performance Index (EPI_j) scores as a proxy. This index is derived by Wolf et al. (2022) and considers air quality, water and sanitation, biodiversity and habitat, forests, fisheries, climate and energy along with agriculture metrics. For social conditions, we employ the Human Development Index (HDI_j), offering insights into overall societal well-being. Governance conditions are controlled for using a composite indicator (WGI_j) from the World Bank's governance indicators database. By including these controls, we consider the larger contextual forces that shape ESG risk.

To account for any remaining macro-level influences on ESG risk relevance, we introduce additional country-level controls. In order to account for the financial system's development, the model includes a proxy variable – private bank credit as a proportion of GDP ($PrivateCreditGDP_j$). Country specific non-performing loan ratios are controlled for by including $CountryNPL_j$. Alternative specification with country dummies were estimated for all OLS regressions.

4. Results and discussion

The outcomes from the estimation of model (1) are detailed in Tables 4 through 7, including both OLS form for continuous relevance scores and ordered logit for discrete relevance scores. Table 4 features models with aggregate ESG relevance scores as the dependent variable, while Table 5 focuses on models with E scores, Table 6 with S scores, and Table 7 with G scores as the dependent variables.

National development banks

Considering the aggregated continuous ESG relevance scores first, our findings indicate that ESG risk manifests as comparatively less relevant for credit risk of national development banks, as supported by the negative coefficients Ind_{DB} (β_{DB}). This observation holds statistical significance at the 5% level across five out of six regression specifications. Notably, while this reduced relevance is statistically significant, its magnitude remains modest due to low coefficient estimates. However, these estimates lack statistical significance in ordered logit models with aggregated discrete ESG relevance scores as dependent variables. Consequently, differences in ESG relevance for credit risk between national development banks and conventional counterparts are not robust to model specification. The multifaceted roles of national development banks, including countercyclical lending, addressing financial market gaps, and shaping developmental policies, contribute to a nuanced understanding of their risk landscape, which is not necessarily intertwined with ESG risk. Development banks frequently operate under mandates requiring the integration of ESG oriented projects into their portfolios. Although increased engagement with such projects may enhance their positive socio-environmental impact as discussed in the literature review section of this chapter, our results show no convincing differences in the relevance of ESG risks to their credit risk when compared to conventional banks.

In our analysis of the granular E, S and G decomposition, our findings reveal that national development banks exhibit no statistically significant differences in the importance of either environmental or social factors to credit risk when compared to conventional banks. This observation further reinforces the proposition that, on a broader scale, national development banks have not undergone a significant increase in credit risk emanating from projects with a substantial emphasis on ESG considerations.

Table 4: Determinants of overall ESG relevance scores:

	OLS						Ordered Logit					
	(1a)	(2a)	(3a)	(4a)	(5a)	(6a)	(1b)	(2b)	(3b)	(4b)	(5b)	(6b)
DB	-0.062*	-0.020	-0.059*	-0.028	-0.060*	-0.030	0.193	-0.056	0.242	-0.108	0.376	0.035
	(0.025)	(0.024)	(0.027)	(0.026)	(0.028)	(0.026)	(0.449)	(0.616)	(0.462)	(0.627)	(0.476)	(0.641)
MDB	1.241***	0.554***	1.272***	0.537***	1.269***	0.537***	3.327***	3.454***	3.817***	3.792***	3.924***	3.888***
	(0.020)	(0.111)	(0.068)	(0.111)	(0.077)	(0.111)	(0.603)	(0.614)	(0.678)	(0.719)	(0.689)	(0.740)
Profitability			-0.003	-0.010	-0.003	-0.010			0.225*	0.117	0.287*	0.162
			(0.015)	(0.010)	(0.014)	(0.011)			(0.104)	(0.152)	(0.123)	(0.159)
LoanQuality			0.003	0.001	0.003	0.001			-0.336***	-0.390*	-0.392***	-0.474**
			(0.012)	(0.010)	(0.012)	(0.011)			(0.095)	(0.157)	(0.108)	(0.162)
Liquidity			-0.009	0.007	-0.009	0.007			-0.110	0.031	-0.114	0.065
			(0.018)	(0.015)	(0.018)	(0.015)			(0.134)	(0.141)	(0.139)	(0.140)
lnTA					-0.001	-0.002					0.102	0.181*
					(0.007)	(0.005)					(0.073)	(0.080)
EPI		-0.008**		-0.008**		-0.008**		-0.096***		-0.094***		-0.091***
		(0.003)		(0.003)		(0.003)		(0.015)		(0.015)		(0.015)
HDI		0.532**		0.531**		0.533**		7.043**		6.551**		6.805**
		(0.198)		(0.199)		(0.203)		(2.222)		(2.149)		(2.202)
WGI		0.003		0.003		0.003		-0.734*		-0.709*		-0.780*
		(0.025)		(0.024)		(0.024)		(0.296)		(0.295)		(0.309)
PrivateCreditGDP		-0.000		-0.000		-0.000		-0.000		0.002		-0.001
		(0.000)		(0.000)		(0.000)		(0.003)		(0.004)		(0.004)
CountryNPL		0.001		0.001		0.001		-0.026		-0.077*		-0.089**
		(0.001)		(0.002)		(0.002)		(0.022)		(0.032)		(0.031)
Country dummies	Yes	No	Yes	No	Yes	No	No	No	No	No	No	No
Observations	567	567	567	567	567	567	567	567	567	567	567	567
R^2 / Pseudo R^2	0.26	0.16	0.26	0.16	0.26	0.16	0.04	0.22	0.07	0.23	0.07	0.24

Robust standard errors in parentheses. *** p<0.001, ** p<0.01, * p<0.05 Dependent variable includes the aggregate ESG relevance scores on continuous scale (for OLS regressions) and discrete scale (for ordered logit regressions).

Table 5: Determinants of overall environmental relevance scores:

	OLS						Ordered Logit					
	(1a)	(2a)	(3a)	(4a)	(5a)	(6a)	(1b)	(2b)	(3b)	(4b)	(5b)	(6b)
DB	-0.019	-0.039**	-0.013	-0.024	-0.021	-0.032*	-0.989**	-1.356**	-0.534	-0.797	-0.725	-0.931
	(0.012)	(0.012)	(0.015)	(0.013)	(0.016)	(0.014)	(0.350)	(0.426)	(0.418)	(0.493)	(0.525)	(0.584)
MDB	-0.001	-0.043**	0.085*	-0.010	0.050	-0.013	-0.989**	-1.444**	0.431	0.093	0.278	-0.203
	(0.001)	(0.015)	(0.034)	(0.023)	(0.035)	(0.023)	(0.350)	(0.480)	(0.575)	(0.626)	(0.596)	(0.641)
Profitability			-0.009	0.007	-0.008	0.004			0.323*	0.233	0.183	0.153
			(0.013)	(0.009)	(0.013)	(0.009)			(0.146)	(0.186)	(0.145)	(0.178)
LoanQuality			-0.005	0.003	-0.004	0.005			0.125	0.105	0.247	0.094
			(0.009)	(0.008)	(0.009)	(0.008)			(0.147)	(0.217)	(0.161)	(0.215)
Liquidity			-0.023*	-0.025***	-0.022*	-0.024**			-0.905***	-0.931***	-0.961***	-0.965***
			(0.010)	(0.007)	(0.010)	(0.007)			(0.229)	(0.257)	(0.239)	(0.278)
lnTA					-0.010	-0.011**					-0.312**	-0.348**
					(0.006)	(0.004)					(0.102)	(0.114)
EPI		-0.002		-0.002		-0.002		-0.057		-0.048		-0.059
		(0.001)		(0.001)		(0.001)		(0.031)		(0.034)		(0.032)
HDI		-0.067		-0.077		-0.061		-2.056		-2.251		-2.692
		(0.149)		(0.147)		(0.146)		(3.091)		(3.132)		(3.120)
WGI		0.017		0.012		0.012		0.412		0.281		0.334
		(0.016)		(0.016)		(0.016)		(0.386)		(0.417)		(0.413)
PrivateCreditGDP		-0.000		-0.000		0.000		-0.002		-0.002		0.004
		(0.000)		(0.000)		(0.000)		(0.004)		(0.005)		(0.006)
CountryNPL		-0.002		-0.001		-0.001		-0.068*		-0.065		-0.077
		(0.001)		(0.001)		(0.001)		(0.029)		(0.039)		(0.041)
Country dummies	Yes	No	Yes	No	Yes	No	No	No	No	No	No	No
Observations	567	567	567	567	567	567	567	567	567	567	567	567
R^2 / Pseudo R^2	0.25	0.02	0.26	0.04	0.27	0.05	0.05	0.06	0.08	0.12	0.12	0.16

Robust standard errors in parentheses. *** p<0.001, ** p<0.01, * p<0.05. Dependent variable includes the E relevance scores on continuous scale (for OLS regressions) and discrete scale (for ordered logit regressions).

Table 6: Determinants of overall social relevance scores:

	OLS						Ordered Logit					
	(1a)	(2a)	(3a)	(4a)	(5a)	(6a)	(1b)	(2b)	(3b)	(4b)	(5b)	(6b)
DB	0.051	0.100	0.070	0.117	0.073	0.119	1.578	1.361	1.870	1.803	2.014	1.913
	(0.070)	(0.072)	(0.072)	(0.075)	(0.071)	(0.074)	(0.982)	(0.982)	(1.095)	(1.146)	(1.064)	(1.101)
MDB	0.203***	0.507***	0.240***	0.546***	0.252***	0.547***	3.237***	3.131***	3.780***	3.986***	3.918***	4.051***
	(0.005)	(0.144)	(0.065)	(0.147)	(0.069)	(0.147)	(0.678)	(0.663)	(0.819)	(0.827)	(0.801)	(0.791)
Profitability			0.048	0.035	0.048	0.036*			0.551**	0.666**	0.632**	0.737**
			(0.026)	(0.018)	(0.026)	(0.018)			(0.180)	(0.244)	(0.198)	(0.249)
LoanQuality			-0.028	-0.013	-0.028	-0.014			0.000	-0.191	-0.058	-0.239
			(0.015)	(0.012)	(0.015)	(0.012)			(0.148)	(0.184)	(0.133)	(0.185)
Liquidity			-0.002	-0.005	-0.002	-0.005			-0.111	-0.041	-0.104	-0.016
			(0.017)	(0.011)	(0.017)	(0.011)			(0.199)	(0.182)	(0.193)	(0.175)
lnTA					0.004	0.003					0.135	0.169
					(0.008)	(0.005)					(0.120)	(0.118)
EPI		-0.004		-0.003		-0.003		-0.051		-0.050		-0.051
		(0.002)		(0.002)		(0.002)		(0.029)		(0.030)		(0.030)
HDI		-0.303		-0.294		-0.299		-6.956*		-6.630*		-7.132
		(0.253)		(0.254)		(0.257)		(3.405)		(3.346)		(3.643)
WGI		0.070*		0.073**		0.073**		1.262**		1.411***		1.438***
		(0.028)		(0.028)		(0.028)		(0.402)		(0.409)		(0.414)
PrivateCreditGDP		-0.000		-0.000		-0.000		-0.005		-0.002		-0.004
		(0.000)		(0.000)		(0.000)		(0.005)		(0.006)		(0.005)
CountryNPL		0.001		-0.001		-0.001		-0.009		-0.040		-0.045
		(0.001)		(0.002)		(0.002)		(0.022)		(0.032)		(0.032)
Country dummies	Yes	No	Yes	No	Yes	No	No	No	No	No	No	No
Observations	567	567	567	567	567	567	567	567	567	567	567	567
R^2 / Pseudo R^2	0.21	0.10	0.23	0.11	0.23	0.11	0.07	0.12	0.11	0.16	0.12	0.16

Robust standard errors in parentheses. *** p<0.001, ** p<0.01, * p<0.05. Dependent variable includes the S relevance scores on continuous scale (for OLS regressions) and discrete scale (for ordered logit regressions).

Table 7: Determinants of overall governance relevance scores:

	OLS						Ordered Logit					
	(1a)	(2a)	(3a)	(4a)	(5a)	(6a)	(1b)	(2b)	(3b)	(4b)	(5b)	(6b)
DB	-0.119***	-0.064**	-0.123***	-0.081**	-0.123***	-0.081**	-1.263*	-1.945*	-1.289*	-2.018**	-1.194*	-1.923*
	(0.033)	(0.022)	(0.034)	(0.026)	(0.036)	(0.026)	(0.565)	(0.763)	(0.593)	(0.737)	(0.604)	(0.752)
MDB	1.082***	0.403***	1.110***	0.377***	1.110***	0.377***	3.520***	3.909***	3.919***	4.023***	3.994***	4.098***
	(0.040)	(0.100)	(0.079)	(0.099)	(0.092)	(0.099)	(0.645)	(0.682)	(0.727)	(0.861)	(0.738)	(0.876)
Profitability			-0.020	-0.028*	-0.020	-0.028*			0.042	-0.226	0.083	-0.204
			(0.014)	(0.011)	(0.014)	(0.012)			(0.110)	(0.187)	(0.123)	(0.197)
LoanQuality			0.004	-0.005	0.004	-0.005			-0.347***	-0.260	-0.387***	-0.347
			(0.014)	(0.012)	(0.014)	(0.012)			(0.093)	(0.169)	(0.103)	(0.184)
Liquidity			-0.010	0.008	-0.010	0.008			-0.106	-0.015	-0.108	0.041
			(0.017)	(0.016)	(0.017)	(0.016)			(0.148)	(0.170)	(0.152)	(0.165)
lnTA					-0.000	-0.000					0.077	0.198*
					(0.007)	(0.005)					(0.076)	(0.092)
EPI		-0.009**		-0.009***		-0.009***		-0.113***		-0.109***		-0.106***
		(0.003)		(0.003)		(0.003)		(0.018)		(0.017)		(0.017)
HDI		0.869***		0.848***		0.848***		10.547***		10.244***		10.667***
		(0.213)		(0.213)		(0.216)		(1.998)		(2.058)		(2.085)
WGI		-0.040		-0.041		-0.041		-1.062**		-1.115***		-1.226***
		(0.027)		(0.025)		(0.025)		(0.324)		(0.322)		(0.340)
PrivateCreditGDP		-0.000		-0.000		-0.000		0.000		0.001		-0.003
		(0.000)		(0.000)		(0.000)		(0.004)		(0.004)		(0.004)
CountryNPL		0.000		0.000		0.000		-0.014		-0.045		-0.059
		(0.001)		(0.002)		(0.002)		(0.021)		(0.034)		(0.036)
Country dummies	Yes	No	Yes	No	Yes	No	No	No	No	No	No	No
Observations	567	567	567	567	567	567	567	567	567	567	567	567
R^2 / Pseudo R^2	0.35	0.17	0.35	0.18	0.35	0.18	0.06	0.28	0.08	0.29	0.08	0.30

Robust standard errors in parentheses. *** p<0.001, ** p<0.01, * p<0.05. Dependent variable includes the G relevance scores on continuous scale (for OLS regressions) and discrete scale (for ordered logit regressions).

However, our results indicate that governance risk and its translation to credit risk of national development banks is lower compared to conventional banks. The negative and statistically significant coefficients Ind_{DB} (β_{DB}) for national development banks in all models with G relevance scores as the dependent variable suggest two potential explanations – internal factors within the bank, relating to their governance structures, and external factors influencing the bank, associated with the broader governance issues in the jurisdictions where they operate. Luna-Martinez and Vicente (2012) highlight an ongoing global effort to fortify national development banks, making them financially self-sustainable entities with innovative and robust governance structures. Our results may reflect this trend, indicating that national development banks possess specific governance frameworks that mitigate certain risks or exhibit greater resilience to governance-related challenges.

Contrary to the generalized criticism of "poor governance", our data, incorporating the latest ESG risk relevance scores, suggests that this critique may not be universally applicable or at least may not be as relevant for credit risk in national development banks as it is for conventional banks. Alternatively, the observed pattern could be attributed to portfolio selection, as national development banks may prioritize projects where governance is not an issue (this may include projects with good governance, a criterion frequently imposed in their mandates).

Multilateral development banks

The coefficient estimates for multilateral development banks reveal that aggregate ESG risk contributes more significantly and is therefore more relevant to credit risk compared to conventional banks. This is supported by positive and highly statistically significant ($p<0.001$) coefficient estimates Ind_{MDB} (β_{MDB}) across all OLS and ordered logit models. This outcome also underscores distinct disparities in risk profiles between national and multilateral development banks, emphasizing variations in portfolio selection strategies.

In the more nuanced exploration of the E, S, and G decomposition, the findings reveal a higher significance of social risk for the credit risk of multilateral development banks in comparison to conventional banks. This is supported by consistently positive and highly statistically significant coefficient estimates Ind_{MDB} (β_{MDB}) across all regressions in both OLS and ordered logit settings. The extensive geographic scope of operations of multilateral development banks exposes them to diverse social contexts and cultural intricacies, amplifying social risks such as community

resistance, labour issues, and social unrest. Their inherent long-term orientation places a priority on social development, further exposing them to unique social risks not as prominently considered in the decision-making processes of conventional banks. Moreover, the mission-driven involvement of multilateral development banks in financing the development of areas and countries marked by deficient labour practices, human rights transgressions and inadequate supply chain oversight accentuate "S" risk, augmenting the overall relevance of social considerations in their credit risk assessments.

Multilateral development institutions also exhibit higher levels of governance risk relevance, as indicated by positive, significant and substantial coefficient estimates Ind_{MDB} (β_{MDB}) across all OLS and ordered logit regression models. This outcome is aligned with expectations, given that governance risk is inherent to the operational framework of these entities, with due consideration to the rule of law, institutional robustness, and regulatory quality. All variables associated with governance relevance exert adverse effects on the credit profile of multilateral development banks. Specifically, our dataset indicates that all included multilateral development banks possess a governance relevance score of at least 4, denoting a moderate to high significance of governance risk in relation to credit risk.

Notwithstanding the influence of external governance pressures on creditworthiness, it is imperative to recognize that multilateral development banks are susceptible to internal governance challenges. Fitch Ratings' 2020 report underscores the integral role of the internal governance structure in shaping governance risk. Consequently, the level of board independence, subject to potential political pressures (Stiglitz, 2000; Wade, 2001; Thacker, 1999; Gwin, 1994; Dreher, Lang, and Richert, 2019; Woods, 2000), emerges as a determining factor influencing lending patterns within these institutions. A pertinent illustration of this is observed in the case of the Development Bank of Latin America (CAF), where an overwhelming majority of borrowing countries (over 90%) in the capital structure has influenced the bank's lending strategy (Fitch Ratings, 2021). Our estimated results align with expectations, indicating that governance risk poses a significant challenge for multilateral development banks.

It is important to note that our estimations do not provide a value judgement on externally projected governance and the impact of bank's operations. Woods (2000) notes that while the Bretton Woods institutions fall short in fully internalizing externally projected "good governance" principles such

as democratization, transparency, and anti-corruption strategies, they are still guided by these principles in loan conditionality and objectives in member countries. Our analytical framework cannot capture the impact of those principles and thus focuses solely on the risk aspect.

Bank financials and bank size

Our findings reveal a constrained impact of bank financials on aggregate ESG relevance scores. Specifically, loan quality demonstrates a negative association with ESG relevance scores in ordered logit models indicated by negative and statistically significant coefficient estimates *LoanQ* (β_2), indicating that, on the whole, banks emphasizing higher loan quality portfolios tend to exhibit diminished ESG risk relevance to credit risk. Institutions prioritizing elevated loan quality often institute robust risk management practices, involving due diligence in evaluating the ESG dimensions of potential borrowers. This approach can contribute to a reduced likelihood of ESG-related credit risks. However, in OLS models, coefficient estimates on loan quality lack statistical significance.

In the context of E risk, our results indicate lower E risk relevance for banks with higher liquidity levels. Coefficient estimates *Liq* (β_3) are negative and statistically significant across all regressions. In the context of S risk, our findings indicate that banks with heigher profitability levels generally encounter higher levels of S risk relevance. Positive and statistically significant coefficient estimates *Prof* (β_1) in ordered logit models support this observation, though the statistical significance diminishes in OLS models. In essence, while profitability appears to weakly influence S risk relevance, its statistical significance is nuanced and subject to regression model specifications. On the whole, bank financials and bank size do not emerge as pivotal determinants of ESG relevance for credit risk.

Indicators of macro environmental, social, governance and banking system conditions

Results pertaining to country-specific macro conditions for environmental, social, and governance factors reveal that banks situated in countries or regions characterized by higher Environmental Performance Index (EPI) values demonstrate moderately but consistently lower levels of aggregate ESG and G risk relevance for their creditworthiness across all regression analyses. Intriguingly, both aggregate ESG and specific G risk relevance for banks' credit risk exhibit an increase when operating in countries with higher socio-economic development, as measured by a higher Human

Development Index (HDI), across all regressions. Countries with advanced socio-economic development often enforce more rigorous regulatory frameworks and standards, particularly those related to governance practices. Consequently, banks operating in such jurisdictions encounter heightened scrutiny and adherence requirements, thereby amplifying the relevance of ESG factors in credit risk assessments.

The conditions and development of the banking system, as measured by the ratios of private bank credit to GDP and country-specific (or region specific) banking system NPL ratios, do not manifest any apparent influence on the relevance of ESG factors for bank's credit risk.

5. Concluding remarks

Risk stemming from ESG factors is becoming increasingly relevant for financial institutions and banks. In this article we studied the determinants of ESG risks' relevance for banks' credit risk. We constructed a comprehensive database integrating ESG relevance scores and bank financials from Fitch Ratings, along with country-level variables data from multiple sources. Our dataset spans 567 banks globally, with 40 of them categorized as development banks. We aimed to discern the differences between development and conventional banks with respect to the relevance of ESG risks for credit risk in the global banking landscape by employing regression analysis, (OLS and ordered logit models) complemented by principal component analysis (to consider bank-specific financial performance factors).

First, we investigated the general relevance of ESG risks for credit risk across all banks. Regardless of bank type and operational scope, environmental relevance scores remain consistently low, hovering around 2. This positions environmental risk as relatively insignificant at the individual entity level but potentially holding some relevance at the sectoral level. In contrast, social and governance factors emerge as more potent contributors to credit risk, with governance risk exerting a more substantial influence. ESG issues aggregately are a moderately relevant component in credit risk for both development and conventional banks reflected in average scores approaching 4. Although relevant, ESG issues do not emerge as key drivers of credit risk in the banking sector.

Furthermore, our analysis investigates whether distinct bank types, namely national development banks, multilateral development banks, and other bank categories, manifest varying levels of relevance of ESG risks for credit risks, as indicated by different ESG relevance scores. The results

indicate significant differences between national and multilateral development banks. While ESG risk does not statistically significantly influence the credit risk of national development banks compared to conventional banks, it emerges as a noteworthy component influencing credit risk in multilateral development banks. Specifically, multilateral development banks exhibit elevated ESG risk relevance, primarily stemming from S risk and G risk. The mandate-oriented engagement of multilateral development banks in financing regions and countries marked by challenges such as deficient labor practices, human rights violations, inadequate supply chain oversight, and occasional insolvency issues may accentuate the relevance of social risk. Additionally, risks associated with the rule of law, institutional robustness, regulatory quality, and internal governance challenges could contribute to the heightened governance risk for multilateral development banks.

Throughout our research, we have recognized a potential avenue for further exploration, specifically concerning the comparison between ESG relevance for credit risk and the tangible impact of banks' operations on ESG conditions. This includes examining the internal ESG conditions within the banks themselves and the external impact on the socio-economic environment in which they operate. However, it is important to note that, at present, the availability of data related to the novel metrics assessing ESG impact poses a significant challenge.

Our findings lead to several policy recommendations. Firstly, beyond the consideration of financial performance and countercyclicality metrics in assessing credit risk, additional ESG-related metrics should be integrated into internal credit risk assessments. This approach would enhance the financial viability of development banks, which typically operate in jurisdictions and sectors where social and governance risks are particularly significant.

Secondly, we echo other researchers' policy recommendations regarding the internal governance risks of multilateral development banks. The alignment of voting rights with the financing share of member countries should be decreased to provide fairer representation and influence for predominantly borrowing countries in the decision-making processes of multilateral development banks.

Additionally, transparency issues arising from internal informal political pressures should be addressed. We propose that each multilateral development bank establish an independent research department to review lending decisions and compare them with publicly disclosed rationales behind major decisions, as well as the voting records of member countries. Furthermore, we

recommend that multilateral development banks conduct regular independent audits of their governance and decision-making processes. The results of these audits should be made publicly accessible to ensure accountability and transparency.

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Draft Guidelines on the management of ESG risks

EBA´s consultative document highlights

General overview

EBA requirements

Why Management Solutions?

Annexes

1 General overview
General aspects

EBA has published a Consultation Paper Draft Guidelines on the management of ESG Risks to set up the preliminary requirements for institutions

Objective

- Define the **requirements for institutions** for the **identification, measurement, management and monitoring of ESG risks**, including through **plans** aimed at addressing the risks arising from the **transition towards an EU climate-neutral economy**.

Calendar

- **Public hearing** on the consultation paper on **28 February 2024**
- Comments' **submission** until **18 April 2024**
- **Expected final guidelines by the end 2024. Application: TBC** (aligned with the amended CRD6 application date)

Scope

- **Requirements for environmental**, **social and governance risks. Extending environmental beyond climate**-related ones, such as risks stemming from **degradation of ecosystems and biodiversity loss**, as well as of other ESG factors[1].
- Applicable to **all institutions including SNCI[2]**, considering the **proportionally** criteria and covering their **material ESG risks**.
- **Cover all material subsidiaries in and outside of the EU**, by having regard to applicable local legislation and ESG regulatory objectives.
- **Proportionality** criteria based on size and internal organization, and the nature, scale and complexity of their activities, when developing and implementing the approaches for ESG risks management[3].

Main challenges

- Assessment and monitoring of **ESG risks** over institutions' **exposures/assets** in different **time horizons** and **climate scenarios through…**
  - Exposure method to obtain a short-term view of how **ESG risks are impacting the credit risk profile and the profitability of counterparties** (embedding in **KRIs, internal credit scoring or rating models or valuation of collateral**, when it is applicable).
  - Portfolio-based & Scenario-based methods to support the **medium-term planning process** and to define **risk limits**, **appetite and EWIs** steering the institution towards its strategic objectives and assess their **sensitivities to ESG risks** in different time horizons.
- **Data collection** related to **ESG factors at least for large corporates** based on client engagement approach to gather it (onboarding or periodic reviews), public information or external providers. Possible application of estimation/proxies to be reduced progressively.
- **Portfolio alignment & transition plan:** setting of **targets at least for the most climate contributing sectors,** as well as definition and monitoring of **transition plan** leveraged on embedding in **lending policies, new product offering, client engagement tools**…

1. Annex 1 of EBA Report on management and supervision of ESG risks
2. Small and non-complex institutions.
3. Title I of the EBA guidelines on internal governance. Paragraphs 17 & 18.
4. Early Warning Indicators

Access to Document

1 General overview
Calendar

EBA has published a Consultation Paper Draft Guidelines on the management of ESG Risks to set up the preliminary requirements for institutions

Calendar

January 2024

Publication of **new Guidelines on the management of ESG Risks (Draft)**

February 2024

Public hearing on the consultation on **28 February**

April 2024

The **deadline** for the **submission** of comments is **18 April.**

December 2024

Publication of **Final Guidelines on the management of ESG Risks**

January 2025

Expected application of CRR3 from 1 January 2025, with certain elements of the regulation phasing in over the coming years

June 2025

Amendment of the CRDVI expected to be **transposed by member states by mid-2025**.

EBA is **consulting on the draft guidelines for a period of three months**. Feedback from the public consultation will be taken into account when finalising the guidelines. It is planned that the **guidelines** will be finalised **by end-2024** and **apply from [tbc – depending on CRD6 application date]**

2 EBA requirements
Key aspects (1/4)

EBA CP Draft Guidelines on ESG Risks management is split by three building blocks: i) reference methodology for identification and measurement of ESG Risks; ii) minimum standards and reference methodology for the management and monitoring of ESG risks; iii) Plans in accordance with CRD6

i) Reference methodology for identification & measurement of ESG Risks

Materiality

- Execution of **materiality assessment of ESG risks at least annually** (every 2 years for SNCI) to ensure that ESG risk identification and measurement are integrated into their strategies and internal procedures. To be included in ICAAP.
- **Covering all financial risk categories** (credit, market, liquidity, operational, reputational, business model, and concentration) and **highly climate contibuting sectors[1] at short, medium and long term.**
- Include **qualitative and quantitative data and ESG assessment of impacts** on the most significant **activities, services and products** (considering the climate risk drivers under different climate scenarios)
- Use of **risk-based approach** that considers the **likelihood and the severity of the materialisation of the risks**.

Identification & Measurement

Data processes

- **Implementation** of **systems to collect and aggregate ESG risks-related data across the institution** as part of the overall data governance and IT infrastructure (including arrangements to assess and improve ESG data quality)
- **Capture of data** for the assessment of the **current and forward-looking ESG risk profile** of **counterparties** (at least for large corporates), including **client and asset-level data**. Data collection from onboarding or periodic reviews or external sources[2]. Examples:
  - i. for **environmental**, emissions, material impacts on climate and biodiversity, dependency on fossil fuels energy and water demand, EPCs, forward-looking adaptive capacity such as transition plans, etc.;
  - ii. for **social and governance risks:** compliance with and due diligence on social standards, governance practices,…

Methodo-logies

Combination of three methodologies to assess ESG risks across time horizons, supported by **Key Risk Indicators:**

- **Exposured-based:** assess the exposure of their counterparties' activities and key assets to ESG factors (including risk factors and mitigants). Considering ESG factors into overall assessment of default risk of a borrower and, where justified by their materiality, embedded in the risk indicators, internal credit scoring or rating models, as well as the valuation of collateral.
- **Portfolio-based:** use of at least one portfolio alignment methodology to assess the degree of alignment of institution's portfolios with climate-related sustainability targets. Measuring the gap between existing portfolios and benchmark scenarios and its financial impacts[3].
- **Scenario-based**: perform climate/environmental scenario-based analyses.

1. Sectors listed in Sections A to H and Section L of Annex I to Regulation (EC) No 1893/2006.Exceptions may be considered if it is justified by institution.
2. Where data from counterparties and public sources is not available, institutions should have remediating actions (e.g. estimations/ or data providers)
3. List of sectors with portfolio alignment required: power; fossil fuel combustion; automotive; aviation; maritime transport; cement, clinker and lime production; iron and steel, coke, and metal ore production, chemicals.

2 EBA requirements
Key aspects (2/4)

EBA CP Draft Guidelines on ESG Risks management is split by three building blocks: i) reference methodology for identification and measurement of ESG Risks; ii) minimum standards and reference methodology for the management and monitoring of ESG risks; iii) Plans in accordance with CRD6

ii) Minimum standards and reference methodology for the management and monitoring of ESG risks

ESG risks management principles

- Embedding **of ESG risks within the regular risk management framework, systems and processes** ensuring consistency with the overall business and risk strategies, including policies and limits.
- **Manage and mitigate ESG risks** over the short, medium and long term through **risk management tools.**
- Tools should be considered, among others, **engagement** with counterparties, **financial or conditions terms or pricing** adjustments, ESG embedding within **global, regional and sectoral risk limits, diversification** of lending portfolios or financing reallocation to better ESG profiles.

Strategies & Business Models

- Consider **ESG risks** when **developing and implementing business and risk strategies**.
- Understand how **ESG risks can impact** the **company's business model** and its **strategic objectives.**
- Formulating and monitoring **ESG risk-related strategic objectives** and related **Key Performance Indicators** based on insights **from portfolio alignment, environmental scenario analyses and stress testing.**

Risk appetite

- Clearly define **all material ESG risks** to which the institution is exposed and the type and extent that it is **willing to assume**.
- Set **risk appetite** and associated **KRIs** are appropriately **cascaded down** within institution, including limits, thresholds and exclusions.
- At least consider **metrics listed by EBA** with backward-looking and forward-looking views.

Internal culture, capabilities & controls

- Clear **communication from the management** body ('tone from the top') and appropriate measures to **promote knowledge of ESG factors** and risks **across the institution**, as well as **awareness** of the institution's **ESG strategic objectives and commitments.**
- Ensure, through training policies, that management body and staff are **adequately trained** to understand implications of **ESG factors.**
- Embed ESG risks into **internal control frameworks** across the **three lines of defense** with a clear definition and assignment of responsabilities and reporting lines.

2 EBA requirements
Key aspects (3/4)

EBA CP Draft Guidelines on ESG Risks management is split by three building blocks: i) reference methodology for identification and measurement of ESG Risks; ii) minimum standards and reference methodology for the management and monitoring of ESG risks; iii) Plans in accordance with CRD6

ii) Minimum standards and reference methodology for the management and monitoring of ESG risks

ICAAP/ILAAP	• **Material effects of ESG risks** to be embedded in ICAAP and ILAAP considering appetite, thresholds and limits set for material impacts to **identify and measure internal capital needs.** • Include in the ICAAP a **forward-looking** view of institution's capital adequacy **under an adverse scenario** that includes environmental elements specifying any changes to their business plan derived from climate risk stress testing, in line with EBA Stress Testing Guidelines[1].
Credit risk policies & procedures	• Embedding **in credit risk policies** to ensure clear **processes to identify, measure, manage, mitigate and monitor** impacts from ESG. • Implement **quantitative credit risk metrics** covering most significant client segments, type of collaterals and risk mitigation instruments. • Ensure that **credit sectoral policies,** reflecting ESG risks, are **cascaded down** to business lines and business relationships officers.
Other risk policies	**Assess current and potential future** ESG-related impacts on **market, liquidity & funding, operational, reputational & concentration risks**: • **Market**: how ESG risk affect the **value of the financial instruments,** evaluate the **potential risk of losses and increased volatility in their portfolio's value,** and establish effective processes to control or mitigate the impacts. • **Liquidity**: how ESG risks affect **net cash outflows** or the value of assets comprising their **liquidity buffers** and, where appropriate, incorporate these impacts into the calibration of their buffers or risk management framework. Also assess the **availability and stability of funding sources** at different time horizons and normal/adverse conditions (including potential impacts of ESG reputational risks). • **Operations: how ESG risks affect regulatory risk event types** and the potential impacts on **conduct risks, litigation and reputational risk** related to **lending and investing** in business which may be prone to **ESG-related controversies**. • **Concentration:** assess of **shares of exposure affected** relative to total & if ESG-related concentration **aggravates its financial vulnerability**.
Monitoring	• **Monitor** ESG risks on a **continuous basis** through **internal reporting framework** to senior management, implementing a granular monitoring of counterparties, exposures and portfolios. Include ESG factors in **regular credit reviews for medium-sized and large counterparties**. • Set **Early Warning Indicators** and **backward & forward-looking ESG risk metrics** such as historical losses related to ESG risks or share of income stemming from business with counterparties that contribute to climate change.

1. EBA Guidelines on institutions stress testing (EBA/GL/2018/04). Paragraph 90.

2 EBA requirements
Key aspects (4/4)

EBA CP Draft Guidelines on ESG Risks management is split by three building blocks: i) reference methodology for identification and measurement of ESG Risks; ii) minimum standards and reference methodology for the management and monitoring of ESG risks; iii) Plans in accordance with CRD6

iii) Plans in accordance with Article 76(2) CRD6

Key principles	• Institution's **transition plan** should **address and mitigate** the portfolios and exposures **materially exposed to ESG risks**, covering those that **highly contribute to climate change** (Sectors A to H, plus L) unless institution may provide an appropriate justification. • Ensure that **short, medium and long-term objectives and targets interact and are well-articulated,** including long-term objectives translate into medium-term strategies and that short term financial metrics or targets are consistent (e.g. profitability indicators, cost of risk, …) • **Transition plan** should be properly reflected in **risk appetite** (PIA[1], limits) aligned with business strategy in different time horizons and their **internal capital needs**, considering potential deviations over planned trajectory under adverse scenarios.
Governance	• **Roles & responsibilities:** assign ESG responsibilities at 3LoD. Approval/oversee of plan implementation by management bodies. • **Internal process and capacity:** regular **interaction** at **all levels of the organization** to ensure that insights and feedback from internal stakeholders. Ensure **sufficient capacity, expertise and resources** to develop, implement and monitor their transition planning process, identifying existing gaps in skills and expertise and take **remedial actions where necessary**.
Metrics, Targets & Climate scenarios	• **Set and monitor the targets with cascade these down to the sectoral/portfolio levels** at least for the **materially exposed sectors and portfolios** more subject to these risks (different time horizons and **applying scenarios and patways consistent across the organization**). • **Use of metrics:** financed GHG emissions, portfolio alignment metrics, climate-related income, energy efficiency of real estate collateral and % counterparty engagement on sustainable economy. **Also require** other metrics to assess the **resilicience to physical risk**, management of **nature and biodiversity-related risks**, **ESG-related concentration and reputational risks**.
Transition Planning	• Clearly lay out **processes** and implement **objectives and targets for transition** such as integrating ESG factors in loan origination policies, changes in strategic financing choices or development of new products or services. • Define **data processes** to collect verify and aggregate data needed to **formulate and monitor transition plans.** • **Client engagement** through tools such as reviewing counterparties ESG risk profile and transition plans and actions to promote the client transition through adjusting product offering or agreements to enhance the counterparty's transition. • Assess the **implications of transition process** (e.g. revenues impact) and **align the financing activity evolution** with **risk management policies.**

1. Profitability impact assessment.

3 Why Management Solutions?
Key aspects and differential value

Management Solutions has an expert working group that supports its clients in the implementation of their sustainability framework within each of the 6 defined lines of activity, bringing expertise in each business area

MS capabilities on sustainability

1 Strategy, Governance and Culture

- Diagnosis, strategic framework and general action plan.
- Definition of the Framework: Governance, methodologies, reporting.
- Change Management: Project Management (PMO), Regulation Observatory, Training.

2 Methodologies for measuring climate risks

- Implementation of climate risk measurement methodologies.
- Scenario analysis and evaluation of the impact on the portfolio.
- Climate stress test exercises, Regulatory – ECB, BoE) and Internal. Integration in ICAAP
- Financed emissions calculation and alignment to NZBA

3 Sustainable business and Social Impact

- Taxonomy definition and marking of sustainable operations according to international standards.
- Social Impact measurement methodologies
- Market diagnosis and analysis.
- Sustainable business strategy design (industries, products, services).

4 Risks

- ESG risk management.
- Integration of the ESG dimension within the Risk Appetite, Credit Risk (admission and monitoring, models, pricing...), Operational Risk (continuity plans), Market Risk and Liquidity.

5 Data and Technology

- Requirements and definition of the ESG information model.
- Metrics model definition and KPIs.
- Functional and technological architecture.
- Analysis of alternatives (Vendors vs. in-house).
- Implementation

6 Reporting

- Analysis of information requirements (CSRD, Pilar 3, TCFD, GRI Standards, GHG Protocol + Local regulation and best practices).
- Definition and implementation of reporting models.
- Governance and mechanisms data quality.

Business

- *Retail*
- *Customer*
- *Companies and Markets*
- *Management of Assets*
- *Insurance*

3 Why Management Solutions?
Key aspects and differential value

Management Solutions has been involved in several projects related to ESG embedding into risk management

Proven ESG experience

Extensive experience in the field of **sustainability and climate and environmental risk management** in **large financial institutions, non-financial sector companies and the World Bank**. We offer services in all areas of sustainability and climate risks with a **360º vision** (framework, governance, organisation, methodologies, management processes, tools, data and reporting).

Extensive experience in the field of risk management

Extensive experience in projects in different areas such as risk appetite, risk identification and assessment, limit setting, implementation of regulatory requirements in the granting and monitoring of credit, collateral management, regulatory stress testing exercises, ...

Experience in the field of integration of ESG factors in credit risk management

Proven experience in the integration of ESG factors in credit risk management based on the several projects undertaken: definition and implementation of the target operating model of integration in the management of ESG factors, materiality analysis, development of ESG policies, embedding of KPIs ESG in strategical plans, risk appetite and portfolio management, development of ESG assessment workflow of clients, climate stress testing exercises (EBA Climate data, ECB & PRA Climate ST)

ESG data

Holistic view of the ESG reporting model to cover both regulatory requirements (e.g. Pillar 3 ESG, ECB climate ST, CSRD...) and management requirements (e.g. annual report, sustainability reporting, green finance reporting...).

Benchmark capability

***Benchmarking* capacity** in the field of ESG and specifically in the integration of credit management as a result of extensive **experience in various financial institutions in Europe and America, having carried out more than 200 projects.**

Specialist team

Specialist sustainability team with **extensive experience in regulatory requirements, supervisory expectations and market best practices.**

A Annex 1
Data requirements

Environmental risks	Social & Governance risks
• **Geographical location of key assets and exposure** to environmental hazards (e.g. floods, water stress, soil erosion)	• **Compliance with and due diligence on social standards** (ej. ILO conventions or World Bank's Environmental and Social Standards)
• **Current & forecasted GHG scope 1, 2 and 3 emissions** in absolute and/or intensity such as per million-euro revenues or per units of production	• **Governance practices**
• **Material impacts on the environment,** including **climate change and biodiversity**, and related **mitigation or adaptation policies**	• **Adherence to voluntary or mandatory social and governance reporting**
• **Dependency on fossil fuels**, either in terms of economic factor inputs or revenue base	• **Negative impact on local communities,** including due diligence policies to prevent that
• **Energy and water demand and/or consumption**, either in terms of economic factor inputs or revenue base	• **Litigation risks including imminent, pending or completed litigation** case related to social or governance issues and due diligence policies
• **Energy performance certificates** and score in kWh/m² for real estate	
• **Adherence to voluntary or mandatory climate/environmental reporting**	
• **Litigation risk including imminent, pending or completed** litigation case related to environmental issues	
• **Forward-looking adaptive capacity,** including transition plans prepared by non-financial corporates	

Annex 2
List of metrics (1/2)

Metrics of Plans in accordance with Article 76(2) CRD6 (to be considered for risk apettite)
• **Financed GHG emissions** by scope 1, 2 and 3 emissions split by sectors (absolute emissions and intensity of emissions, relative to revenues or units of production)
• **Portfolio alignment metrics** (projections and (mis)alignment with a pathway consistent)
• **Amount and/or share of income** related to business with counterparties operating in **sectors that highly contribute to climate change**
• Breakdown of **real estate portfolio by energy efficiency level**
• **% counterparties** with whom the institution **actively engages** regarding **adaptability and resilience to the transition** to a sustainable economy
• **% positive outcomes** with whom the institution **actively engages** regarding **adaptability and resilience to the transition** to a sustainable economy
• **Other metrics** to support risk assessment and strategic steering related to: (i) **resilience to physical risk;** **(ii) management of environmental risks** other than climate-related (**nature and biodiversity);** **(iii) ESG-related concentration risks;** **(iv) ESG-related reputational risk**

Annex 2
List of metrics (2/2)

Monitoring Indicators
• **Historical losses and forward-looking estimate(s) of exposures-at-risk and (potential) financial losses** related to ESG risks
• **Amount and share of income** (interest, fee and commission) stemming from business relationships with counterparties **operating in sectors that highly contribute to climate change**
• **Gap between existing portfolios vs benchmark portfolios** consistent with the **climate target applicable**
• **GHG financed emissions,** at least for sectors towards which the institution has material exposures
• **% counterparties** with whom the institution has **engaged on ESG risks** matters, supplemented with the **results and/or outcomes of such engagement**
• **% environmentally sustainable exposures financing activities** that contribute or enable the objective of **climate change mitigation vs total exposure** • **% carbon-intense exposures** over total institution's exposures Also for **large institutions**: ○ **% Taxonomy-aligned exposures for other objectives of the EU Taxonomy vs total exposure** ○ **% exposures detrimental** to the achievement of these objectives For exposures detrimental to the objective of biodiversity, assess material negative impacts of their counterparties' production sites, processes or products on biodiversity.
• **Concentration risk related to physical risk drivers** (e.g. measurement of exposures and/or collaterals in high flood risks or wildfire risks areas)
• **ESG-related litigation claims** in which the institution has been, is or may become involved
• **Progress against all institution's targets** set in relation to ESG risks and ESG objectives

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Criteria Guidance
Report Date: 30 October 2020

ESG Factors and Credit Risk Analysis

1. Overview

Environmental, social, and governance (ESG) considerations are becoming an increasingly important component of credit risk analysis, although their relative importance differs by entity, sector, and country. This guidance note outlines CIôs approach to capturing ESG risks in credit analysis. It does not establish new criteria; rather it explains how ESG factors are, or may be, considered within CIôs current credit rating methodologies.

Key Points

- Governance factors have long been a staple of credit analysis and CI already incorporates such considerations into its ratings for all sectors.
- Social factors are an important element of sovereign ratings but have so far received little weight in the analysis of financial institution (FI) and corporate creditworthiness due to limited evidence of a direct causal link between many social factors and default risk, as well as the normative nature of a number of social issues.
- Environmental factors have not generally been considered as a significant rating factor for the entities in our ratings universe, around 90% of which are FIs (mostly banks).
- Although ESG factors have seldom driven credit rating actions, their significance is growing due to greater awareness of the potential risks to franchise value, cash-flow generation, and debt serving capacity posed by a number of ESG risks, as well as by ESG-related changes in public policy, evolving social norms, the rise of socially responsible investing, and the integration of ESG analysis into portfolio management.
- Climate change is generally recognized as the biggest long-term environmental challenge facing the global financial system. However, we currently do not expect long-horizon risks associated with climate change to trigger rating changes in the short to medium term for most of the entities we rate. Further ahead, climate-related financial risks could emerge as a potential ratings driver unless ameliorated by appropriate mitigation and adaptation strategies.
- CI is cognizant of the practical challenges of assessing ESG risks in a consistent manner, including the lack of information on many of these risks at the issuer level, as well as measurement difficulties and the absence of common metrics for comparative analysis. While international initiatives to improve data quality should eventually help make it easier to assess some of the risks, progress on improving ESG-related disclosures is likely to vary by industry and country in the years to come.
- The timing and magnitude of some ESG risk factors is uncertain and the eventual impact on future debt repayment capacity is impossible to assess with any degree of accuracy. Some risks are also unlikely to materialise until well beyond the typical rating horizon. Nevertheless, we may incorporate probable long-horizon risks into our ratings analysis ï albeit qualitatively ï if exposures or identifiable vulnerabilities indicate that debt is likely to be significantly harder to service in the long term if such risks crystallise.
- While the focus of this guidance note is on risks, ESG factors are not simply a potential credit rating constraint. The effective management of ESG risks, or exploitation of ESG-related opportunities, may help to support or enhance ratings. The integration of ESG factors into a companyôs risk analysis and business strategies should help it to better manage and mitigate potentials risks and ultimately build resilience to ESG-related shocks, as well as structural and secular changes, including the consequences of climate change.

2. Introduction

ESG considerations are becoming an increasingly important component of international finance, driven by rising institutional investor interest in socially responsible investing, growing awareness of the material impact ESG issues may have on corporate performance, and global policy initiatives to promote sustainable finance.

For example, as of end-March 2020, more than 3,000 investors across the world, representing USD103.4 trillion in assets under management, had pledged to incorporate ESG issues into investment analysis and decision-making processes by signing up to the UNôs Principles for Responsible Investment (PRI) initiative.

At the intergovernmental level, the Paris Agreement on climate change and the UN 2030 Agenda for Sustainable Development adopted by nearly 200 governments in 2015, as well as growing public awareness of sustainability issues, suggests that ESG considerations will feature more prominently in policy agendas over the coming decades. Indeed, multilateral organisations, such as the G20, OECD and IOSCO have begun to issue ESG guidance or incorporate sustainability into financial workstreams, increasing the possibility that minimum globally adhered-to standards might be introduced in the medium term.

Of all ESG factors, climate change is receiving perhaps the most attention since it poses a systemic risk to the global economy and could have significant implications for financial stability. Accordingly, the demand for corporate disclosure of climate-related information is growing quickly. The most prominent initiative in this regard is the industry-led Task Force on Climate-related Financial Disclosures (TCFD), which is supported by the G20ôs Financial Stability Board (FSB). In June 2017, the TCFD published recommendations on the disclosure of exposure to climate-related risks and opportunities, as well as related strategies, governance and risk management practices.

While companies are being encouraged to adopt the recommendations on a voluntary basis, a number of governments and national regulators have begun to integrate them into their guidance and policy frameworks. For example, the Network for Greening the Financial System (NGFS), which is comprised of 66 central banks and supervisors and 13 observers, representing five continents, has called for all companies issuing public debt or equity, as well as financial sector institutions, to disclose information in line with the TCFD recommendations.

In the banking sector, the Basel Committee on Banking Supervision recently established the Task Force on Climate-related Financial Risks, a high-level group which is charged, among other things, with developing effective supervisory practices to mitigate climate-related financial risks. In the European Union, the European Banking Authority (EBA) is currently considering how to include ESG risks in supervisory reviews and has been given until June 2025 by EU authorities to report on whether a dedicated prudential treatment of exposures related to assets or activities associated with environmental and/or social objectives would be justified. In addition, in May 2020 the EBA published guidelines on loan origination and monitoring which, among other things, require credit institutions to consider ESG factors, environmentally sustainable lending and associated risks in their credit policies and procedures. The guidelines will apply from 30 June 2021.

3. Defining ESG Factors

There is currently no common classification of ESG risks and the scope of ESG factors has the potential to be very wide. Focusing on those with perhaps the most immediate relevance for credit risk and drawing on the work of the European Commission[1], the key elements can be described as follows.

E ï includes climate change mitigation and adaptation, as well as the environment more broadly (e.g. natural resource depletion, pollution, water scarcity, waste management, and biodiversity loss) and related risks such as natural disasters.

S ï covers issues relating to labour standards, health and safety, inequality, inclusiveness, and consumer protection.

G ï refers to the management and oversight of public and private institutions and includes board/management structure (skills, independence, diversity); executive pay; shareholder rights; disclosure of information; bribery and corruption; internal controls and risk management; and employee relations.

Many of these issues overlap or are interrelated. For example, climate change has social and welfare implications; diversity is both a social and governance issue; while a companyôs environmental management policies may also be viewed as a governance issue.

An overview of the types of ESG issues that could have an impact on an entityôs business risk profile, financial performance, and overall credit strength is provided below.

3.1 Environmental Factors

Environmental issues have increased in prominence in recent years as the impacts of climate change and environmental degradation have become more visible and rising regulatory and socio-political pressures have begun to affect the performance of some emission-intensive sectors.

The most pressing concern in the financial sphere is climate change as it is expected to drive long-term, broad-based structural change across the global economy. Climate change gives rise to financial risks via two main channels: physical risks and transition risks.

- Physical risks arise from the increasing severity and frequency of (climate change-related) weather events and changing climate patterns. These risks may manifest in direct damage to property, infrastructure, agricultural land, and health, and may also disrupt business supply chains and drive mass migrations in those parts of the world that become less hospitable to human settlement or uninhabitable.

- Transition risks arise from the process of adjustment towards lower-carbon and more sustainable economies (since emissions must eventually reach ñnet zeroò to prevent further climate change). The process of combating climate change will necessitate major changes in environmental regulations and other public policies, and is likely to be accompanied by technological innovations and changes in consumer preferences (e.g. for more sustainable products) ï developments which are likely to give rise to significant challenges for some entities, particularly those in natural resource and extractive industries, as well as those engaged in carbon-intensive activities (e.g. power generation, chemicals, cement and steel production, transportation etc).

The speed of transition matters from an economic and financial stability perspective. In an extreme scenario in which the transition to a low-carbon economy is delayed and consequently has to be achieved quickly, many companies and financial market participants might struggle to adapt to rapid changes in policies while fossil fuel industry assets would likely plummet in value in a short period of time and possibly become stranded (i.e. unusable). Such developments and associated spillovers into other parts of the economy could lead to a wave of corporate defaults and financial sector instability, as well as severe fiscal stress for governments reliant on hydrocarbon industries. Moreover, the later

[1] Action Plan: Financing Sustainable Growth, published by the European Commission on 8 March 2018.

the transition, the greater the physical risks from climate change and the more economically and socially disruptive the environmental consequences of climate change are likely to be.

Even under less disruptive scenarios, fossil fuel companies and other greenhouse gas emitters are likely to face credit-relevant challenges. These may include: significantly higher costs of doing business (e.g. from carbon taxes or other measures to change the relative price of carbon-intensive assets); more expensive and possibly less stable access to capital markets (due to the stigmatisation of the sector and/or redirection of investor funding to ógreenôactivities); the expense and challenge of switching to low-carbon technologies (which for some applications may not yet exist) or of acquiring carbon capture technology; regulatory and technical constraints to output growth; and lower demand due to changing consumer values and the increasing availability of more sustainable alternatives.

Besides climate change, credit risk may also arise from environmental degradation (e.g. scarcity of fresh water, loss of biodiversity, air and water pollution) and hazardous environmental events (including natural disasters and major accidents, such as oil spills) ï some of which will have obvious physical impacts.

Key risks for banks and other FIs

CIôs ratings universe consists overwhelmingly of FIs (mainly banks). FIs are primarily vulnerable to climate change through their exposure ï via lending or investing ï to those entities or business segments that are more likely to be directly impacted by physical hazards and transition-related developments (ranging from coastal real estate and agriculture to mining and oil production).

Some examples of the possible ways in which FIs might be impacted by the materialisation of physical and transition risks are shown in table1.

Table 1. Physical and Transition Risks for Financial Institutions

	Asset Quality & Credit Risk	Market & Liquidity Risk	Operational & Reputational Risk
Physical	Increased risk of default from underinsured clients impacted by extreme natural events / climate change.	Marked-to-market losses on financial instruments issued by entities whose performance is vulnerable to extreme natural events / climate change.	Disruption to business and reduced profits if a bankôs key infrastructure and personnel are directly impacted by a natural disaster or hazardous event.
	Higher expected losses / increase in loss given default due to the fall in value of collateral damaged by, or at increased risk of being affected by, such events.	Liquidity pressures if a natural disaster triggers sizable deposit withdrawals.	
	Credit losses from the materialisation of concentration risk for lenders with high exposure to areas or sectors impacted by extreme natural events / climate change.		
Transition	Higher probability of default and/or loss given default if clients are adversely impacted by changes in regulation and taxation, the cost of new ógreenô technologies, shifts in consumer values, or the devaluation of their carbon-based assets.	Marked-to-market losses on financial instruments issued by entities whose performance is significantly affected by climate change policies or technological or market shifts.	Loss of customers and potential liability risk due to financing heavy users of fossil fuels (particularly firms with inadequate transition plans).
	Decline in collateral values driven by shift to higher energy efficiency standards.	Systemic liquidity stress if transition risk concerns trigger a sharp and sudden change in investor sentiment and asset prices, in turn driving up counterparty risk perceptions and contributing to the hoarding of liquid assets and severe funding-market dislocations.	

3.2 Social Factors

The social issues most relevant to FI and corporate credit analysis typically concern labour relations, health and safety, and customer and community relations.

Failure to establish and foster good employee relations and safe working conditions may contribute to lower productivity, higher rates of absenteeism and sick leave, as well as labour disputes. It may also drive up recruitment costs due to lower retention rates.

Violations of employment or safety laws may result in regulatory action against an entity, as well as fines or legal challenges, while practices that are below internationally acceptable standards could damage an entityøs reputation and brand image, contributing to a loss of sales. Similar adverse consequences could also arise for entities with operations that pose a health risk to, or have a significant socioeconomic impact on, local communities.

Customer-driven risks may arise from concerns about product safety and quality, the mis-selling of products and services (which is often linked to governance deficiencies), and fears about privacy and data security. Product responsibility failings, financial misconduct and data breaches may damage the entityøs brand and increase legal and regulatory risk ï potentially resulting in compensation claims and fines.

An entity may also be vulnerable to shifts in customer preferences driven by changing views on environmental and social issues linked to its activities or products. Exposure to social risks may also arise from the policies and actions of an entityøs supply chain partners and clients (e.g. sourcing inputs from firms that utilise child labour).

3.3 Governance Factors

Governance has traditionally been the most heavily emphasised ESG factor in credit ratings analysis due to the number of FI and corporate failures that have been attributable to poor management decisions, weak risk management, or ineffective internal controls.

Good corporate governance helps to protect the legitimate interests of depositors, creditors, shareholders and other stakeholders, including employees. It also plays an important role in an entity implementing successful business strategies, using resources efficiently, and conducting day-to-day operations in a safe and sound manner, consistent with its established risk appetite and overall risk profile.

Good corporate governance is also a key contributor to an entityøs ability to identify and respond to new risks and emerging challenges and to cope with adverse changes in business, economic and financial conditions. Conversely, governance deficiencies can lead to a range of potential credit-relevant problems. For example, concentrated ownership structures (e.g. institutions owned by management, families or non-financial corporates) may give rise to potentially harmful conflicts of interest, while overly-complex or non-transparent structures can create significant challenges for board of director oversight.

Boards of directors that lack independence or sufficient diversity and expertise may be less committed to fulfilling their fiduciary and other responsibilities, opening the door to ineffective or irresponsible management behaviour. Similarly, weak governance may contribute to the pursuit of aggressive business growth strategies and excessive risk taking ï particularly if accompanied by inadequate risk management or inappropriate incentive structures and compensation schemes.

The quality and transparency of financial information is another key governance-related rating consideration. For example, a lack of comprehensive and timely disclosures, or an aggressive interpretation of accounting standards, can make it difficult for non-executive board members, shareholders, and other stakeholders to monitor performance and identify adverse developments at an early stage. Accounting deficiencies and weak internal controls ï such as an internal audit function lacking in independence and authority ï may enable operational and other risks to go undetected or be used to hide fraudulent activity or corrupt practices.

4. Consideration of ESG Factors in Rating Methodologies

CIôs credit ratings are an indicator of creditworthiness: they summarise the ability and willingness of an entity to meet its financial obligations on time and in full.

Credit ratings are not sustainability assessments. An entity could have a strong (favourable) ESG profile but be weak from a credit perspective. Conversely, an entity could have strong debt repayment capacity, but less impressive ESG credentials. That said, it would be unusual for a bank or non-bank FI with weak ESG characteristics (particularly with regard to governance, customer welfare and employee safety practices) to receive a high investment grade credit rating.

CI does not treat ESG risk as a separate analytical category in rating methodologies. At present, only governance tends to be identified explicitly as a key rating factor in our rating criteria. Nevertheless other ESG factors could potentially be captured in our credit analysis provided they are of material importance to the ability and willingness of the rated entity to honour its financial obligations in full and on time.

The analytical dimensions and key rating factors of our Sovereign Rating Methodology and Bank Rating Methodology that may involve ESG considerations are identified below.

4.1 Sovereign Rating Methodology and ESG Considerations

CI may assign either a public credit rating or an internal óshadowô rating to a sovereign using our Sovereign Rating Methodology. Shadow sovereign ratings are not intended for publication and are used to ensure that sovereign risk factors are adequately reflected in the ratings of FI and corporate issuers. Consequently, although publicly-rated sovereigns account for just 6% of CIôs public ratings universe, sovereign credit risk is an important consideration in almost all ratings we assign, regardless of asset class or sector.

CI assigns sovereign credit ratings following a detailed analysis of a range of political, economic and financial factors which we believe have a significant bearing on the ability and willingness of sovereign governments to adopt and implement sustainable fiscal policies (from a debt perspective) and to take other measures that reduce the risk of default.

The ratings we assign take into account the governmentôs capacity to service its debts under present and expected political and economic conditions, as well as its capacity to continue doing so through typical macroeconomic fluctuations and in the event of plausible shocks, which could include ESG-related events.

Within our Sovereign Rating Methodology, ESG factors are explicitly considered as part of our assessment of:

- Political and Institutional Risk;
- Economic Strength;
- Long-Term Risks for Exporters of Non-Renewable Resources; and
- Information Risk.

In addition, ESG factors could also be considered as part of our assessment of Reform Efficacy.

(a.) Political and Institutional Risk

This analytical dimension of our sovereign methodology captures the potential effect or influence of political and institutional factors on the willingness and ability of a government to pursue sustainable economic and financial policies and to undertake, where necessary, reforms and other measures to safeguard its capacity to repay maturing financial obligations.

Domestic and external political risk factors, as well as governance standards, can have an important bearing on sovereign creditworthiness and may in some settings emerge as the dominant rating driver. Stable political environments and policymaking institutions support government effectiveness and lower the risk of dramatic swings in the direction of policy. Political and social cohesion reduces

the likelihood of damaging internal power struggles and civil unrest, and also facilitates long-term planning and economic growth.

Governance and social factors are considered in this analytical dimension as part of two key rating factors:

- Political and Policy Risk; and
- Institutional Strength and Administrative Capacity.

Political and policy risk ï refers primarily to policy decisions and political events that could materially affect sovereign creditworthiness. It also takes into account the durability of the social and political fabric of a country and the existence of any underlying vulnerabilities that could potentially engender political instability and undermine the workings of government.

As part of this assessment we consider the ability and willingness of the government to implement reforms to improve economic and social outcomes and mitigate or reduce any fiscal and external vulnerabilities.

Our assessment of political risk also takes into account the general volatility of the political environment, including the tendency for governmental instability and the propensity for civil disobedience and social unrest. Risks to political stability are often highest in countries with a recent history of violent conflict and in societies characterised by factionalism, where politics is polarised between competing groups with self-perceived irreconcilable differences (often based on ethnic, religious and other identity cleavages) and, in particular, where systematic discrimination is strong.

The determination of the relative position of each country is largely subjective. However, we typically use survey-based indicators of political risk as a guidepost, in particular: (i) the political stability and absence of violence/terrorism index ï one of the World Bankôs six Worldwide Governance Indicators (WGI); (ii) the voice and accountability indicator ï another of the WGIs; and (iii) the Fragile States Index, produced by The Fund for Peace.

Institutional Strength and Administrative Capacity ï refers to the effectiveness and equity of the rules and conventions that govern political and economic interaction within a country and the ability of state organisations that operate within these rules and conventions (for example the executive, legislature, judiciary, bureaucracy and monetary authorities) to perform their mandated functions competently, achieve policy objectives, and respond effectively to changing circumstances.

The evidence suggests that the quality of institutions matters for economic performance and fiscal outcomes, as well as for the level of political stability. Sound institutions and high standards of governance are associated with transparency and predictability in policymaking and in the application of laws, as well as greater oversight of the use of public resources.

Our assessment takes into account several dimensions of institutional strength, including:

- The predictability of the legal system, the independence of the judiciary, and the enforcement of property rights.
- The strength of institutions for holding the executive accountable for its actions, including for the use of public resources and funds (e.g. the national legislature, internal and external audit functions and non-governmental bodies). We also consider the strength and impartiality of the media and whether the government is sufficiently open to enable adequate public scrutiny of its activities.
- The extent of corruption in the public sector.
- The effectiveness of state institutions in terms of their ability to perform mandated functions and meet operational targets.

Our opinions on institutional quality are largely based on analytical judgment, but may draw on international surveys, particularly: (i) the rule of law and government effectiveness indices from the World Bank WGIs database; and (ii) Transparency Internationalôs Corruption Perceptions Index.

(b.) Economic Strength

Social and, to a lesser extent, environmental factors are considered in this analytical dimension as part of our assessment of three key rating factors:

- Economic Growth Performance;
- GDP per Capita; and
- Economic Diversification.

Economic Growth Performance ï To evaluate economic growth performance we first consider a countryôs real GDP growth record over a five-year horizon (a period that would generally be long enough to cover most, if not all, of the duration of a typical economic cycle). We next consider the durability of real output growth going forward and its effectiveness in improving socio-economic outcomes. In accordance with our criteria we may consider lowering our quantitative based assessment if economic growth is vulnerable to natural disasters, climatic factors, or resource scarcity ï and there is a reasonable likelihood of such adversities materialising in the medium term ï or if unemployment is stubbornly high.

GDP per Capita ï Nominal GDP per capita is an indicator of economic affluence and a useful proxy for a countryôs ability to absorb shocks. In addition, the level of public debt that a country can sustain tends to be positively correlated with the level of GDP per capita, in part because the economic and institutional context for borrowing tends to improve as a country moves up the income scale.

However, while GDP per capita facilitates comparative analysis, it has a number of limitations as a measure of economic strength as it does not take into account income distribution and might not provide an accurate gauge of the standard of living. Consequently, while we initially assess countries based on the level of GDP per capita, we will mark down a countryôs assessment if income inequality is relatively high (proxied by a large Gini coefficient) or if other indicators of socio-economic development (e.g. the UN human development indices for health and education) suggest that relative living standards are significantly lower than indicated by income per head.

Economic Diversification ï Countries with diversified production and export sectors are often more resilient to adverse external shocks and tend to experience more broad-based and sustainable GDP growth. When assessing a countryôs relative strength in this area, we tend to view negatively a high reliance on primary commodities or agriculture ï sectors which typically have weak international pricing power and also tend to be vulnerable to adverse weather shocks and longer-term climate change.

(c.) Long-Term Risks for Exporters of Non-Renewable Resources

Our sovereign methodology explicitly recognises hydrocarbon exporting economies to be among those most vulnerable within our ratings universe to international efforts to combat climate change and reduce carbon emissions. The intensification of such initiatives, together with related technological developments, would likely constrain or reduce demand for hydrocarbon products and weigh on real export prices.

The degree of vulnerability and risk associated with a global move towards lower carbon economies will depend on the pace of transition (and therefore the aggressiveness of the policy response to emerging environmental threats), as well as on the rated sovereignôs relative reliance on hydrocarbon revenues and the success of efforts during the transition period to diversify, de-carbonise, and reform the domestic economy.

We currently view climate-related risks for hydrocarbon exporters to be of a long-term nature and unlikely to significantly impact sovereigns in the medium term. However, we may adjust ratings downwards if our assumptions are subsequently challenged by developments ï in particular if the pace of climate mitigation policies, or secular shifts in consumption, suggest that oil demand will decline significantly in the medium-to-long term.

The above notwithstanding, since climate-related risks could potentially materialise quickly, with systemic implications, particularly for under-prepared economies, we intend to monitor more closely countriesô climate mitigation efforts and resilience to such risks. Indeed, we currently expect the

relative importance of these factors in credit rating analysis to gradually increase over the medium term and for them to eventually emerge as key rating drivers (positive as well as negative).

(d.) Information Risk

The quality and transparency of data on public and external finances tends to vary across countries and hence is often an important rating consideration. Indeed, it is widely accepted that informational deficiencies were a major factor behind the failure of many economists to accurately assess the extent of underlying imbalances in many Asian economies prior to the 1997 crisis. Moreover, the misreporting of fiscal data, once uncovered, contributed to the sharp lowering of Greeceôs sovereign ratings in 2010.

CI generally sources economic, fiscal and external accounts data from national authorities. The quality and timeliness of the data are a function of each governmentôs statistical and administrative capacities, reporting requirements, and willingness to disclose accurate and comprehensive information, particularly on the public finances. Any concerns we have about the accuracy and coverage of data may be reflected in the ratings assigned.

(e.) Reform Efficacy

As part of our assessment of sovereign creditworthiness we also consider whether recently adopted or planned reforms will help to strengthen the sovereignôs credit profile over the medium term or, conversely, whether the government is pursuing policies that are likely to contribute to a deterioration in sovereign risk or is failing to address emerging threats to creditworthiness.

In this context, for sovereigns exposed to environmental risks, policies aimed at reducing risks and improving resilience could have a positive impact o n the ratings, while failure to address material risks could weigh on the ratings.

4.2 Bank Rating Methodology and ESG Considerations

In order to assign foreign currency issuer ratings to a bank, we consider both the bankøs standalone credit profile and the likelihood of it receiving extraordinary external support from owners or the government should such assistance be required in order to avoid default. Our assessment of standalone repayment capacity is reflected in the Bank Standalone Rating (BSR), while potential extraordinary support is indicated by the External Support Level (ESL).

The BSR in turn is derived from two key analytical inputs: the Operating Environment Risk Anchor (OPERA) and the Core Financial Strength (CFS) rating.

ESG factors may be considered in the context of OPERA and CFS.

4.2.1 OPERA

OPERA encapsulates our assessment of the political, economic, institutional, and system-wide factors that may impact the standalone financial strength of a bank and is, therefore, a key element of the BSR.

To assign OPERA we consider a number of key rating factors across five analytical dimensions:

- Macroeconomic Strength
- Monetary Flexibility and Capital Market Development
- Industry Structure and Performance
- Regulatory Environment and Institutional Frameworks
- Political and Policy Risk

Macroeconomic Strength takes into account a number of key rating factors from our Sovereign Rating Methodology. These factors include some of those identified in section 4.1 (above) as ESG relevant, such as Economic Growth Performance, GDP per Capita, and Economic Diversification. The assessment of Political and Policy Risk is also derived from our sovereign methodology (see above). Consequently, if ESG considerations have shaped our assessment of these key rating factors in the context of our sovereign criteria, they will also have an impact on a bankøs ratings through OPERA.

ESG factors ï specifically governance ï also feature in our assessment of Regulatory Environment and Institutional Frameworks. This key rating factor is based on two sub-factors:

- The effectiveness of bank regulation and supervision; and
- The quality of the legal and financial infrastructure.

In the first sub-factor we consider:

- The scope and quality of prudential regulations and disclosure requirements;
- The capacity of supervisory authorities to identify institution-specific and systemic risks;
- Their ability and willingness to take timely corrective action (including independence from political influence); and
- Their track record in doing so.

The second sub-factor is highly governance focused. Besides general banking laws and regulations, the elements of a countryøs legal infrastructure that are of high importance to financial institutions include those governing creditor rights, ownership, contract enforcement, accounting, auditing and disclosure. Also important are laws and practices relating to failure resolution, particularly rules and procedures concerning insolvency, deposit insurance, and the recovery and resolution of distressed banks.

4.2.2 Core Financial Strength

CFS is based on six analytical pillars:

- Business Model and Strategy
- Ownership and Governance
- Risk Profile and Risk Mitigation
- Earnings Strength and Sustainability
- Funding and Liquidity
- Capitalisation and Leverage

In terms of ESG factors, governance has historically been the most important risk factor for the banking industry and is considered as part of the second analytical pillar.

Social and environmental factors are addressed less explicitly in our bank methodology but may be considered in the context of Business Model and Strategy and Risk Profile and Risk Mitigation. High exposure to ESG risk could also have implications for a bankôs earnings strength, capital position and funding, but for brevity we allude to the potential impact on financial fundamentals in our discussion of the business model and risk profile.

(a.) Business Model and Strategy

This part of our methodology focuses on a bankôs business model (including the nature, scope, and stability of its activities), franchise strength, and the managementôs ability to develop and execute strategic plans.

ESG factors may be relevant in cases where we expect a bankôs franchise strength or market position to be adversely affected by practices or exposures that are socially or environmentally sensitive and may therefore render it vulnerable to shifts in public opinion or public policy.

A bankôs reputation and the loyalty of its customers could be potentially tested by a number of social issues ranging from a lack of diversity and a high gender pay gap to product mis-selling and the (perceived) overcharging of retail clients. Similarly, a bank with an unfavourable ESG profile may find it increasingly challenging to raise debt and equity as more and more institutional and other investors incorporate ESG analysis into their decision-making processes.

High direct or indirect exposure to sectors at risk from climate change may pose a long-term risk to asset quality and financial strength and a more immediate strategic challenge of transitioning the business model (or at least the risk profile of the corporate loan portfolio) towards more sustainable income-generating activities.

The pace at which banks may have to reduce or eliminate ESG risks ï and adapt business models ï may accelerate with shifts in societal expectations and ESG-driven changes in laws and regulations. For example, for institutions that lend heavily to carbon intensive sectors, the adaptation challenge could become more urgent if regulators revised prudential capital rules and introduced high risk weights for existing fossil fuel exposures and set risk weights for new fossil fuel exposures at levels that would imply full equity financing of the loan.[2]

On the positive side, the financing of investments in, for example, carbon-neutral transportation, renewable energy and building energy efficiency is expected to provide significant opportunities for FIs in the coming decades and could help bolster business profiles.

[2] Although unlikely to be adopted in the near future, these measures were proposed by the NGO Finance Watch in its report ôBreaking the climate-finance doom loopõ published in June 2020.

(b.) Ownership and Governance

Corporate governance tends to be an asymmetrical rating factor. The impact of good governance on an FIôs ratings is usually neutral, in part because it cannot on its own outweigh weaknesses in an entityôs business or financial risk profile.

However, significant governance deficiencies may result in a rating being notched below the level that might otherwise have been assigned because of the high associated risks, such as poor decision making, insufficient planning, and excessive risk-taking (e.g. if the board of directors is uninformed or passive). Moreover, where governance and oversight are weak, there is greater scope for financial and other key risks to be missed by senior management and directors, or ï more nefariously ï hidden from investors and other stakeholders.

Our overall assessment of Ownership and Governance is based on four key rating factors:

- Ownership;
- Organisational structure and complexity;
- Risk management and control; and
- Accounting, disclosure and transparency.

Ownership ï The focus of this key rating factor is on identifying potential challenges and conflicts of interests arising from a bankôs ownership model and structure, including how these are mitigated and how they might affect its risk profile and financial strength.

Potentially problematic characteristics include overly complex and non-transparent ownership structures (as these can create significant challenges for management and board overview), the exercise of undue public or political influence by owners (e.g. directed lending or investments, insider and related-party transactions), as well as unrealistic or aggressive financial expectations by shareholders (which may give rise to poor strategic decision making and threaten the viability of the bankôs business model).

Organisational Structure and Complexity ï In some countries the organisational and legal structure, as well as business model of banks has become increasingly complex and opaque. This partly reflects domestic and cross-border acquisitions, but has also been driven by tax and regulatory arbitrage considerations. Unnecessary complexity makes it hard for senior management (as well as supervisory authorities and investors) to understand the organisational structure and assess the implications for the bankôs risk profile, funding, profitability, and capitalisation.

Complexity may be treated as a negative rating factor if not adequately mitigated by appropriate understanding from senior management teams (including boards) and if sufficient public transparency and disclosure is lacking.

Risk Management and Control ï A critical factor in assessing the current and prospective risk profile of a bank is the quality and adequacy of risk management and risk control. This includes the comprehensiveness of risk management and control systems, the standing and independence of the risk management function within the bank, and the strength and rigour of underwriting standards. It also includes the bankôs management of, and vulnerability to, operational risk ï including risks involving people (conduct, fraud, incompetence), system failures (breakdowns in systems or technology), and process failures (e.g. back-office problems).

In terms of conduct risk, CI assesses the relevance and significance of possible exposure to social and governance-related issues such as:

- Product mis-selling in retail and wholesale markets;
- Potential breaches of political sanctions and money-laundering legislation;
- Poorly designed distribution channels that may enable conflicts of interest with false incentives, including pushed cross-selling of products to retail customers;
- Conflicts of interest in conducting business; and
- Cases concerning the manipulation of benchmark interest rates, foreign exchange rates or any other financial instruments or indices.

As the risks associated with climate change evolve, we may also consider a bankôs approach to climate risk management, including whether it has been integrated into the bankôs more established risk management frameworks and processes and supports pre-emptive risk monitoring and mitigation (e.g. to avoid excessive exposure to climate-sensitive sectors).

Accounting, Disclosure and Transparency ï Timely, relevant and comprehensive accounting, disclosure and transparency regarding a bankôs financial condition and performance, business activities, risk profile, and risk management practices are essential for sound and effective corporate governance.

When assessing the quality of transparency and disclosure, we focus on potential weaknesses and warning indicators which may warrant further investigation. These include:

- A lack of independence, skills, experience and diversity of non-executive boards;
- A lack of quality and independence of external and internal auditors;
- Instances where external auditors have issued an adverse opinion, determining that the financial statements are materially misstated and do not conform to the relevant accounting, regulatory or legal standards;
- Aggressive interpretation of accounting standards; and
- Shortcomings regarding the timeliness, comprehensiveness, materiality and consistency of disclosures.

Where we observe deficiencies in, or have significant concerns about, the quality and integrity of the data produced by a bank, this may have a negative impact on the ratings assigned.

(c.) Risk Profile and Risk Mitigation

Our assessment of a bankôs risk profile includes consideration of its balance sheet structure, asset quality and exposure to market risk, as well as its ability to withstand credit losses in its loan book and investment portfolio without impairing its capital and earnings base. Concentration risk is an important part of this assessment as the most important vulnerabilities in the asset structure tend to arise from high exposure to individual borrowers or single sectors.

CI generally regards credit risk to be highly concentrated and a potential rating constraint when a bank has high exposure to a single issuer, industry or economic sector, or to a highly correlated set of sectors or activities, particularly if they are inherently cyclical or volatile and dependent on potentially more volatile income streams (e.g. commercial real estate, construction, subprime lending, ship financing, and airlines).

By extension, we could consider as a potentially constraining rating factor a bankôs high exposure (via lending or investment) to businesses, sectors or territories that, in our opinion, are potentially vulnerable to ESG-related risks. In the case of large exposure to carbon-intensive sectors, expected losses could potentially be high, not just because of the diminished debt-servicing capacity of the borrower, but also because the assets that form part of any loan collateral ï if carbon linked ï may become partially or fully stranded.

Determining the rating impact of climate-related risks in particular is not a straightforward exercise since such risks might not be expected to materialise until well beyond the term of a typical bankôs current loan portfolio. Consequently, these long-term risks have to be weighed against the likelihood of the bank taking timely and appropriate steps to de-risk its balance sheet from carbon-linked assets and build the capabilities needed to compete in new business segments and markets.

5. Incorporating ESG Risks into Credit Analysis: Key Challenges

The incorporation of ESG factors into credit risk analysis is complicated by a lack of data and, in the case of climate change, the long-term nature of many of the associated financial risks.

Reporting on ESG factors ï including bank disclosures of climate-related financial risks ï is relatively low in most jurisdictions. A contributing factor (and analytical challenge in its own right) is the lack of timely, consistent and reliable indicators (quantitative and qualitative) for assessing a large number of ESG risks. Indeed, in terms of environmental exposures there is no universal classification of what constitutes a sustainable activity.[3]

Given that most types of credit ratings are meant to measure relative credit risk on an internationally comparable basis, significant work still needs to be done to develop standardised data and metrics that can be used for peer group analysis.

In addition, social and governance risks are generally hard to quantify, and some significant threats to an entityôs reputation, financial performance and business viability are difficult to detect and assess before they have materialised. For example, the likelihood and impact of fraud, money laundering, sanctions violations, market manipulation, and cyber attacks (that compromise customer data) are seldom easy to evaluate ex ante.

The long-horizon nature of a number of environmental risks poses further challenges. Climate-related risks in particular are unlikely to materialise for many FIs until well beyond current credit rating horizons. At present we are unable to provide even an approximate time of impact ï it could be years or decades depending on a host of factors, including the timing and depth of policy and regulatory changes. We are also unable to assess with any degree of certainty the magnitude of such risks and their impact on credit strength.

This lack of certainty, and the fact that for many entities credit strength on a 5-10 year horizon is more likely to be driven by other key rating factors, means that the weight attached to very long-term risks by rating committees may often be relatively low.

Moreover, while for some carbon-intensive sectors climate-related risks are a current or emerging challenge, for many FIs (and sovereigns) the time to impact is sufficiently long for resilience to be built up with the implementation of appropriate mitigation and adaptation strategies, including adjustments in the composition of corporate loan portfolios.

That said, we fully expect the relative importance of such considerations to increase over the time as climate-related disclosures improve and as public policy to de-carbonise economies advances. Consequently, the weight given to the management and mitigation of environmental risks (as well as the exploitation of associated opportunities) is expected to increase steadily over the next decade or so.

[3] The EU is, however, in the process of developing a detailed classification system for sustainable activities following the adoption of framework legislation in June 2020.

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OUTCOMES BEYOND PERFORMANCE

PRICING ESG RISK IN SOVEREIGN CREDIT

Research paper

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In 2017, Hermes Investment Management published its first study on the relationship between environmental, social and governance (ESG) factors and corporate credit spreads[1]. The research filled a void left by the dearth of external studies and tools to help price ESG risks in credit markets, and was reinforced by subsequent work[2]. The most important finding was the existence of a significant relationship between ESG factors and credit spreads – and that issuers with stronger ESG performance benefit from lower credit-default swap (CDS) spreads. In this paper, Hermes partners with Beyond Ratings to learn whether ESG risk is similarly potent in sovereign-bond markets.

This research aims to contribute to the growing body of literature that points to the importance of ESG considerations across asset classes[3], and for fixed income investors. It has three main objectives:

1. to establish whether there is a relationship between ESG factors and sovereign CDS spreads;
2. if so, to determine which of the three ESG factors have the strongest relationship with sovereign CDS spreads; and
3. to create an implied CDS spread curve that depicts the relationship between country-level ESG scores and sovereign CDS spreads.

We believe the findings of this paper will give investors a better understanding of the full range of risks that sovereign bonds involve. This should help Hermes make better-informed investment decisions and enable Beyond Ratings to improve its sovereign credit assessments.

KEY FINDINGS

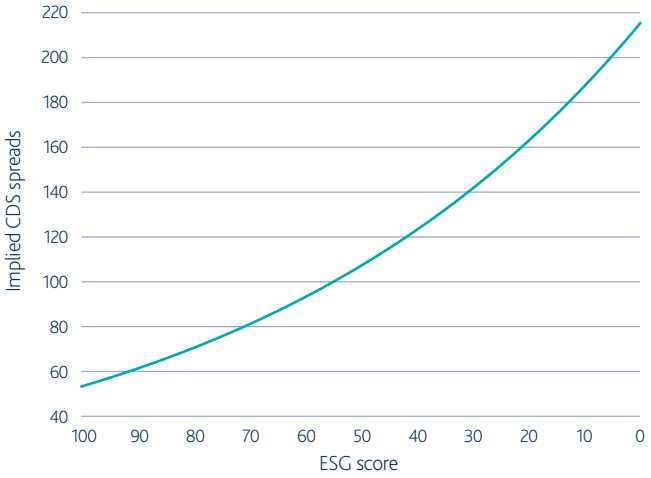
To price ESG risk for sovereign bonds, we use Beyond Ratings' ESG scores, which measure a country's ESG performance by using a rigorous quantitative method. They range from 0 to 100, with a high score indicating strong ESG performance.

Our study shows that:

- countries with the lowest ESG scores have, on average, the widest CDS spreads, and countries with the highest ESG scores have the tightest spreads (see figure 1);
- there appears to be a positive correlation between sovereign ESG scores and sovereign credit ratings. However, there is a very wide variation in ESG scores within each rating band, suggesting that credit ratings do not entirely explain the extent of CDS spreads (see figure 7);
- among the three dimensions of ESG, governance has the strongest relationship with sovereign CDS spreads (see figure 6). Environmental risks do not seem to have a strong relationship with sovereign CDS spreads, which could be explained by the fact that these problems are not currently fully reflected in sovereign ratings.

Based on the strong relationship between ESG scores and sovereign CDS spreads, we derived a sovereign pricing model for ESG risk that is comparable to the model that Hermes developed in its original study on corporate credit. This model could be used by investors to identify countries with wide spreads and high ESG scores (outperformers), and those with tight spreads but poor ESG performance (underperformers), which might be exposed to more risk than traditional credit ratings imply.

Figure 1. Sovereign ESG risk: implied CDS spreads and corresponding ESG scores



Source: Hermes, Beyond Ratings as at May 2019.

ABOUT THE PARTNERSHIP

Hermes Investment Management and Beyond Ratings partnered in this study because both companies wanted to better understand the relationship between ESG risks in sovereigns and their CDS spreads. The two entities' complementary skillsets and experience in ESG investment and credit-risk assessments made it a natural partnership. In this study, we use Beyond Ratings' proprietary ESG score, which is a significant component of its sovereign assessments. Having already carried out a similar study focused on corporate credit, Hermes had the blueprints to run the analysis, as well as access to historical sovereign CDS spreads. Together, we combined our efforts to design and run this groundbreaking study on a significant market that remains under-investigated in relation to ESG.[4]

ESG FACTORS AND SOVEREIGN RISK

When assessing the willingness and ability of governments to meet their financial obligations, it is of course necessary to take political, economic and financial factors into consideration. But focusing solely on these matters when analysing sovereign risk is not enough. In our view, investors must also consider ESG factors to obtain a more complete picture of a country's risk profile.

[1] "Pricing ESG in Credit Markets" – research report by Hermes Investment Management: https://www.hermes-investment.com/ukw/wp-content/uploads/sites/80/2017/04/Credit-ESG-Paper-April-2017.pdf

[2] See "Pricing ESG risk in credit markets: reinforcing our conviction" available at https://www.hermes-investment.com/uki/insight/fixed-income/pricing-esg-risk-credit-markets-reinforcing-conviction/

[3] See, for example, Bauer and Hann (2010), Kleimeier and Viehs (2016), Chava (2014) and, most recently, Eichholtz, Holtermans, Kok and Yonder (2019).

[4] The analysed period is characterised by unconventional monetary policies, such as the quantitative-easing programmes led by the US Federal Reserve and the European Central Bank, which may have an impact on the results and could be addressed in further publications.

These factors can affect sovereign risk in several ways. For example, climate change can hit agricultural production, which could in turn trigger economic and financial stress and political and social uncertainty. In 2016 and 2017, for instance, the El Nino phenomenon led to 160 deaths and adversely affected 185,000 people in Peru – impairing livelihoods, creating hunger, displacing communties. It caused agricultural output to fall by 3.8% between January to May 2017 relative to the previous year, contributing to economic growth declining from 4.0% in 2016 to 2.5% in 2017. Meanwhile, according to the World Meteorological Organization, Hurricane Katrina in 2005 caused an economic loss of $146bn in the US, and flooding in Thailand in 2011 resulted in an economic loss of $40bn. A drought in Morocco in 2000 caused economic losses of $1.2bn.

These direct impacts of climate change can affect the creditworthiness of countries, and in this paper we test the following hypothesis: that there is a direct link between country-level ESG scores and sovereign CDS spreads.

The critical element here is to assess whether ESG factors have a material effect on sovereign risk. And, if they do, to assess the probability and timing of such an impact. We show in this paper that integrating ESG factors in sovereign risk analysis is just as strong an imperative as it is when analysing credit risk for corporates.

Integrating ESG factors in sovereign risk analysis is just as strong an imperative as it is when analysing credit risk for corporates.

UNDERLYING METHODOLOGY AND DATA

To establish whether there is a relationship between ESG factors and sovereign credit risk and to determine whether it is possible to draw an implied credit curve based on those ESG factors, we analysed the relationship between five-year CDS spreads and ESG scores for 59 countries between 2009 and 2018. In total, this delivered 2,036 country-quarter observations.

We sourced sovereign five-year CDS spreads from Bloomberg and used Beyond Ratings ESG scores – as described below – as our proxy for ESG risk. Credit-rating information also came from Bloomberg: we used the Bloomberg composite credit rating, which is a blend of the credit ratings from the three major rating providers.[5]

We chose to use CDS spreads rather than spreads of physical bonds because they are the purest market-driven measure of sovereign credit risk. Rolled CDS have no maturity and they are essentially immune to changes in interest rates as they are floating-rate instruments: CDS roll into a refreshed five-year maturity every six months. Sovereign CDS, in most cases, are also more liquid than the underlying physical bonds, which may not trade very often. Meanwhile, the spreads of physical bonds become more static at lower levels as the security rolls down the maturity curve and approaches maturity. As such, it becomes less a reflection of credit risk and therefore less useful in a time-series study.[6]

We used Beyond Ratings' ESG scores, which are one of three underlying factors that determine the firm's aggregate sovereign risk scores, the other being a country's economic and financial profile. (A detailed explanation of Beyond Ratings' ESG scores can be found below.)

First, we consider the relationship between ESG scores and sovereign CDS spreads.

BEYOND RATINGS' ESG SCORES

For the key independent variable in our analysis – a country's ESG profile – we used Beyond Ratings' ESG scores, which measure a country's ESG performance. These scores have been calculated quarterly according to a systematic, quantitative approach based on 40 indicators from the end of 1999.

To calculate an aggregate ESG score, individual environmental, social and governance scores are weighted 30%, 30% and 40% respectively. The weights for each indicator are estimated using an econometric modelling technique called Partial Least Squares (PLS), with a score for Variable Importance in Projection (VIP) added on. The methodology also assesses ESG risks, taking into account a country's state of development.

The assessment of a country's environmental performance takes into account three dimensions: energy policy, climate risks, and natural-resources endowment and management. Energy policy considers energy as a production factor that has direct and indirect effects on economies and societies. It captures the government's efforts in terms of access to affordable energy and use of renewable energies. In the long term, this indicator measures the inclusiveness and sustainability of the country's energy policy. Climate-related risk follows the Task Force on Climate-related Financial Disclosures definition. It assesses countries' exposure to two types of climate-related risks: (i) physical risk and (ii) the transition to a lower-carbon economy. The natural resources assessment provides information about potential risks related to food security, clean air and purified water. This dimension aims to assess whether a country manages renewable and non-renewable resources sustainably.

The social performance assessment includes five dimensions: human capital and innovation, health, inequality, employment and societal. Human capital and innovation measures a country's capacity to develop new technologies and high value-added production. Health measures a country's capacity to keep its population, and thus its labour force, healthy. Inequality measures the dispersion of incomes and wealth within the country. Societal performance is a measurement of a country's progress in terms of the society's political and social freedom. Finally, employment measures a country's capacity to provide jobs for the entire working population, thus maximising its potential output.

The governance performance assessment measures risks related to corruption, government effectiveness, the rule of law, regulatory quality, political stability and the absence of violence, and voice & accountability. These indicators refer to World Bank estimates from the Worldwide Governance Indicators database.

[5] Bloomberg explains the calculation of the BB composite credit ratings as follows: "The agency ratings are evenly weighted when calculating the composite. The composite is the average of existing weighting rounded down to the lower rating in case the composted is between two ratings.

[6] In all the analyses, we winsorised the distribution of the observed CDS spreads at the 97.5% level to remove significant outliers that would bias our analyses and conclusions.

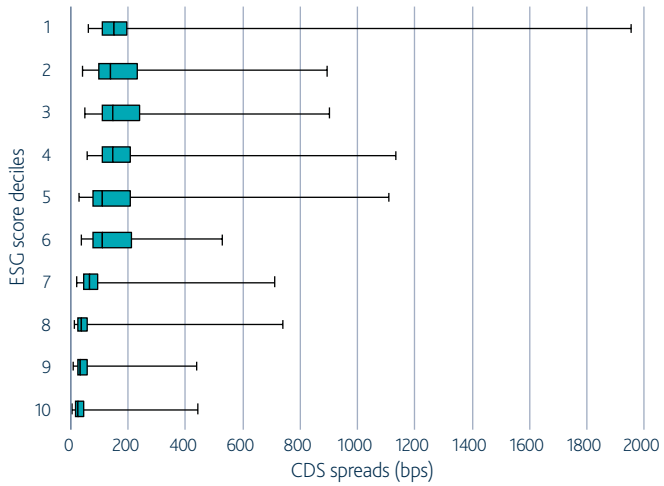
Figure 2. Beyond Ratings' ESG scores

THE RELATIONSHIP BETWEEN ESG RISK AND SOVEREIGN CDS SPREADS

First, we performed an analysis that was similar to what we did in our original ESG in credit paper, looking at the relationship between ESG and CDS spreads in an unconditional way, without controlling for any confounding effects that might influence the observed relationship.

We started by splitting the underlying data sample into 10 deciles based on each country's ESG score, with decile one representing those countries with the lowest ESG scores and decile 10 those with the highest. We then looked at the distribution of the observed CDS spreads in each decile. Figure 3 shows boxplots of the underlying CDS spread distribution in each decile.

Figure 3: Sovereign CDS spreads by ESG decile, 2009–18

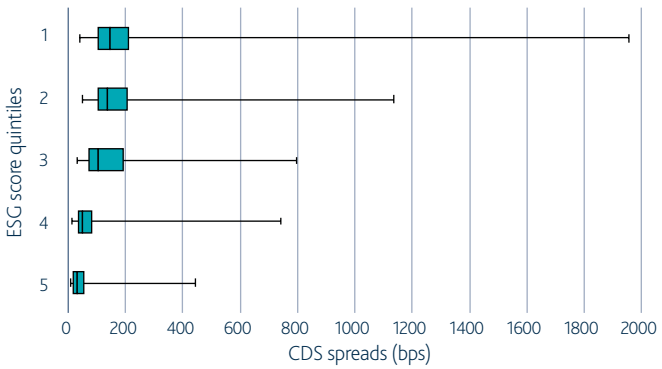


Source: Beyond Ratings and Bloomberg. Data as at April 2019. Hermes calculations.

Each boxplot depicts the median spread for that decile (the vertical line within each box), within the minimum and maximum spreads. We can see that countries with the lowest ESG scores (decile 1) have the highest median CDS spreads and the widest distribution of observed CDS spreads. This implies that countries with lower ESG scores produce more volatile investment returns than countries with the highest ESG scores – those that make up deciles nine and 10. It is important to note that deciles two to eight have significantly greater distributions of spreads than other deciles, which suggest that investors might wish to consider carrying out additional assessments of creditworthiness on the very worst-performing countries in terms of ESG risk.

If we group the deciles together into quintiles – bands of 20% rather than 10% – the picture becomes even more convincing. Figure 4 shows the results.

Figure 4. Sovereign CDS spreads by ESG quintile, 2009–18

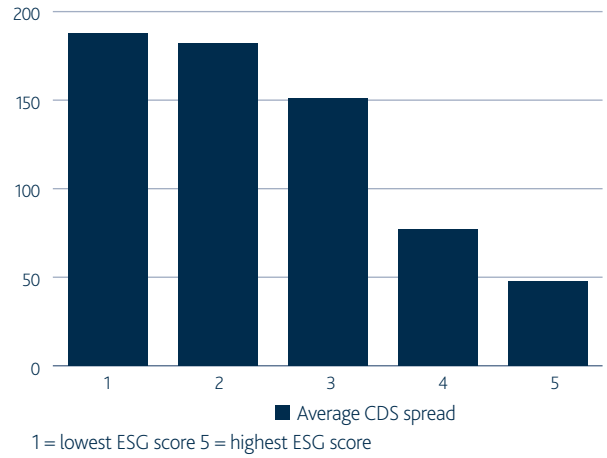


Source: Beyond Ratings and Bloomberg. Data as at April 2019. Hermes calculations.

We can see that our previously documented relationship between CDS spreads and ESG scores is robust, and in a quintile context almost linear: countries with the lowest ESG scores tend to have the highest CDS spreads, and those spreads are significantly more widely distributed than for quintiles four and five. We should point out, at this stage, that in this unconditional analysis the results so far only point towards certain correlations and do not necessarily imply a cause-and-effect relationship.

To shed further light on the question if countries with the worst ESG scores have on average the highest CDS spreads, we went on to calculate the average CDS spread for each ESG quintile. Figure 5 shows the results.

Figure 5. Average sovereign CDS spreads by ESG quintile, 2009–18



Source: Hermes and Beyond Ratings. Data as at April 2019.

Figure 5 clearly indicates that countries with the highest ESG scores (quintile five) have the lowest average CDS spreads, while those with the lowest ESG scores (quintile one) have the highest average CDS spreads. The difference in average spreads between these quintiles in terms of basis points is 140bps. Again, it is important to note that these results are unconditional: we do not control for any confounding effects that might affect the relationship between ESG scores and CDS spreads.

Then, we repeated this analysis for the three sub-dimensions of ESG – environment (E), social (S) and governance (G) – to determine which has the strongest link with spreads. We can see the results in figure 6.

It is important to consider the three sub-dimensions of ESG separately. For countries, just like for companies, exposure to the three sub-categories can differ depending on the nature of a sustainability topic.

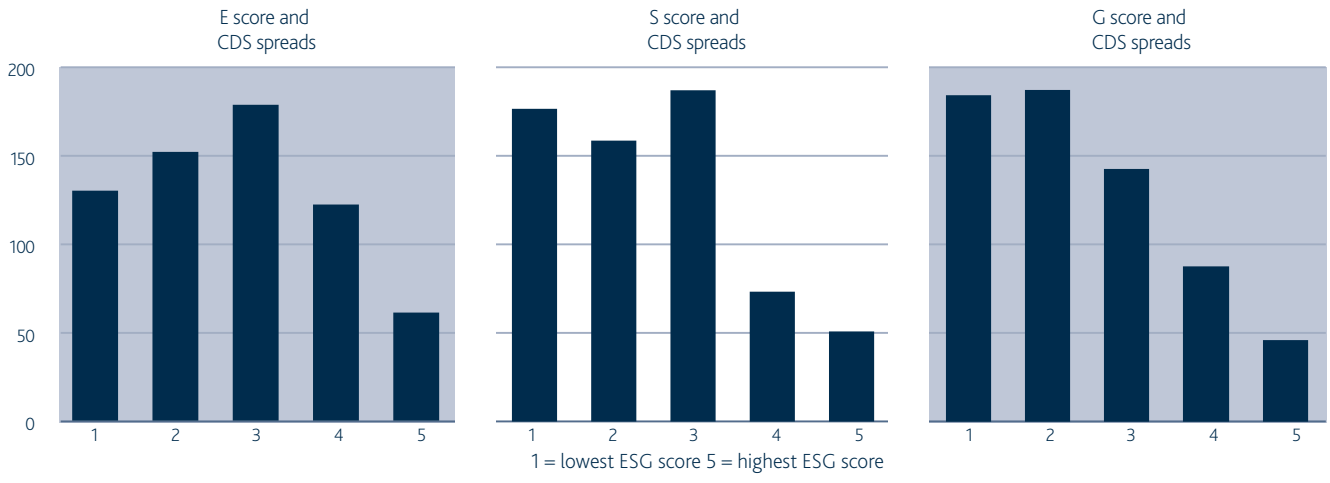
We can see from figure 6 that no matter which ESG dimension is analysed, countries with the highest scores for each dimension (quintiles five) have the lowest average CDS spreads. Unlike for corporate issuers, we can see that the correlation exists for governance scores: the relationship between governance scores and CDS spread quintiles is almost linear and the difference in spreads between the first and fifth quintiles is 138bps. The only slight discrepancy is that countries in the second quintile have marginally higher average CDS spreads than those in the first.

For the environmental and social sub-dimensions, we observe similar, but less linear, effects. Interestingly, the third quintile in terms of environmental and social performance have the highest average spreads, at close to 180bps. We would have expected that the first quintile of countries, which have the worst performance on those dimensions and might therefore be more exposed to environmental and social risks, would have had the highest spreads.

The fact that the relationship of the environmental dimension with CDS spreads is the least linear could be explained by the fact that environmental issues are not yet fully reflected in sovereign risk ratings. We also acknowledge that the risks associated with environmental issues, in particular climate change, are difficult to quantify (whether in terms of transition risk or physical climate risk) and their time horizon is even more uncertain.

The fact that the relationship of the environmental dimension with CDS spreads is the least linear could be explained by the fact that environmental issues are not yet fully reflected in sovereign risk ratings.

Figure 6: Average sovereign CDS spreads by individual environmental, social, and governance quintiles 2009–18



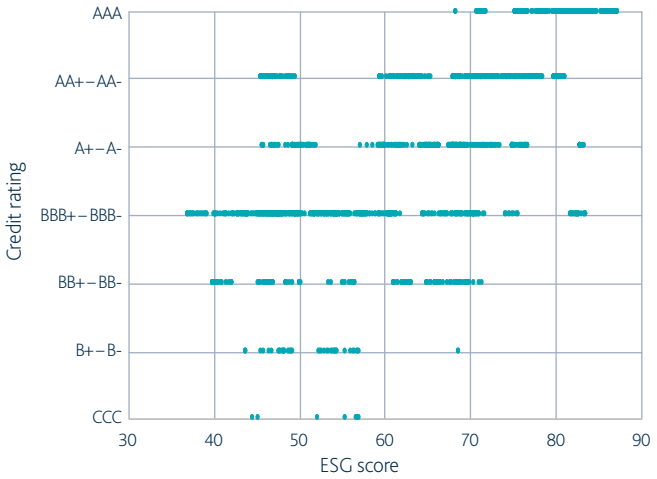
Source: Hermes and Beyond Ratings. Data as at April 2019.

ARE ESG SCORES CORRELATED WITH SOVEREIGN CREDIT RATINGS?

The obvious question that emerges, after having established the relationship between ESG scores and sovereign CDS spreads, is whether credit ratings incorporate ESG risk. To investigate this question, we compared the ESG scores with countries' credit ratings. Figure 7 shows a positive correlation between ESG scores and credit ratings, implying that to a certain extent sovereign credit ratings integrate ESG information, so that countries with higher ESG scores tend to have better credit ratings.

What is striking is that despite the positive relationship between sovereign credit ratings and ESG scores, there is huge variation in ESG scores within each credit rating band. For example, in the AA category, we observe ESG scores between 45 and 80. For the single A category, ESG scores range between 45 and 83. These results show that while sovereign credit ratings are positively correlated with ESG scores, there are still many countries that have very good credit ratings despite relatively low ESG scores. This raises a question about whether ratings for those countries properly take ESG risk into account.

Figure 7: Sovereign ESG scores by credit rating from 2009–18



Source: Beyond Ratings and Bloomberg. Data as at April 2019.

THE PRICING CHART

Based on the correlations we observed between sovereign CDS spreads and ESG scores, we went on to replicate the ESG pricing model we developed in the original Hermes paper on pricing ESG risk in corporate credit. Ultimately, we wanted to test the idea if a similar relationship exists between sovereign CDS spreads and ESG scores even after controlling for credit ratings.

To ensure our quantitative study on sovereign CDS spreads and ESG was robust and credible, we used a pooled regression approach covering the nine years of our sample period, between Q4 2009 and Q4 2018. A cross-sectional study would only have provided details of the relationship between sovereign CDS spreads and ESG risk at a single moment in time, and this might look totally different from another point in time. Such an approach is important if we wish to be able to draw any substantial conclusions and develop a useful tool for asset managers, asset owners and credit-rating agencies.

We conducted an ordinary least squares (OLS) regression model in which the natural logarithm of the quarterly five-year CDS spread was the dependent variable and the ESG score and the credit rating the independent (or explanatory) variables. We lagged both independent variables by four quarters, as we did in the original Hermes ESG credit study.[7]

The results of the regression indicate that there is a significant negative relationship between credit ratings and CDS spreads: that is, on average, the higher the credit rating, the lower the CDS spread. Our results also suggest a significant negative relationship between CDS spreads and ESG scores: countries with higher ESG scores have lower CDS spreads, on average, even after controlling for credit ratings.[8]

Based on an econometric specification that we used (see appendix), we calculated an implied CDS spread per ESG score. We show the results in figure 8.

Figure 8: Implied CDS spreads based on ESG scores

ESG score	Implied CDS spreads
100	53.2
90	61.2
80	70.3
70	80.9
60	93.0
50	107.0
40	123.1
30	141.6
20	162.8
10	187.2
0	215.4

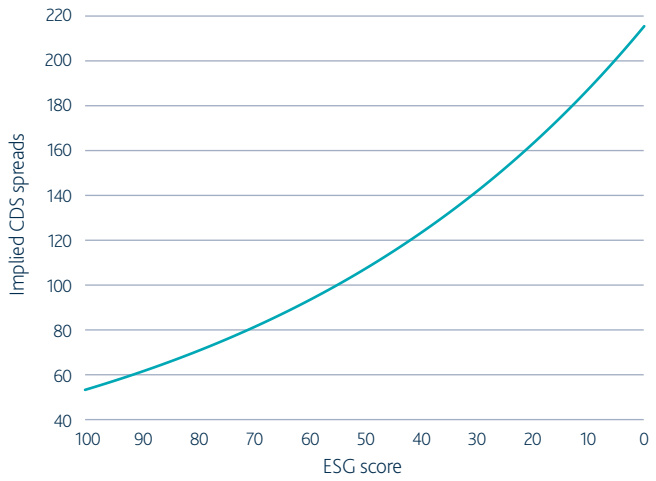
Source: Hermes, Beyond Ratings as at May 2019.

Based on the implied CDS spreads in figure 8, we plotted the results in figure 9, which represents our illustrative ESG pricing chart for sovereign bonds. It shows the implied CDS spreads from our OLS regression, which expressed the natural logarithm of the sovereign CDS spread with the ESG scores from Beyond Ratings and the credit rating.

[7] The OLS regression model is estimated using robust standard errors.

[8] In some cases it is possible that a more ESG-friendly government can also be perceived as being more likely to increase debt issuance, therefore leading to a widening of the spread.

Figure 9: The relationship between implied sovereign CDS spreads and ESG scores



Source: Hermes, Beyond Ratings as at May 2019.

CONCLUSION

In this paper we found, first and foremost, that the bonds of countries with the lowest ESG scores tend to have, on average, the highest CDS spreads. Zooming in on the individual sub-dimensions of ESG, we documented that the strongest (and almost linear) relationship exists between governance factors and sovereign CDS spreads (see figure 6).

We also identified a positive correlation between credit ratings and ESG scores. However, the distributions of ESG scores for each rating category are very wide: countries with good ratings can have relatively low ESG scores, giving rise to additional risks that might not be picked up by conventional credit ratings (see figure 7).

We empirically established that there is a significant negative relationship between ESG scores and sovereign CDS spreads, even after controlling for credit ratings. This means that investors should consider ESG factors as part of their assessments of countries' creditworthiness, because they might not be fully reflected in credit ratings (see figures 1 and 8).

The model we developed could be used to identify outliers, outperformers and risky investments – just like the model in our study on the link between ESG and corporate credit. Our model helps investors identify countries with tight spreads and low ESG scores – these are investments that investors might wish to avoid as the CDS spreads may not fully reflect the ESG risk inherent in these countries. The model can also help identify countries with wide spreads and high ESG scores given that the ESG risk may not – according to our model – be properly reflected in the price.

LOOKING AHEAD

In this study, we looked at 59 countries from around the world. There are obviously interesting research questions to be asked regarding the effects of ESG on sovereign credit in various markets. In particular, the extent to which environmental risks are captured in sovereign CDS spreads warrants further examination. As a follow-up, we have started looking at the different effects of ESG on sovereign credit spreads in developed markets compared to emerging, and also in the context of investment-grade relative to high-yield bonds, as well the aspect of change in CDS. While this study has focused on risk, we may also want to further investigate the contribution of ESG factors to returns in future publications.

APPENDIX

1. Ordinary least squares regression analysis

The table below shows the output of the underlying regression model for our pricing model, using robust standard errors.

$$ln(\text{Quarterly average CDS spreads})_{i,t} = Constant + \beta 1 * \text{ESG score}_{i,t-4} + \beta 2 * \text{Credit Rating}_{i,t-4} + Error_{i,t}$$

	ln (CDS spreads)
ESG score (-4)	-0.0140***
	0.0012
Credit ratings (-4)	-0.4024***
	0.0126
Constants	7.4389***
	0.0627
R-squared (adj.)	60%
Degrees of Freedom	1816
F-Statistics	1351

***,**,* indicate statistical significance at 1%, 5% and 10%.

2. Credit rating conversion table

Bloomberg index rating	Rating grade	Assigned rating code
AAA	Investment	7
AA1		6
AA2		6
AA3		6
A1		5
A2		5
A3		5
BBB1		4
BBB2		4
BBB3		4
BB1	Speculative	3
BB2		3
BB3		3
B1		2
B2		2
B3		2
CCC1		1
CCC2		1
CCC3		1
CC		1
C		1

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An ESG-Modified Credit Risk Assessment Model Based on Decision Tree Model

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ABSTRACT

How to accurately assess corporate credit risk is a very important issue for financial institutions such as banks. Especially after the 2008 financial crisis, the discussion of credit ratings has gained more and more attention, and various evaluation models have been proposed to predict credit risk for enterprises. This paper is different from the traditional evaluation system, relying only on financial indicators. In this research, the ESG performance that reflects the sustainable development ability of the enterprise is included in the company's evaluation system for analysis. In addition, considering the inherent differences in ESG performance between different industries, a new indicator—relative ESG scoring is created to eliminate industry impact and obtain a more fair ESG evaluation. Then, this paper collects the data of 51 companies in different industries, establishes three decision tree models for comparison, adds ESG performance and relative ESG scoring in turn, and finally gets the model prediction accuracy rates: 71.43%, 80.95%, and 85.71%, respectively. After analyzing the results, it is proved that the addition of ESG performance and the newly created indicator can significantly improve the prediction accuracy of the credit risk assessment model, which provides a new idea for improving the index system of the credit risk assessment model.

Keywords: *Credit risk assessment, ESG scoring, Relative ESG scoring, Decision tree model.*

1. INTRODUCTION

1.1 Background

Credit risk is the possibility that the borrower (e.g. a listed company) is unwilling or unable to repay the lenders due to financial crisis, bankruptcy, or other reasons, resulting in losses to the bank, investor, or counterparty. Once credit risk occurs, corporate defaults can have a knock-on effect on banks and other related entities[1]. The assessment of credit risk is a matter of great concern to banks around the world since imprudent approval of the loans can have dire consequences, like the devastating financial crisis in 2008. Therefore, credit risk assessment has attracted great attention from many researchers, financial institutions, and the government in recent years. To accurately measure the credit risk of an enterprise, the core problem is to make a reasonable prediction of the default of the companies that may occur in the future. Up to now, the majority of scholars have made judgments only from the financial performance based on the indicators and data in the financial statements, without taking other factors that may affect credit risk into consideration.

Meanwhile, ESG ratings are showing an increasingly crucial impact on measuring the overall performance and potential of companies. With the promotion of sustainability and low-carbon awareness, governments and financial institutions are paying more attention to the ESG performance of enterprises. Companies with excellent ESG performance tend to get more policy privileges and investor preferences, which will furthermore have a non-negligible indirect impact on the financial situation of these enterprises. Therefore, ESG performance is included in the credit risk assessment to predict the default more accurately, which can significantly reduce the credit loss of the banks.

1.2 Related Research

In the selection of evaluation indicators, most of the research is only based on the financial indicators in the public financial statements of enterprises. However, the concept of sustainability has become more and more important, especially in today's world. Weber et al. analyzed the role that criteria pertaining to sustainability and environmental orientation play in the commercial credit risk management process based on data from

Y. Jiang et al. (Eds.): ICEDBC 2022, AEBMR 225, pp. 15–21, 2022.
https://doi.org/10.2991/978-94-6463-036-7_4

Bangladeshi banks and proposed that the company's sustainability performance may affect its creditworthiness as part of its financial performance [2]. Nevertheless, only a small number of studies have added the indicators of ESG performance so far and the existing research on ESG performance only depicted the indicators roughly.

To accurately assess the credit risk of different companies, much research has been conducted to build an effective assessment system. The credit risk assessment is essentially analyzing relevant data such as financial indicators to predict the default probability of the enterprise. Most mainstream research uses the credit scoring model to score each enterprise of their credit risk and sets risk warning lines to divide enterprises into two categories: defaulting enterprises and non-defaulting enterprises. The existing risk evaluation methods can be categorized into two types, the univariate analysis method, and the multivariate analysis method. The univariate analysis method is first proposed by Beaver, using only a single financial indicator, which is relatively simple to calculate but less accurate [3]. This is because a single indicator is not possible to comprehensively reflect the complex business conditions of the company. So the multivariate analysis method is better on this issue, and it is also more often used by researchers.

Multivariate models can be subdivided into three categories: statistical, operational research, and data mining. Statistical methods include option pricing theory, such as the EDF model developed by KMV, which combines real-time data from the stock market to measure the company's expected default frequency to determine credit risk. Durand established a reliable discriminant function under the structure of the discriminant analysis method and imported the company's data for classification to make credit decisions [4]. Methods of operational research include linear programming, integer programming, and the analytic hierarchy process. Freed et al. developed a linear discriminant algorithm eliminating the complexities of conventional statistical approaches[5]. Bajgier et al. compared the results of three linear programming approaches for the discriminant problem which included two formulations from Freed and Glover and indicated that each method was statistically preferable [6]. Besides, some models based on data mining are prevalent in recent research, such as the decision tree method, neural network, genetic algorithm, and nearest-neighbor interpolation [7-9]. With these methods, it is feasible to find the correlations between indicators and identify data features to make the right predictions through computer programs.

1.3 Objective

According to the related research above, it is obvious that detailed and accurate measurement of ESG performance hasn't been taken into the assessment model, which is also the problem that this paper tended to solve.

This paper aims to select ESG scores and add these indicators into the credit risk assessment procedure to reflect a company's sustainability, instead of only analyzing the financial variables. The ESG scoring is used to reflect the ESG performance of the enterprise, which is also the authoritative ESG evaluation method common to listed companies. In this essay, the ESG scores are gathered from SynTao Green Finance ESG ratings and RANKINS CSR Ratings, two authoritative ESG scoring institutions. Additionally, a new indicator called Relative ESG Performance is created to reduce the impact caused by the difference between various industries. In this way, the assessment model can not only depict the ESG performance well but also effectively reduce the bias due to the intrinsic differences between different industries.

This paper also meticulously portrays the financial performance of the enterprise and selects 18 different indicators from different aspects of the financial performance for analysis, which enables a comprehensive evaluation of the company's default probability by considering both financial performance and ESG performance.

Based on the decision tree model, our goal is to figure out whether ESG performance can help better predict the probability of credit defaults of companies and enhance the prediction accuracy of the credit assessment system using financial and ESG indicators.

2. METHOD

2.1 Data Collection

This article collected the financial and ESG performance data of 51 Chinese listed companies from various industries, (retail, manufacturing, insurance, transportation, real estate, finance, etc.) to ensure that this assessment model can be widely applicable. According to the provisions of the stock exchange, ST stock refers to the stock of enterprises that are given special treatment since they have been operating for two consecutive years of financial loss. Similarly, *ST stock refers to the stock of enterprises that receive delisting warnings since having operated for three consecutive years of loss. Such enterprises are often in unhealthy financial conditions or even bankruptcy, which means they are very likely not to repay their debts. For this reason, this article chose ST and *ST enterprises as defaulting enterprises. Through the CSMAR database, a total of 17 defaulting enterprises and 34 non-defaulting enterprises are selected, which are matched following the principle of similar size in the same industry.

In general, the data disclosure is relatively comprehensive, only a very small amount of data is

missing. Noticing this, the missing-value filling is conducted to continue the next steps. In addition, a sample equalization process was carried out to improve the accuracy of the prediction, expanding the number of default samples to 34. The enriched sample data is then divided into two categories: train set and test set. Since the decision tree model requires enough data to learn and train to ensure a high accuracy rate, 24 non-defaulting companies and 24 defaulting companies are selected as train sets, and 10 non-default companies and 10 default companies are used as test sets.

2.2 Indicator System

In terms of indicators, two major types of data are collected: financial indicators and ESG indicators.

Financial indicators are mainly divided into four aspects: Solvency, Profitability, Operating Capacity, and Development Ability. It includes 18 indicators of Class A financial statements (shown in Table 1) including current ratio, quick ratio, cash ratio, cash flow-based interest coverage ratio, debt to assets ratio, return on assets, return on equity, gross operating margin, accounts receivable turnover, the growth rate of net profit and so on.

In terms of ESG performance, this article uses ESG scorings issued by professional rating agencies-- SynTao Green Finance ESG Ratings and RANKINS CSR Ratings to reflect the overall ESG performance of the company. ESG rating agencies collect public information on the company's environmental, social and corporate governance aspects and self-disclosure information, quantitatively evaluate the ESG situation and finally convert the ESG information into a sustainable development performance score that investors can easily use. This score has also become a necessary disclosure content for listed companies stipulated in many exchanges so it can better reflect the true ESG performance of the enterprise.

Apart from the above, when collecting ESG rating data from companies in different industries, the phenomenon that the ESG scores of listed companies in different industries vary greatly is noticed. Some enterprises such as integrated financial services, telecommunications services, medical services, banking, insurance, and other service industries score between 2.4-4.7, while other manufacturing industries, such as the power production industry, textile, garment industry, and paper industry score only in the range of 0.4-1.5, which shows that there are likely to exist inherent differences between different industries, resulting in a large gap in the ESG rating results of companies in different industries.

Table 1. Indicator System

Facets	Indicators	
Financial Performance	Solvency	Current Ratio; Quick Ratio; Cash Ratio; Times Interest Earned; Cash Flow-based Interest Coverage Ratio; Debt to Assets Ratio
	Profitability	Return on Total Assets; Return on Assets; Return on Equity; Gross Operating Margin; Return on Investment
	Operating Capacity	Accounts Receivable Turnover; Inventories Turnover; Total Assets Turnover
	Development Ability	Growth Rate of Total Assets; Growth Rate of Net Profit; Growth Rate of Operating Profit; Growth Rate of Total Operating Revenue
ESG Performance	ESG scoring	
	Relative ESG scoring	

For further discussion, it is because some industries have their inevitable problems that are unfavorable to ESG ratings, which makes it difficult for listed companies in these industries to obtain higher ESG ratings. The electricity production and paper industries, for example, inevitably produce a lot of pollution and emissions in their production processes, resulting in negative ratings of environmental-level scores in ESG ratings. It is unfair and biased to score uniformly in the presence of such industry gaps. In response to this problem, this paper created a new ESG performance indicator based on the authoritative ESG score, which can not only describe ESG performance well but also eliminate this unfair problem caused by the inherent differences between different industries. This article created the indicator "Relative ESG Scoring", defined as follows:

$$\text{Relative ESG Scoring} = \frac{\text{ESG scoring of the company}}{\text{Average ESG scoring of the industry to which the company belongs}}$$

Finally, the whole indicator system is described in Table 1.

2.3 Decision Tree Model

The decision tree is essentially a graph structure and classifier that can analyze decision rules from a series of samples with features and labels, complete the classification and regression of samples, and present the classification results in the form of a dendrogram. This paper chooses the decision tree model in the machine learning field to conduct the research. It is because credit risk assessment is a relatively complex process, many independent variables are difficult to guarantee that the default risk is acted in the form of linear regression and it is often difficult to meet the assumption of normal distribution. So this paper does not use linear regression models such as logistic model and probit model used by many scholars[10-11].

The amount of data on defaulting enterprises in this article is small, only half of that of non-defaulting enterprises, so there is an imbalance problem in the data, which would cause biased predictions. Therefore, the SMOTE algorithm is used to equalize the positive and negative samples, so that the proportion of defaulting companies and non-defaulting companies can reach a 1:1 equilibrium state. After the sample equalization process is completed, the stratified sampling of 68 samples is carried out to complete the division of the train set and the test set. This paper selects a commonly used 7:3 ratio to let the train set contain 48 samples: 24 defaulting companies and 24 non-defaulting companies. And the test set contains 20 samples in total, 10 companies for each category. Besides, due to the relatively large number of indicators, several indicators are appropriately deleted during the actual model operation to avoid overfitting problems.

In this paper, the C4.5 decision tree algorithm is used to construct a decision tree recursively from top to bottom based on the selection rule that the indicator with the maximum information gain rate would be selected as the decision attribute. After the decision tree is generated, the decision tree is pruned to reduce the size of the tree structure, alleviate the overfitting problem, and finally obtain the decision tree classification result graph and model accuracy.

$$\text{Classification accuracy} = \frac{\text{number of correctly classified samples}}{\text{total number of test samples}} \times 100\%$$

To explore whether ESG indicators have an impact on the accuracy of credit risk assessment models and whether the newly constructed Renewable ESG scoring can solve the problem of industry differences and improve model accuracy, three different decision tree models are constructed for analysis.

3. RESULTS AND DISCUSSION

In this paper, a credit evaluation model is established based on the decision tree method. Through the analysis and learning of enterprise-related indicators, enterprises are classified into two categories: defaulting companies and non-defaulting companies. A total of 18 classic financial indicators in four aspects: Solidity, Profitability, Operating Capacity, and Development Ability are considered in the indicator system of the decision tree model. First of all, only financial indicators are considered in Model 1, Model 2 is added ESG scoring to see the impact of ESG scoring on the accuracy of the model. Model 3 includes Relative ESG scoring, which is the newly created indicator in this paper, to study whether excluding industry factors can improve the model prediction ability. After processing the data and model settings, the classifier is trained with a training set. When the classifier is formed, the test set data is tested to output the accuracy.

The results of the output accuracy of the three models are as follows:

Table 2. Accuracy Result

	Model 1	Model 2	Model 3
Accuracy	71.43%	80.95%	85.71%

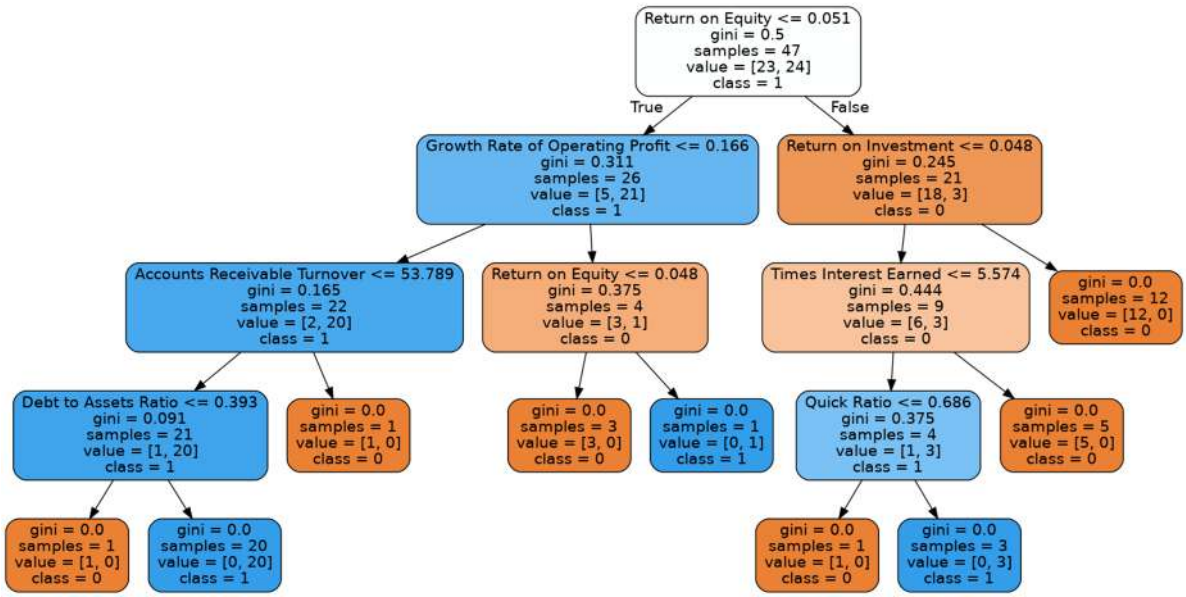

Figure 1 Decision Tree in Model 1

From the accuracy of the classification model, it is obvious that the accuracy rate of the three models is over 70% and increases in turn. The maximum can reach nearly 86%, indicating that the prediction ability of the model is accurate and the prediction results are also reliable. Besides, according to the results of the ROC curve, the deviation from the X-axis indicates that the probability of misjudgment is low and the AUC value is about 0.86, which can both evince that the decision tree classifier in this paper is effective.

Based on the results above, the decision tree model is effective in predicting corporate default risk, which can assist banks and other financial institutions to make more rational credit decisions and reduce credit risk.

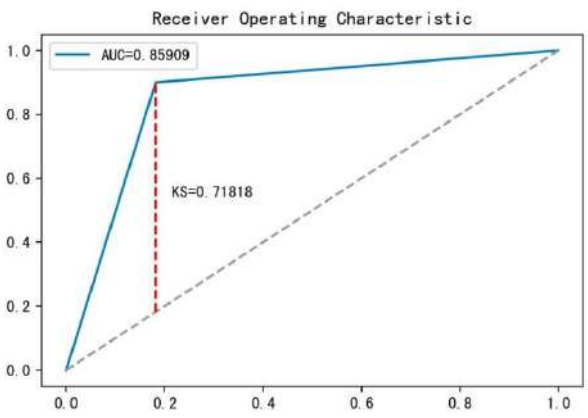

Figure 2 Receiver Operating Characteristic

For further analysis, from the comparison between model 1 and model 2, it can be found that after adding ESG scoring, the prediction accuracy has increased significantly, from 71.43% to 80.95%, which greatly improves the accuracy of the model prediction. This can also prove that the ESG performance of enterprises can be added to the credit risk evaluation system to measure the strength of enterprises from a richer and more comprehensive dimension, output more accurate prediction results, and reduce credit risks. This also provides new ideas for banks to credit ratings of enterprises.

Comparing Model 2 and Model 3, it can be found that the addition of a new relative ESG indicator can improve the accuracy rate by nearly 5 percent. This shows that in the specific process of ESG rating, the inherent differences between different industries hurt the objective measurement of the company's environmental performance, which reduces the accuracy of model discrimination. The newly created relative ESG scoring eliminates the industry gap, reduces this bias, and allows banks and investors to evaluate the overall performance of enterprises more wisely.

4. CONCLUSION

This paper collects the financial and ESG data of 51 listed companies in different industries and establishes three decision tree models to assess their credit risk based on different indicator settings. Through the models' prediction accuracy, the answer to whether ESG performance can help improve the credit risk assessment is clear. Finally, the models' accuracy rates are 71.43%, 80.95%, and 85.71%, respectively, which verifies that the addition of ESG performance can attribute to predicting the default risk of enterprises more accurately, which will help improve the current measurement of credit risk. The addition of ESG performance means that sustainability can have a beneficial effect on assessing the overall performance of a company. Moreover, the increasing emphasis on ESG is also a signal for the development direction of industries, indicating that publicly listed

companies should attach more attention to their environmental, social and government performance. After adding the ESG indicators into the evaluation system, the companies with outstanding sustainability can get higher scores and then receive the investment and loans more easily, which concurs with the trend of "responsible investment"(investors are inclined to invest in a morally acceptable way).

In addition, by providing insight into ESG's industry rating distribution data, this paper identifies the potential drawbacks of using ESG scores solely to reflect sustainability. To tackle this problem, this paper creates a new ESG indicator, Relative ESG Scoring, to eliminate industry differences and obtain a more fair ESG performance. With this indicator, investors and governments can eliminate this inherent industry gap when making investment decisions and assessing companies in these industries, rather than just judging by the absolute size of the ESG score. Rational decision-makers can consider the company's relative ESG performance in the specific industry (i.e. whether the company's ESG performance is comparatively better than that of other competitors in the industry), to make investment choices, credit decisions, and strategies. This indicator also significantly improved the accuracy of the model and proved its value for properly measuring ESG performance and credit risk assessment.

Regarding the research on credit risk assessment, a large number of scholars have invested energy and got fruitful results. There are dozens of evaluation models, and this paper only chooses the decision tree model for analysis and obtains the results considering the data characteristics. Subsequent research can be conducted by trying more models to improve generalization ability.

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GROUP ESG RISK POLICY

January 2, 2023

GROUP ESG RISK POLICY			
☒ Group Procedure		Process Owner:	ESG Risk team under Group ESG
☐ Business Procedure		Approving Authority:	Board Risk & ESG Committee (BRCC)
☐ Country Procedure		Effective Date:	02 January 2022
Version:	V01_January 2022 V02_January 2023	Next Review Date:	02 January 2024

Table of Contents

DOCUMENT CONTROL					Version: 1.0
Policy Owner (Department):	ESG Risk team under Group ESG		**Responsible Executive:**	EVP & Chief Sustainability Officer	
Approved by	Board Risk and ESG Committee		**Effective Date:**	January, 2023	
Review details	**Date reviewed:**	December 28, 2022	**Version Control**	**Created by:**	ESG Risk team
	Last revised:	December 28, 2022		**Maintained by:**	ESG Risk team
	Next Review Due:	January 2, 2024		**Modified by:**	ESG Risk team

VERSION CONTROL		
Version number	**Version date**	**Change (applicable section and sub-section)**
V01_January 2022	January 2, 2022	Initial release
V02_January 2023	January 2, 2023	Second version, 1.3, 1.4, 2.4, 3.2, 7.5, 7.6, 7.7

1 Introduction

Environmental, Social, and Governance (ESG) related issues as well as the impacts they create, the opportunities they provide and risks that they generate are becoming more and more relevant for financial institutions. FAB Group recognizes the importance of incorporating ESG risks as part of the Enterprise Risk Management framework.

Managing ESG risks are just as important as opportunities in the pursuit of sustainable growth and transitioning towards a more ESG friendly environment.

FAB Group's ESG Risk Policy (ESGRP) is designed to integrate ESG risks within the Enterprise Risk Management framework while being fully aligned with the Group's ESG targets and the strategic business objectives of the Group.

1.1 Purpose

The purpose of ESGRP is to establish principles and guidelines for identifying, assessing, managing, monitoring, mitigating, and reporting ESG risks, throughout the FAB Group.

1.2 Objectives

The core objective of the ESGRP is to provide assurance to the Board of Directors, investors, regulators, and other stakeholders that ESG risks threatening the Group's business activities, achievement of its core values and purpose are addressed within an effective integrated risk management framework.

The ESGRP also defines the broad principles for the identification, assessment, and measurement, monitoring and reporting of ESG risks for all business units across the Group. It will act as a guide for embedding strong ESG risk awareness culture within the Group.

The more specific objectives for the ESGRP include:

- Establishing a reference guideline for identifying and assessing ESG risks across the Group
- Defining key ESG risk metrics and performance indicators for monitoring and reporting
- Developing ESG risk assessment tools and defining processes for onboarding of new clients, transactions, and vendors

The following objectives are covered by the ESG Risk framework description:

- Setting an effective ESG risk governance structure and oversight with clear responsibilities across the Three Lines of Defence (addendum to framework)
- Encouraging an ESG risk culture within the Group through building ESG risks awareness and understanding at all levels

1.3 Scope

ESG risks for FAB Group ("Group") arise from its internal business activities as a Company, from its counterparties and from its vendors. Therefore, it impacts a wide range of activities within the Group. There are other policies within the Group that currently address different aspects of ESG risks.

This document serves as the umbrella policy for all ESG risk related topics. However, it does not explicitly address the ESG risks arising from the Group's internal activities as a Company. ESG risks arising from the Group's internal business activities as a Company are covered as part of the following:

- Group ESG Policy
- Group Environmental Policy
- FAB Employee Code of Conduct
- FAB Directors Code of Conduct

The ESGRP lays out the principles of ESG risk management and addresses, primarily, the indirect risks and impacts emanating from counterparties and vendors.

Group policies and documents will be cross-referenced in the ESGRP wherever applicable.

The scope of the ESGRP will be covered in the following four phases:

Phase	Phase 1	Phase 2	Phase 3	Phase 4
Timeline	2022	2022-23	To be decided	To be decided
Scope coverage across business products and operations	• Selected clients from Investment Banking (IB)[1] • Group's own investments[2] in bonds and equity • Group's internal supply chain[3] management with specific focus on vendors	• Private banking • All Group Investment Banking (except FI/NBFI) and Corporate and Commercial Banking[4] Clients	• Consumer Banking • All Group Investment Banking and Corporate and Commercial Banking clients, with either one or more of the following products: ○ Supply chain finance	• Commit to other relevant business activities with material ESG risks (based on the annual ESG risks materiality assessment results and decision by Group ESG Committee)

Note: Products and operations covered under each phase will continue to be in the scope of the subsequent phases. Above implementation plan is tentative and subject.

The ESGRP is applicable to all FAB Group entities (Head Office, domestic and international branches, and subsidiaries) across all countries of operations. Involved stakeholders are expected to know the framework and policy instruction and act accordingly.

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[1] *Phase 1 and 2 excludes Financial Institutions (FI/NBFI/CB & Supra). The geographic scope of the clients included in phase 1 will be limited to the UAE, USA, UK, France, Switzerland, Singapore, Hong Kong, Egypt, India, and China..*

[2] *Significant investments, within Global Markets, in bonds and listed equity will be assessed through external ESG ratings. Private equity and securities, including advisory services and supply in Private Banking Group and FAB Securities, are planned for later stages of the ESG roadmap.*

[3] *During Phase 1 of the ESGRP implementation, the Strategic Vendor Management team will conduct ESG risk assessment for the top 100 companies with the highest PO values based on the last two years transactions.*

[4] *The CCIB geographic scope will be limited to the UAE in phase 2.*

In accordance with relevant local guidelines and requirements, the international entities will define specific addenda to address local regulatory and compliance requirements that are not covered by the ESGRP.

1.4 Control and Maintenance of the Policy

This Policy will be approved and issued by the Board Risk & ESG Committee under the authority delegated to it by the Board of Directors (BoD) of the Group.

The ESGRP is intended to be an evolving document as new guidelines and regulations are introduced across different jurisdictions. As the area of ESG risks management evolves and in line with the evolution of Group activities, it is anticipated that the existing policy may require amendments and/or inclusions.

The ESGRP will be reviewed once every year or more frequently (if required), to ensure it is relevant. All amendments, additions or deletions to the Policy will be subject to version control and approvals prior to implementation.

The approved revisions will be provided in both hard copy form and the electronic version (with access restricted to relevant stakeholders). All stakeholders will be immediately informed through an internal memorandum which may also be communicated via email.

The VP & Head of ESG Risk Framework and Assessment (HoESGRFA) shall hold the master register of amendments and records of the approved amendments. A Version Register will be maintained by HoESGRFA that shows the Policy version information relating to the version number, version date, and section amended (as per Document Control Table at the beginning of this document).

1.5 Abbreviation

Abbreviation	Description
BoD	Board of Directors
BRESGC	Board Risk and ESG Committee
CEC	Credit Execution Committee
EP	Equator Principles
ERM	Enterprise Risk Management
ESG	Environmental, Social and Governance
ESGRP	ESG Risk Policy
ESG-SFC	ESG Risk and Sustainable Finance Committee
G-ESGC	Group ESG Committee
GOFRC	Group Operational and Fraud Risk Committee
GCC	Group Compliance Committee
GRC	Group Risk Committee
UNEP FI	United Nations Environment Programme Finance Initiative
NGFS	Network for Greening the Financial System
SFF	Sustainable Finance Framework
TCFD	Task Force on Climate related Financial Disclosures
UNGC	United Nations Global Compact

1.6 Structure of the Policy

The framework description has been divided into the following areas:

- Section 1 – Introduction
- Section 2 – ESG risk identification
- Section 3 – ESG risk assessment and measurement
- Section 4 – ESG risk mitigation
- Section 5 – ESG risk reporting and monitoring
- Support 6 – Annexures

2 ESG risk identification

2.1 Relevant laws, regulations, and external standards

Central banks and policymakers where FAB Group operates are becoming interested in understanding how the banking sector is effectively managing and monitoring ESG related risks within their operations, particularly in response to climate change challenges, socio-economic topics, and governance transparency.

When setting this policy, the Group has considered relevant legislations and guidelines, which are updated from time to time.

2.2 Definition of ESG Risk and Transmission Channels

ESG risks are manifested within the principal risks that are defined under the Key Risk Taxonomy of Enterprise Risk Management Policy and broadly defined as any negative financial and non-financial impacts to the Group stemming from the current or progressive impacts of Environmental, Social and Governance factors on the Group's internal business activities as a company, its counterparties and vendor management.

ESG risks can emerge from the customers' activities, inherent from sector-specific activities, externally from the stakeholders they interact with (e.g., customers, regulators, shareholders, etc.) and the countries we operate in. These risks are not bound by timelines and can occur within the short, medium, and long-term.

The ESGRP instructions along with risk appetite metrics and risk assessment tools primarily aim to identify, assess, and manage the indirect ESG risks emanating from counterparties and vendors.

2.2.1 Environmental risks

Environmental risks refer to any negative impact to the Group's premises, reputation and credit exposures to counterparties that may potentially contribute to or be affected by climate change and other forms of environmental degradation (such as air pollution, water pollution, scarcity of freshwater, land contamination, biodiversity loss and deforestation).

2.2.2 Social risks

Social risks refer to any negative impact to the Group's business activities and reputation as a company, its financing to counterparties and sourcing of vendors due to social factors, such as violation of human rights, unfair labour practices, unsafe working conditions and mishandling of customer privacy. For example: the risk of default and/or financial loss by the exposure to counterparties who are exposed to potential fines and reputational damage due to fatalities and incidents in the workplace.

2.2.3 Governance risks

Governance risks refer to any negative impact to a Group's business activities and reputation as a company, its financing to counterparties and sourcing of vendors due to weak governance structure and failures in business ethics. For example: the risk of default and/or financial loss by the exposure to counterparties who are affected by the disruptions in business, reputational damage, and regulatory fines due to acts of negligence from the Board.

The ESG risks crosscut the principal risk categories and can materialize from both direct (through operation of the Group's own premises, infrastructure and organizational culture) and indirect (the financial services and support that the Group provides to its customers who may be exposed to ESG risks) channels.

2.3 Risk Appetite Statement

The Group's ESG risk appetite is aligned with the enterprise wide risk appetite framework. The risk appetite has been defined using a set of quantitative metrics (i.e. key risk metrics and performance indicators) and qualitative criteria. The risk appetite statement will be reviewed and approved by the Board on an annual basis and monitored on a quarterly basis.

2.3.1 Quantitative Risk Appetite Metrics

Quantitative risk appetite metrics comprise the following:

- **Key ESG Risk Indicators**: These risk appetite metrics establish the Group's risk tolerance to indirect ESG risk emanating from exposures to counterparties and vendors from high-risk sectors, geographies and third party/ internal ESG risk ratings and cascaded down by products and business functions.
- **Key ESG Performance Indicators**: These risk appetite metrics establish the Group's risk tolerance to Direct ESG risk. The key performance indicators are established to monitor among other things the performance of the Group's own emissions, social responsibility, and governance structure.

The risk metrics and performance metrics used are deemed to be appropriate for the current risk profile of the Group and will be updated on an annual basis.

Note: Please refer to Annexure I for key risk metrics and performance indicators (also see Group ESG Policy and Framework).

2.4 Qualitative Risk Appetite Criteria

FAB Group is committed to identifying, evaluating and managing ESG risks in lending, investment, funding and vendor management processes. On top of the standard Know-Your-Customer and Group Customer Due Diligence process, the Group will identify countries, sectors and activities of heightened sensitivity to ESG risks which could negatively impact the Group based on prior experience of engagement with the customer and external third party ESG risk assessment from credible sources.

Based on this, the appetite of the Group towards negative screening list, ESG critical activities and high ESG risk areas are defined below:

2.4.1 Negative and exclusionary screening list

The Group will not knowingly engage with companies or customers including:

1. Unsuccessful resolution of ESG issues on previous engagements with customer
2. Violators of UN Global Compact principles[5]
3. Violates of national or international legislation[6]
4. Potential negative impact on critical natural habitats and areas protected including e.g. UNESCO World Heritage Sites
5. Illegally infringe ownership of land or resources without Free, Prior and Informed Consent (FPIC)
6. Obligors on the Office of Foreign Assets Control (OFAC) blacklist
7. Classified as severe risk under the ESG risk assessment tool and approved by the relevant committees.
8. Financing[7] (including trade financing) of thermal coal (power and mining), and tobacco and alcohol manufacturers[8].

Note: Please refer to Annexure II for the UN GC Principles.

2.4.2 ESG critical activities

In addition, the Group will not knowingly engage in the activities from the "ESG Critical Activities", while not illegal, are not aligned with Group's values, principles and code of conduct if the revenue threshold is not met.

The Group can engage with customer under one of the following conditions as long as the purpose of the transaction and new engagement is in accordance with the Group's vision and principles in order to help the customer to rely increasingly more on ESG friendly business areas:

1. Critical activities make up less than 25% of the total revenue *(With the only exception for thermal coal, which will make up less than 10% of the total revenue),*
2. Risk mitigation actions in place[9].

If a transaction is under the Group's Sustainable Finance Framework, other requirements are in place such as restrictions on the use of proceeds from sustainable finance transactions.

Note: Please refer to Annexure II for the ESG critical activities.

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[5] *No alleged very high-risk breaches of the UN GC principles over the last two years as per the vendor's ESG rating.*
[6] *No alleged very high-risk violation of legislations over the last two years as per the vendor's ESG rating.*
[7] *Other key considerations include respecting current standing commitments to clients, annual renewals, until facility end date and engaging with existing customers to understand their current transition plans and explore transition finance.*
[8] *Tobacco and alcohol wholesale and retail distributor clients will be considered as an ESG critical activity.*
[9] *Will require an action plan attached to the transaction, see section 4.*

2.4.3 High ESG risk areas

The Group recognizes that certain sectors and activities are more likely to be exposed to higher ESG risks. The Group will actively engage with current and prospective clients even if the client is classified as high and severe risk as part of ESG risk assessment process. The ESG Risk/Credit team, as appropriate, will conduct enhanced due diligence assessment, reviewing the client's exposures to high ESG risk activities and reviewing risk mitigation actions in accordance with section 4.

The Group identifies sectors particularly susceptible to ESG risks based on external sources, along with additional inputs from internal portfolio analysis and monitors significant changes in sector performance on a periodic basis. Note: Please refer to Annexure II for high ESG risk sectors and high and very high ESG risk countries.

2.4.4 ESG deals eligible for sustainable financing

ESG deals are assessed for ESG risks and eligibility criteria in alignment with the Sustainable Finance Framework (SFF), as described in section 3.2.2. This includes a due diligence assessment for ESG risks at an obligor(s) and project level, if applicable, using the Equator Principles (EP) framework, which is a risk management framework adopted by financial institutions for determining, assessing and managing environmental and social risks in project finance. The Group is a signatory of the Equator Principles.

Once assessed as acceptable, deals undergo an additional assessment to check eligibility for sustainable financing. Any transaction that does not meet the minimum requirements set out in the SFF are disqualified.

Sustainability linked instruments will be reviewed and assessed for material and ambitious Key Performance Indicators (KPIs) and Sustainability Performance Targets (SPTs). The Group will validate the sustainability linked products issued under the SFF's classification through our due diligence processes, taking into consideratoin the clients material ESG issues and market standards.

2.4.5 Net zero considerations within portfolios

The Group has signed up to the Net Zero Banking Alliance (NZBA), which is an important step towards aligning the Group's lending portfolios with net-zero emission targets by 2050. Three high emitting sectors, namely Oil and Gas, Aviation and Power, were selected and prioritized for setting baseline measures and interim net zero targets for 2030.

For these sectors, additional monitoring measures will be needed to assess our exposure. All new credit facilities with *'Oil and Gas, Aviation and Power'* will be shared with the ESG risk team to have an overview on FAB's net zero performance.

3 ESG Risk Assessment and Measurement

3.1 Materiality assessment of ESG risks

Materiality assessment is an exercise conducted to gather insight on exposure and materiality of different ESG risks for the Group and to proactively manage the identified risks. This exercise helps in identifying the critical ESG risks and understanding which issues are most material or relevant to business and stakeholders. It is aligned with the principles of materiality as described in Global Reporting Initiatives (GRI) standards and recommendations of Task Force on Climate related Financial Disclosures (TCFD) and Sustainability Accounting Standards Board (SASB).

Group ESG will hold workshops and meetings with key stakeholders within the Group to conduct the materiality assessment. The materiality assessment will be done biannually or more, based on a need for basis, to assess potential ESG risks likelihood from occurring and severity of impact on business.

Note: Please refer to Annexure III for illustrative Materiality Assessment.

The outcome from the Materiality Assessment will be presented to the Group ESG Committee for review and approval.

3.2 ESG Risk Assessment at Counterparty, Transaction and Vendor Level

The Group is committed to identifying, evaluating and managing ESG risks in lending, investment and vendor management processes. As outlined in Group ESG Policy and Group Environmental Policy, the Group seeks to identify and manage any strategic or reputational risks arising from environmental and social impacts associated with Group's lending and commercial activities.

ESG risk assessment at counterparty and transaction level begins with front line units through negative and exclusionary screening, then and determining the ESG risk rating of the customers through ESG due diligence at the credit life cycle and vendor management process.

Trade Finance deals and clients will be assessed through an external ESG rating agency specialised in supply chain transactions. A pilot phase is initiated for Supply Chain Finance (SCF) clients.

When more clients and products are being taken into scope, the processes described below will be adjusted accordingly.

3.2.1 ESG risk assessment tool

ESG risk assessment tool includes quantitative and qualitative assessments, which collectively, provide a combined ESG risk rating outcome for counterparties. This assessment is completed at the onboarding phase of new clients, vendors and periodic credit review.

Quantitative assessments rely on a counterparty's ESG risk ratings provided by credible external ESG rating agencies. Meanwhile, the qualitative assessment is an internally developed ESG questionnaire that assesses the counterparty's current ESG policies, commitments and practices in effectively managing ESG risks.

The combined ESG risk rating from quantitative and qualitative assessments will categorize counterparties in three ESG risk categories:

1. Acceptable risk: No further action, approving the counterparty's relationship and transaction, if transactions comply with requirements in section 2.4. The ESG Risk team will undertake a sample check of acceptable risk clients to confirm the combined ESG risk rating and check for those with conflicting external and internal ratings.
2. High risk: Conditionally approved, with well founded motivation (more in-depth due diligence) and reasoning, encouraging the client to improve its ESG risk profile with agreed-upon mitigation action plan, performance-enhancing measures or addition of loan covenants, conditions or other requirements attached to the onboarding or transaction.
3. Severe risk: No engagement and exit from the client or vendor relationship, unless overridden by relevant committee.

Note: Please refer to Annexure IV for the ESG rating model.

3.2.2 ESG risk assessment of counterparties during life cycle (IB and CCIB)

Onboarding of new clients

The due diligence for onboarding new clients (including non-borrowing and borrowing clients) is conducted at a parent company level if applicable[10]. The front line units will conduct an ESG risk assessment for the clients in scope as included in Annexure 7.5, covering negative screening, external ESG rating and internal questionnaire with adequate evidence of proof.

New transactions

1. New plain vanilla credit facilities will be assessed against:
    a. The negative screening exclusions and ESG critical activities, outlined in section 2.4
    b. If project financing is included, then the front liner will conduct screening to decide if the Equator Principles[11] will apply. If applicable, then project categorization and relevant assessments will be needed as per the EP requirements described in annexure VI.
    c. If it is a sector that falls within the net zero scope, outlined in section 2.4
2. New ESG deals with credit facilities eligible for sustainable financing, as per the Group's Sustainable Finance Framework (SFF) requirements, will be assessed against:
    a. All assessments mentioned for the new plain vanilla credit facilities
    b. Any additional exclusionary considerations mentioned in the SFF

[10] *If the counterparty is a subsidiary and belongs to the same sector as the parent company, then an ESG risk assessment will not be performed at the counterparty level. The same ESG risk score of the parent company will apply (if available). If no parent company exists, then complete the ESG risk assessment at the individual counterparty level.*

[11] *The Equator Principles apply to FAB's project financing products (e.g. project finance advisory services, project finance, project related corporate loans, bridge loans, etc.) if they meet certain thresholds and conditions included in the detailed EP guidelines.*

c. An ESG risk assessment completed for the obligor(s), outlined in section 3.2.1 regardless of their inclusion in scope in Annexure 7.5
d. Fullfillment of the eligibility criteria and thresholds included in the SFF

The front line units will complete these assessments with adequate evidence of proof.

ESG risk assessment aligned with periodic credit reviews and/or periodic customer reviews:

When performing periodic credit reviews for clients with credit exposures, front line units will conduct an ESG risk assessment for clients during periodic credit reviews for the clients in scope as included in Annexure 7.5. Ad-hoc events in between credit renewals can trigger an ESG risk re-assessment in cases where potential adverse effects and lower ESG ratings were identified for the client.

ESG risk assessment for ad-hoc event driven reviews:

The ad-hoc event driven reviews enables the Group to identify customers with potential/ emerging deterioration in its ESG risk profile, pro-actively monitor its portfolio and discreetly approach the customer to help remediate potential ESG risk concerns.

Front line units as their role under the 1st line of defense will identify new ESG risk incidents for the customer through regular dialogue with customer and/or third party information, and perform ESG risk assessment to update the ESG risk rating.

The ESG Risk team will perform periodic monitoring for any adverse changes in external ESG ratings for the customer to identify customers with potential ESG issues and to take appropriate and timely corrective action plans. The event-driven alerts are categorized as:

1. Green alert: No further action, if there are unsubstantial changes in external ESG rating.
2. Amber alert: The ESG Risk team will classify the client under watch list and monitor closely, if the external ESG rating changes from acceptable risk to high risk category and potential changes in existing ESG related regulations and/or emerging new ESG regulations that will have a direct impact to client's business activities are expected.
3. Red alert: The ESG Risk/Credit team, as appropriate, will raise a flag to front line units for an update on ESG risk assessment, if the external ESG rating changes to severe risk level and ESG related risk incidents materialize for the customer.

3.2.3 ESG risk assessment for investments

The ESG risk assessment for investments will rely on data provided by external ESG risk rating agencies due to the limited direct relationship with investees compared to other counterparties.

The ESG risk score for investees will be based on an average score sourced from a number of ESG rating agencies and categrosied into acceptable, high and severe. The investees' combined ESG risk score will be added to a watchlist for monitoring purposes with a special focus on high and severe rated securites and refreshed every 6 months to the relevant ESG committees.

3.2.4 ESG risk assessment for vendor management

ESG risk assessment for vendors of critical activities/ services will be performed by the Strategic Vendor Management (SVM) team when onboarding new vendors. All existing vendors will go through a rapid ESG risk assessment before onboarding through an external ESG risk rating vendor (if the external ESG risk score is high, above 50, then an ESG risk assessment will be needed on the spot). If the external ESG risk score is less than 50, then the vendor will be onboarded.

Once a new purchase order (PO) is set, a detailed ESG risk assessment would be needed for vendors with professional services, IT and Facilities categories with a PO value above 1 million AED.

Note: Please refer to Annexure VII for process illustrations.

3.3 Climate stress testing and scenario analysis

The Group has taken a robust scenario driven and factor push approach for stress testing exercise, combining quantitative and qualitative methodologies to estimate forward-looking ECL impacts adjusted with stakeholder expectation on managing the ESG risk. The purpose for the stress testing tool is to understand the potential impacts on selected portfolios, enhance the methodology, and meet TCFD reporting and supervisor and central bank requirements going forward.

Due to modelling challenges with respect to relatively longer time horizons, limited historical observations and data availability, the climate stress testing and scenario analysis however remains work in progress.

Following are the quantification steps to be followed to conduct stress testing exercise:

Step 1: Design and update scenario library

Scenario library is a living document containing potential external and internal ESG scenarios and their priority level, covering both the climate-risk related scenarios and emerging risk scenarios for social and governance factors. The scenarios will be shortlisted based on the alignment with regulatory recommended scenarios, priority level and the availability of longer horizon estimates for macroeconomic variables to stress the parameters of Expected Credit Loss (ECL) modelling.

Note: Please refer to Annexure VIII for examples of stress scenarios.

Step 2: Quantitative assessment

The modelling of ESG related (including physical and transition risks for climate change) risks is in its infancy. For a start, the Group has taken a simple approach based on external research (NGFS, UNEP FI) and utilization of internal capabilities to estimate the financial impacts of climate change limited to high environmental risk sectors (such as energy, power utilities, mining, transportation, manufacturing, buildings and construction):

1. Identify the key risk drivers of the shortlisted climate change related scenarios on a combination of scenario (GDP forecasts for 30 years horizon available from NGFS) and factor push approach (sector and regional level financial impact on balance sheet or total revenue)
2. Link the key drivers to the transmission functions:
    - Obligor Risk Rating (ORR): Downgrade the credit rating of counterparties who operate in ESG vulnerable sectors by certain notches down and/or historical performance between ORR and EBITDA
    - IFRS 9 ECL model: Revise the baseline GDP forecast for macroeconomic variables used in IFRS 9 modelling
3. Revise the Through-The-Cycle (TTC) PD and consequent Point-In-Time (PIT) PD curves
4. Estimate the net ECL impact under the revised PD curves

Step 3: Qualitative assessment scorecard

The qualitative assessment scorecard is used to understand the management views of actions taken on managing ESG risks and to fine-tune the outcomes of the quantitative assessment (mentioned in step 2) based on the Group's current risk management practices with respect to ESG risks and plans for improvement.

The set of parameters are assessed under qualitative assessment and have been classified as "Control" or "Risk" parameters on a rating scale of 1 to 10 with 1 being Strongly agree and 10 being Strongly disagree.

1. Collect response on the set of parameters from senior management
2. Derive an average score for each parameter
3. Calculate overall weighted average score for ESG risk
4. Derive a mapping table in line with the rating scale to adjust the outcomes of the estimated credit loss due to ESG risks under the stress scenarios
5. Determine the bucket in accordance with overall average weighted score and apply the adjustment factor for the respective bucket to identify the final net financial impact under ESG stress scenarios

While the stress testing exercise will follow ICAAP process and timelines, the estimated impact on ECL and consequent capital shortfall will however not be included in the Pillar II capital charge due to the early stage of stress testing methodology and inclusion of qualitative assessment.

The effort is work in progress, and will evolve over the years as data, taxonomy, assumptions, resources, and insights improve.

4 ESG Risk Mitigation

In line with risk mitigation principles outlined in Enterprise Risk Management policy, the Group adopts following measures and controls as part of risk mitigation for the identified ESG risks:

1. Monitoring vulnerable sectors, geographies and customers, and identifying negative screening and ESG critical activities list as part of ESG risk appetite framework
2. Offering of sustainable finance products, such as Green Bonds, to finance projects that have positive environmental and climate benefits
9. Engaging with high and severe ESG risk counterparties with mitigation plans to assist in reducing customer's exposures to ESG risks and transition towards sustainable business practice.

Front line units, based on discussions with the customer, will recommend risk mitigation action plans to improve customer's ESG risk profile when engaging with high ESG risk counterparties or if the activity is ESG critical, but can be contained with a risk mitigating action plan. This will be adequately documented as part of process documentation and reviewed by the ESG Risk/Credit team, as appropriate.

ESG Risk/Credit team, as appropriate, will review the recommended mitigation actions plans with respect to following principles:

1. Objective: A well-defined set of actions that will improve customer's ESG profile and ensure to stay away further critical activities
2. Direct: To have a direct impact on the customer's business activities and revenue model
3. Measurable: To touch a material portion of the total revenue, so that the revenue share of non-critical activities reaching revenue threshold of 75%
4. Commitment: Backed by buy-in from senior management to committing objectives
5. Timely: A clear timeline with a target date.

The status of the ESG risk mitigation plans must be monitored and communicated to ESG-SFC for corrective actions to be taken.

5 ESG Risk Reporting and Monitoring

Annual disclosures in line with international standards

The Group strives to disclose all relevant sustainability and ESG related information to external stakeholders via Group's annual reporting on its webpage. Going forward, more granular data and information will be provided in the external reports aligned with national and international guidelines.

6 Annexures

6.1 Annexure I: Illustrative list of key risk metrics and performance indicators

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6.2 Annexure II: UN GC Principles, ESG critical activities and high ESG risk sectors

Table 7. 1: United Nation Global Compact principles

Category	Principles	Definition
Human Rights	Principle 1	Businesses should support and respect the protection of internationally proclaimed human rights
	Principle 2	Make sure that they are not complicit in human rights abuses
Labour	Principle 3	Businesses should uphold the freedom of association and the effective recognition of the right to collective bargaining
	Principle 4	The elimination of all forms of forced and compulsory labor
	Principle 5	The effective abolition of child labor
	Principle 6	The elimination of discrimination in respect of employment and occupation
Environment	Principle 7	Businesses should support a precautionary approach to environmental challenges
	Principle 8	Undertake initiatives to promote greater environmental responsibility
	Principle 9	Encourage the development and diffusion of environmentally friendly technologies
Anti-corruption	Principle 10	Businesses should work against corruption in all its forms, including extortion and bribery.

Table 7. 2: ESG Critical activities

Activities:
All restricted activities under the Corporate & Investment Banking Group Credit Policy (CIB GCP)
All excluded activities under Group Customer Due Diligence procedure
Tar sand extraction
Fracking
Ultra-deep-sea drilling
Wholesale and retail distributors with tobacco and or alcohol sales
Arctic drilling
Thermal coal
Palm oil, soy, and timber
Landfill without gas capture
Waste incineration without energy capture
Animal mistreatment
Adult entertainment
Hazardous substances
Speculative transactions
Predatory lending

Hostile takeovers

Table 7. 3: ESG risk sectors classification by FAB

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Table 7. 4: ESG risk countries

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6.3 Annexure III: Materiality Assessment

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6.4 Annexure IV: ESG rating model

Table 7. 5: ESG risk rating structure

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6.5 Annexure V: IB and CCIB clients in scope for the ESG risk assessment

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6.6 Annexure VI: Equator Principles Framework

The Equator Principles (EP) framework is a risk management framework, adopted by financial institutions, for assessing the evaluation, management, and mitigation of environmental and social risks in project finance and project related loans. It aims to provide a minimum standard of environmental and social due diligence to support responsible risk decision-making.

The Equator Principles are based on the International Finance Corporation (IFC) environmental and social performance standards and the World Bank Group health and safety guidelines.

Scope of Equator Principles and applicability screening:

1. Project Finance Advisory Services where total Project capital costs are US$10 million or more.
2. Project Finance with total Project capital costs of US$10 million or more.
3. Project-Related Corporate Loans where all of the following three criteria are met:
    i. The majority of the loan is related to a Project over which the client has Effective Operational Control (either direct or indirect).
    ii. The total aggregate loan amount and the EPFI's individual commitment (before syndication or sell down) are each at least US$50 million.
    iii. The loan tenor is at least two years.
4. Bridge Loans with a tenor of less than two years that are intended to be refinanced by Project Finance or a Project-Related Corporate Loan that is anticipated to meet the relevant criteria described in 2 and 3 above.
5. Project-Related Refinance and Project-Related Acquisition Finance, where all of the following three criteria are met:
    i. The underlying Project was financed in accordance with the Equator Principles framework.

ii. There has been no material change in the scale or scope of the Project.

iii. Project Completion has not yet occurred at the time of the signing of the facility or loan agreement.

Table 7.8 Steps and roles of an EP-aligned project finance process

EP	Subject	Action
EP1	Review and Categorization	Categorize projects as A, B, or C, based on the magnitude of their potential environmental and social risks and impacts.
EP2	Environmental and Social Assessment	For Category A and B projects, borrower conducts an Environmental and Social Impact Assessment (ESIA). Borrower is expected to include assessments of potential adverse Human Rights impacts and climate change risks as part of the ESIA or other Assessment.
EP3	Applicable Environmental and Social Standards	Projects in non-designated countries: Compliance with the IFC Performance Standards on Environmental and Social Sustainability and the World Bank Group EHS Guidelines. Projects located in designated countries: Compliance with national laws and regulations.
EP4	Environmental and Social Management System and Equator Principles Action Plan	For Category A and B projects, borrower develops and maintains an Environmental and Social Management System (ESMS), Environmental and Social Management Plan (ESMP), and/or Equator Principles Action Plan (AP) to address issues raised in the assessment process and comply with the applicable standards.
EP5	Stakeholder Engagement	For Category A and B Projects, borrower demonstrates an effective stakeholder engagement process conducted in a structured and culturally appropriate manner with affected communities.
EP6	Grievance Mechanism	For all Category A and some Category B projects, borrower establishes a grievance mechanism designed to receive and facilitate resolution of concerns about the project.
EP7	Independent Review	For Category A and some Category B projects, independent consultant carries out a review of the assessment documentation to assess EP compliance.
EP8	Covenants	For Category A and B projects, environmental and social covenants linked to EP compliance are incorporated in the financial documentation.
EP9	Independent Monitoring and Reporting	For Category A and some Category B projects, borrower provides periodic reports, verified by an independent

		consultant, that document its compliance with the EP over the life of the loan.
EP10	Reporting and Transparency	Report publicly, at least annually, on transactions that have reached Financial Close and on EP implementation processes and experience.

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ESG Risks and Their Impact on the Creditworthiness of Companies

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Abstract

The integration of environmental, social and governance (ESG) criteria into credit risk assessment has gained significant attention recently. Therefore, it is necessary to understand, select and assess the risks of these ESG criteria and evaluate how they can impact company's creditworthiness. The main objective of this study is to give a thorough overview of the types of ESG risks, their interrelation with credit risk of the company and methodological approaches they can use, along with opportunities for future advancements. The analysis shows that climate change and transition to low-carbon economy provoke two main types of ESG risks – physical risks and transition risks. Both types of ESG risks could affect company's creditworthiness through its cash flows capital and collateral. In order to assess climate-related types of risks methodologies based on forward-looking scenarios are needed with the employment of data that has not been observed in the past. These results are a basis for further development of methodological architecture of ESG-credit risks.

Keywords: ESG risks, climate-related risks, transitional risks, physical risks, forward-looking scenarios.

1. Introduction

The integration of Environmental, Social, and Governance (ESG) factors into credit analysis has garnered significant attention in recent years. This is due to the growing recognition that a company's creditworthiness is not solely determined by its financial standing, but also by other qualitative and non-financial factors. Investors are among those who are gradually becoming more concerned about ESG since they are interested in long-term financial growth

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while also making positive contributions to the ESG aspects. We believe that a company's short-, medium-, and long-term business and financial performance will be more sustainable the better it manages the risks (and opportunities) associated with ESG. Specifically, the impact of climate change on the so-called "physical climate risks" to companies' creditworthiness is becoming more widely acknowledged in the financial community. This has picked up speed since 2015, when governments, financial authorities, and institutions began to integrate a wider range of "climate-related risks" into financial operations. If ESG considerations are successfully addressed, the company may be better positioned to absorb future demand, account for possible damage from hazards, stand out from the competition, and produce cash flows that exceed the original investments. ESG implementation also speeds up recovery, reduces the impact of potential crises, and encourages vital innovations. On the other hand, if ESG factors are ignored, the company may lose out on future business opportunities, see a decline in profitability as a result of shifting consumer preferences, incur additional costs for regulatory compliance, and ultimately be less able to produce cash flows.

It is crucial for creditors, like banks and bond holders, to accurately assess credit risks, including climate credit risk. Creditors face unforeseen and potentially significant financial losses if they undervalue this risk. Financial instability may result from such losses if they are significant and occur simultaneously. The fact that climate costs are not considered by the asset valuation models used by market participants—especially since these models are calibrated on historical data that provides little to no indication of future climate costs—is one reason why the current credit markets do not reflect climate credit risk. It will take specialized methods to assess the climate credit risks in financial portfolios in order to live up to these expectations. Thanks to the current efforts of working and supervisory groups as well as pilot programs among the banking industry, a number of approaches to quantify the impacts of climate-related risks on credit risk are under development, raising the question of what kind of approaches can financial actors mobilize for analyzing their exposure to climate risks?

This paper aims to give a thorough overview of the types of ESG risks, their interrelation with credit risk of the company and state-of-the-art approaches they can use, along with opportunities for future advancements.

The rest of the study is organized as follows: (1) part 2 briefly introduces the notion of ESG risks and how it turns into credit risk of the company; (2) part 3 contains an overview of methodologies available to estimate physical and transition risks and to integrate them into credit risk assessment. The final part of the research is the key findings and conclusions formulated.

2. ESG risks and their interactions with credit risk

2.1. ESG risks

The potential negative impact of climate change leads to a growing number of studies in the field of ESG risks and their effect on the financial stability by international climate risk scientists and policymakers, for example, with [1], [9] and [12]. The definition of ESG risk could be stated as follows: "the risk of a negative financial impact arising directly or indirectly from the effect that environmental ("E"), social ("S"), and corporate governance ("G") issues can have on the bank and its stakeholders, including customers, employees, savers, and suppliers" [13]. ESG factors can also have indirect effect in the way of negative impact on the performance or creditworthiness of a bank's counterparties [15]. More general definition was mentioned by [4] as "environmental, social or governance events or conditions, which if they occur have or may potentially have significant negative impacts on the assets, financial and earnings situation, or reputation of a supervised entity" [4].

The existing scientific literature contains two main types of sources of ESG financial risks, broken down by the impact on the economic activity of companies differentiated by industry, sector and region: transitional risks and physical risks, according to [14], [18], [19], [28], etc. The transition to a sustainable development economy and, as a result, to low-carbon production may require significant structural changes, according to [32], which creates transitional risks. Therefore, transition risk can be caused by (1) policy changes: environmental policies encouraging the use of environmentally sustainable resources, energy efficiency policies, taxes on fossil fuels causing price increases, etc.); (2) technological changes toward new, non-polluting technologies; (3) behavioral changes such as consumption moving toward more sustainable products. Companies from traditionally unattractive industries (for example, coal companies) may disappear after the transition due to reduced demand for their benefits, as well as increased production costs due to the introduction of policies on the transition to low-carbon production. On the other

hand, high-tech companies that are able to adapt to new conditions, on the contrary, increase their creditworthiness in a transitional period by increasing the competitiveness and, as a result, profitability of the company. According to [11], physical risks, in turn, have two sources: 1) natural disasters that arise as a result of sudden severe weather conditions or other ESG factors, and 2) gradual climate changes and shifts towards global warming, rising sea levels or constant changes in precipitation. [11] and [14] emphasize the possibility of reducing the productivity of factors, for example, reducing labor productivity or supply chain failures due to disasters or gradual changes in climate conditions. [30] states possible effect physical risk as the delay in obtaining cash flows caused by the delay in the construction of a project caused by, for instance, flooding.

Some papers highlight the third category of ESG risks – legal risks ([13], [28]). Legal risks are risks arising from losses or damage caused by ESG factors like non-compliance with ESG regulations, to businesses or employees. Table 1 presents all three categories of ESG risks broken down by environmental, social and governance nature:

Table 1. Types of ESG risks.

	Environmental (E)	Social (S)	Governance (G)
Legal risk	✓	✓	✓
Transition risk	✓	✓	
Physical risk	✓		

2.2. ESG risks interaction with credit risk

A credit risk is a risk assessed on the basis of borrower's overall ability to repay a loan according to its original terms and repayment schedule. Three dimensions play a key role in determining credit risk – the borrowers' capacity to generate enough income to service and repay its debt, capital and collateral available to back the loan: (1) borrower's cash flow, (2) borrower's financial wealth and (3) the value of the collateral [24]. As far as climate risks make an impact on all three dimensions and may result in higher probabilities of default (PD) and losses given defaults (LGD), climate-related risks are becoming material risk drivers.

According to [24], transition climate-related risk could impact all three dimensions in the following ways:

- Cash flows: through research and development (R&D) expenditures in new and alternative technologies, decrease in demand for carbon-intensive products and services, increase in production costs caused by changed input prices and output requirements, as well as costs on adaptation and deployment of new practices and processes.
- Capital and collateral: through potential re-pricing of stranded fossil fuel assets, as well as through changes in real estate prices caused by, for instance, more strict standards of energy efficiency.

[24] also noted the effect of physical climate-related risk on mentioned dimensions:

- Cash flows: through raise in operating costs caused by the need to source inputs from more expensive supplies and in capital costs caused by damage to facilities, decrease in revenue from reduced production capacity and lower sales caused by, for instance, demand shocks and transport difficulties.
- Capital and collateral: through write-offs of assets situated in high-risk locations, as well as through direct damages caused by extreme weather events.

Therefore, both transition and physical categories of ESG risks mainly have a negative effect on the creditworthiness of companies, but there is no agreement in the literature on the impact of each category ([2], [21],[22]). In addition, differences in impact are observed in the study of various countries, regions and sectors of the economy [8]. However, the studies agree that companies that improve their environmental performance should suffer less during the transition period, which is reflected in the lowest increase in the probability of default ([12], [16], [19], [20]). [30] in its work examines the relationship between climate and credit risk and asserts that climate risks negatively affect the creditworthiness of companies, emphasizing the importance of selecting the methodology and scope of the study.

3. Overview of methodologies to integrate ESG risk into credit risk assessment

The methodological framework for assessing the ESG risks impact on credit risk is at an early stage of development and have yet to be standardised [8]. However, current market practices employ a mix of approaches (e.g. forward-

looking methodologies and multiple scenario analysis) which involves simulations in order to forecast relevant variables ([6], [7]). Therefore, three main blocks of common methodological approach could be highlighted:

- Climate scenarios: the first step is to define scenarios of physical climate change and factors that will reflect the transition to a low-carbon economy management.
- Financial impact: scenarios identified in the previous block estimate climate change impact on the relevant for economic activities variables. In order to translate the effect into economic terms – reflection on cash flows and balance sheets, the direct and indirect economic impacts on the company should be estimated in this block.
- Financial impact translation into credit risk measures: finally, the effect of cash flows and balance sheets changes on company's creditworthiness should be assessed in terms of PD and LGD.

Fig. 1 shows lately updated climate scenarios framework by NGFS [27]. There are seven possible scenarios highlighted by NGFS in the dimensions of (1) Orderly scenarios which assume early introduction and progressive tightening of climate policies with both low transition and physical risks; (2) Disorderly scenarios investigate increased transition risks as a result of policies that are delayed or vary across countries and industries; (3) Hot house world scenarios presuppose that while certain countries adopt some climate policies, worldwide efforts fall short of what is needed to prevent significant global warming; (4) Too-little-too-late scenarios assume that physical risks will not be reduced by an unplanned, delayed transition.

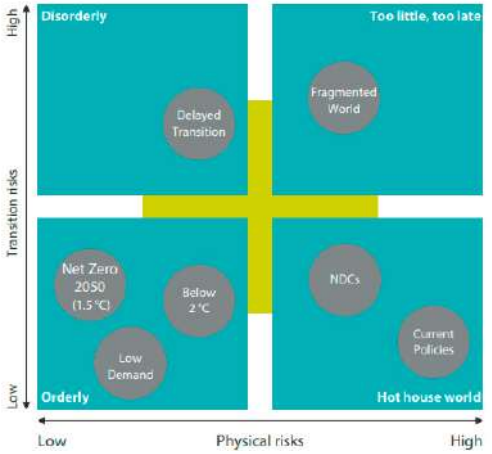

Fig. 1. NGFS scenarios framework. Source: Network for Greening the Financial System (2023).

Financial sector stress testing is a widely used technique to evaluate risk scenarios that could result in significant losses. It measures the vulnerability of a portfolio, a financial institution, or the entire financial system under various fictitious events or scenarios [29]. Stress tests are intended to predict the outcomes of financial sector variables in the event of unfavorable conditions that haven't yet materialized. By definition, stress testing examines the most extreme situations within the range of all potential outcomes. However, due to limitations in neoclassical economic modeling [22] and the possibility of unknown and highly non-linear "tipping points" occurring [3], traditional macro-financial stress testing approaches based on estimated GDP impacts may underestimate losses in adverse scenarios. Therefore, it is critical to develop new methods for stress testing climate risk.

[31] developed a 6-step approach to analyze the impact transitory-climate risk for firms by using climate stress test. Their approach summarizes such climate stress test approaches as top-down macro approach, bottom-up micro approach or any hybrid format.

Table 2. 6-step climate stress test approach.

	Definition
Step 1.	Define transitory risk scenarios. The top-down definition of broad scenarios as future climate situation in the world (i.e. NGFS scenarios, SSPs scenarios, etc.).

Step 2.	Break-down scenarios onto macroeconomic/sectoral level. The translation of scenarios defined on the first step into macroeconomic development of nations, regions or sectors that results in a projection of the economic development of countries or sectors on these scenarios.
Step 3.	Develop climate footprint & cost. The next stage is to compile the climate footprint and any possible associated expenses. These expenses frequently include CO2 emissions as well as any possible taxes or costs associated with them.
Step 4.	Calculate the impact on financial performance. The financial impact can be calculated once the carbon footprint and associated costs have been estimated. The result should be translated into firm's financial metrics such as, i.e., P&L, balance sheet items or financial statements.
Step 5.	Compute the impact on credit risk metrics. After integration of carbon footprint impact into the financial performance of the firm, the impact on common risk metrics (i.e., PDs, LGDs, ECL, etc.) should be calculated.
Step 6.	Calculate the impact on banks/financial sector - credit risk. Adjusted risk metrics calculated at the previous step could be integrated into the common stress test framework to compile the risk-weighted assets (RWA) and change in capital ratios (CET 1, Tier 1 etc.) after transitory-climate risk.

The use of climate scenarios and climate stress testing to quantify climate risks has not been widely used in scientific papers, although [33] identifies it as one of the main problems for the financial system. The reason is emphasized by [24], which presents the main methodological problems in combating the impact of climate risks on creditworthiness in various studies. The most important of these issues include understanding the shortcomings in the use of historical data, determining the impact of climate risks on each company and transforming traditional credit risk models into a wider horizon considering the future.

Also, [30] and [12] assume that using climate scenarios and working with forecast data rather than historical ones should lead to more reliable results. [30] emphasizes the main problems of the reverse approach: historically, companies that do not care about environmental indicators tend to have lower credit risks compared to greener companies, as evidenced by historical default levels. While the realization of climate risks expected in the future should consider the changed economic conditions and the reorientation of companies, which in turn could radically change the results of the study of the relationship between climate and credit risks. Therefore, although the [30] study uses historical estimates to determine the impact of climate risks on creditworthiness, it emphasizes the importance of considering future climate risk forecasts, which will improve the accuracy of the assessment and may lead to fundamentally different results. [5] substantiates the need to mitigate negative climate consequences caused by extreme weather changes. Studies to assess future climate change are being conducted by such international agencies as [26], Intergovernmental Panel on Climate Change (IPCC) [25] and others. The use of climate change scenarios is supported by the relevance of their inclusion in the long-term assessment of economic impacts, climate risks and other related variables. [23] explore scenarios consistent with those established by the Network of Central Banks and Supervisors for Greening the Financial System (NGFS) which are called "Orderly, Disorderly, and Hot House World scenarios". [17] extended the macroeconomic forecasting work of [23] by adapting Moody's Analytics Climate Adjusted expected default frequency (EDF) framework for application to corporate credit which provides a consistent, transparent, and customizable means for analysing physical and transition risks' impact on companies' credit risk [10].

A study led by the Bank of France [2] considers the main problems of climate/credit risks and uses NGFS climate scenarios [26], as well as attempts to forecast real value added and the probability of default for a number of different sectors depending on the level of emissions. Work by [2] can be considered as the closest study in the field of forecasting default probabilities (PD) using these climate scenarios. The study identified significant losses in the profitability and creditworthiness of carbon-intensive industries as a result of the implementation of sudden transition scenarios, while moderate scenarios with a more delayed scheme affect less. It also suggests that France's oil, agricultural and mining industries are most vulnerable to changes in added value and the likelihood of default as a result of increased CO2 emissions, according to [2].

Thus, while the impact of climate risks on credit quality is of primary importance to regulators, there are unexplored issues in the methodological approach that lead to constantly changing outcomes and reaffirm the relevance of studying the economic impacts of climate change.

4. Conclusion

As the above analysis shows, ESG risks in general and climate-related risks specifically have an impact on the traditional financial risks, thus treating their consideration as fundamental drivers of categories like credit risk, market risk, liquidity risk, etc. Furthermore, companies are urged to incorporate climate risks into various aspects of their operations, including business model analysis, strategy formulation, financial planning, governance, risk appetite definition, and disclosures.

In terms of quantification, the methodological approaches for assessing the influence of climate risks on the creditworthiness of companies are still at the early stages of development, requiring further analysis and enhancements in the years ahead. Various challenges, such as broadening the scope of models, developing climate scenarios for financial risk assessment, addressing issues related to the lack of granular data, identifying pertinent metrics for climate risk exposure, and adjusting existing risk tools for climate risk modeling, need to be addressed.

In conclusion, there are still a lot of unknowns, so the shift to a low-carbon economy will take time. However, businesses will be better equipped to reduce the transitional and physical risks associated with climate change the sooner they begin to modify their actual business models and risk management frameworks. Besides, it will be simpler for businesses to adjust and support their operations once the possible risks and opportunities brought about by climate change and transition to low-carbon economy are more fully evaluated and comprehended.

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Responsible financing and investment: identification, development, and assessment of Environmental, Social, and Governance (ESG) metrics

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ABSTRACT

Globally, the Environmental, Social, and Governance (ESG) movement is gaining significant attention. The existing frameworks need to be more standardized and applicable to socio-economic dynamics. A three-phased approach was developed comprised of a comprehensive review and a research survey involving 62 experts. The results showed that the environmental component is ≈5–14 % more important than the social and governance components. The design, operational life, and material sourcing are relatively more important (i.e., ≈14–20 %) than the project type. Risks related to water and air pollution are ≈34–38 % more important than solid wastes. This research offers insights into ESG criteria and metrics.

1. Introduction

Environmental, Social, and Governance (ESG) criteria are a set of metrics or standards that companies and investors consider when deciding on their operations and investments concerning risks, impacts, and opportunities. Investors and lenders use ESG metrics to evaluate the companies' performance, while customers and other stakeholders use ESG-based information to know about a company's environmental and social practices to advocate their purchasing decisions [14,17]

The environmental component of ESG looks at business operations' impact on the natural environment, including climate change, biodiversity loss, carbon management, water pollution and consumption, waste management, energy, and land use. The social component describes the employee situations in the company, their relationships, and the impact of companies' products, services, and operations on society. The governance component examines the company's management, transparency, and ethical practices [18].

ESG was first recognized by the United Nations (UN) in their Principles for Responsible Investment (PRI) report in 2004, using the concept of "Who Cares Wins". The ESG component has gained attention due to increased awareness of climate change and social inequality, particularly in emerging global economies [33]. The expansion of the ESG paradigm after the 2008 financial crisis led to the emergence of new thematic and social impact investment firms. It created new avenues for responsible and impactful investing that align with ESG principles and positively impact society.

ESG has now become an industry with various standards developed and applied by governments, finance firms, and corporations to demonstrate their contributions to responsible investment. As of May 2021, over 2500 signatories representing more than $80 trillion in assets under management (AUM) have signed up and endorsed ESG principles and practices. The widespread adoption of ESG principles and practices has made it increasingly ubiquitous in the corporate landscape, with almost 20 % of earnings calls mentioning ESG metrics. This reflects the importance of ESG metrics in managing risk, adopting sustainable business practices, supporting socially responsible initiatives, and achieving required financial performance while promoting positive environmental and social outcomes [21,33].

The World Bank in 2008 launched the first 'green bond', a new financial instrument designed to provide fixed-income securities for projects with specific environmental benefits. Green bonds offer investors an ethical and stable investment opportunity by providing access to capital for environmentally friendly projects [35]. Green bonds contributed to global efforts to mitigate the effects of climate change and promote sustainable development [15]. Studies have shown that funds invested based on ESG principles demonstrated greater resilience to market volatility due to better risk management, more awareness of social and environmental parameters, strong governance, and sector diversification [24]. Green bond use has now expanded to 80 countries and has been adopted in various development sectors. The market for

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these bonds reached a record of $470 billion [31].

The signing of the Paris Agreement in 2016 was another historic milestone in the global fight against climate change, with signatories committing to limiting global warming to well below 2 °C at pre-industrial levels. As a result of this agreement, a wave of investors and companies signed up for ESG principles and practices [27], and sustainable investments and assets grew by 15 % between 2018 and 2020 [13]. With these developments, ESG's role has become more crucial in investment decisions, as companies that fail to adopt ESG principles may be at risk of losing potential investors who are more socially and environmentally conscious [19].

Several organizations have developed standards and frameworks in response to the growing demand for ESG data and disclosure. Global Reporting Initiative (GRI) and the Sustainability Accounting Standards Board (SASB) have developed widely accepted standards for reporting ESG metrics [25]. Furthermore, governments worldwide are introducing measures to adopt ESG frameworks to promote transparency and accountability and are encouraging companies to take a more holistic view of their impact on society [11].

The effective implementation of ESG principles, practices, and reporting requirements is still lacking due to variations in reporting standards across different regions and jurisdictions, as discussed in Section 2.3. Therefore, this study intends to establish and prioritize selected ESG metrics through survey research by involving knowledgeable individuals from different sectors. By integrating an expert opinion, this study lays a foundation for establishing a generalized and comprehensive knowledge base on ESG criteria and metrics. The outcome of this study can assist companies, governments, and decision-makers in developing their ESG-based performance scale to navigate their impact on society and systems under given socio-economic settings.

2. ESG metrics and reporting

The section provides brief background literature on existing ESG frameworks, guidelines, and metrics established until now. It also discusses the challenges in ESG reporting and the importance of conducting survey research to develop a uniform reporting system.

2.1. ESG standards, frameworks, and metrics

Organizations have developed ESG frameworks, as discussed. The International Financial Corporation (IFC) corporate governance framework provides a holistic approach that considers technology, strategy, organization, and culture to strengthen the board structure and improve transparency and accountability. The framework also develops strategies and policies to enhance risk management and compliance efforts. Adopting the IFC corporate governance framework and following standards can help companies increase their disclosures to investors and other stakeholders through the Disclosure Toolbox [18].

Equator Principles (EPs) are another set of standards that financial institutions can adopt to determine, assess, and manage environmental and social risk in project financing. The EPs provide a benchmark for determining whether a project is financially and socially sustainable. They also help navigate projects to adhere to applicable laws, regulatory requirements, and industry best practices. The EPs broadly cover stakeholder engagement and consultation, assessment of potential project impacts, environmental and social management plans, and monitoring and reporting [9].

The World Economic Forum (WEF) has recently created a diverse set of ESG metrics to support investors in better analyzing, measuring, and understanding the impact of their investments. The ESG metrics cover climate change, environmental performance, social inclusion, diversity, and governance. The metrics address aspects such as pollution and hazardous waste management, biodiversity preservation, respect for labour laws, and responsible supply chain management [34].

The PRI is an international network that supports investors in better managing environmental, social, and governance risks. PRI focuses on integrating ESG factors into the decision-making and analysis of investments to enhance long-term value [29].

The European Union (EU) has also developed an environmental taxonomy to provide a set of criteria to distinguish environmentally sustainable investments. The investments are categorized based on six overarching environmental objectives: climate change mitigation, adaptation, preservation of water and marine resources, circular economy, pollution prevention, and protection of biodiversity and ecosystems. The taxonomy also outlines technical screening criteria to ensure that investments are labelled "green" and meet the requirements for public and private funding [10].

All these standards, principles, and metrics provide guidelines that can better assess the ESG risks and potential impacts of projects and investments.

2.2. Relative importance of established ESG indicators

Organizations identified and established the relative importance of various ESG indicators. For example, EFFAS [8] identified 25 key performance indicators to evaluate ESG performance. The indicators are split into five categories: economic, environmental, social, corporate governance, and stakeholder relations. The indicators measure corporate activities or policies in these categories, ranging from employee satisfaction to energy efficiency and waste management. Similarly, Thomson Reuters [32] have developed key performance indicators for ESG using 400 data points and several ESG measures. The indicators were further grouped into 10 categories: 3 categories of environmental components, 4 social components, and 3 governance components. The categories and their relative importance are presented in Fig. 1.

In 2018, the quantum advisors weighted ESG metrics such as governance (50 %), environmental (25 %), and social (25 %). Besides, the global and domestic systemically important banks in North America, Europe, and Asia have identified governance with relatively high importance, i.e., 60 %, followed by social components (25 %) and environmental components (15 %) [26]. The governance aspect includes culture, risk management, accounting quality, board quality, and human capital. The social components include regulatory requirements, product safety, customer privacy, and data security. The environmental component for these systemically important banks includes sustainable lending impacts, environmental and sustainability plans, and green bond insurance [26].

DFIN [6] incorporates the ESG criteria by considering 10 themes and 37 ESG issues. Among established themes and issues, the critical ones, along with their relative importance (%) are environmental impact (26 %), political contribution (23 %), greenhouse gas emissions (23 %), diversity (22 %), and sustainability (21 %). The Alternative Capital Partners [1] evaluates the ESG performance by considering 7 components, i.e., management (10 %), policy & disclosure (11 %), risk & opportunity (30 %), monitoring (14 %), stakeholder engagement (4 %), performance indicators (28 %), and certificates and rewards (3 %).

Mirova [23] also developed a multidimensional framework to evaluate the ESG performance of investments. The framework considered investments from a risks-based and life-cycle perspective and included both listed and unlisted investments. The framework categorizes investments based on climate change, ecosystem services, employment, and gender/ethnicity inclusion. The knowledge base on ESG and the accompanying literature provides important insights into global trends and practices. These frameworks can guide the decision-makers to identify and evaluate the potential outcomes of the investments and ensure their alignment with specific sustainability goals.

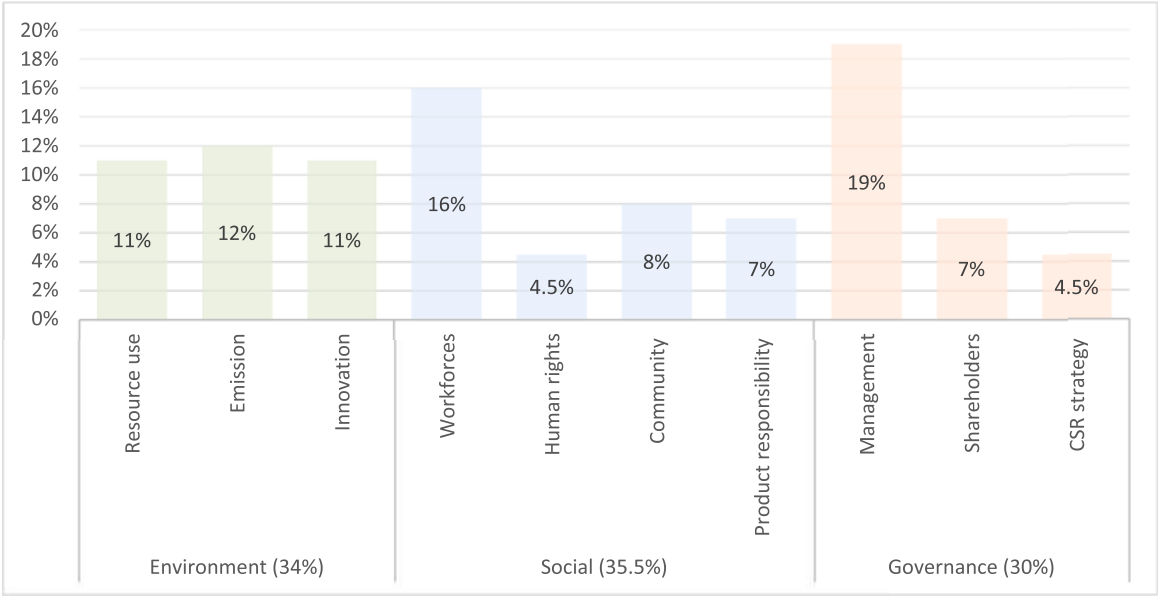

Fig. 1. The relative importance of performance indicators (Thomson [32]).

2.3. ESG reporting challenges

Organizations have become increasingly aware of the importance of sustainable practices and social responsibility, so the demand for comprehensive ESG reporting has grown. Initiatives, frameworks, and criteria have been established, as discussed above. However, the effective implementation of these reporting requirements can be impacted by several factors [4,20].

- Variations in reporting standards across different regions and jurisdictions make it difficult to apply a generalized reporting system that aligns with all applicable regulations and standards. This challenge is compounded by the significant resources required to conduct a complete ESG.
- ESG-based data is currently underdeveloped and may be scattered due to different reporting standards. Additionally, self-reported data from companies can be incomplete or inaccurate, not reflecting a company's true ESG performance or reporting.
- Data collection and reporting itself can be time-consuming and require a certain skill set to ensure accuracy and quality. Further, due to limited subject matter experts and complex stakeholder requirements, it is impossible to validate any available data and progress toward implementing a generalized reporting system.

Therefore, expert surveys can be useful for eliciting opinions from knowledgeable individuals on specific areas and highlighting critical factors. Integrating expert opinions into existing ESG criteria can develop a more generalized and comprehensive knowledge base, guiding decision-makers in selecting relevant ESG metrics to measure progress, ensure compliance with relevant regulations, and establish standardized best practices.

2.4. Survey research

Questionnaires and surveys are useful for integrating large populations or experts' opinions. In survey research, it will always be tempting to take a non-specific approach and ask as many questions as possible; however, this approach does not work as asking too many irrelevant or incoherent questions reduces the response rate [30]. Therefore, it is important to carefully identify critical information and the right participants to extract useful results. The survey distribution and response should be significant to draw reliable conclusions. Therefore, it should follow the central limit theorem (CLT) guidelines.

The CLT states that the distribution of a sample variable approximates a normal distribution as the sample size becomes larger, assuming that all samples are identical in size regardless of the population's actual distribution shape. This allows for easier statistical analysis and inference. Generally, a sample size of 30 is reasonable, as it will increase the confidence interval of the data set to support the findings and arguments. Studies have also suggested that around 5–50 participants are adequate to conduct qualitative studies depending on the research type and questions [5,7]. Nevertheless, the information extracted from the survey needs to be integrated using decision-making techniques to draw simple and interpretable outcomes [12].

2.5. Decision-making process

Decision-making is a cognitive problem-solving process that ends when a satisfactory solution is reached. For selecting or prioritizing alternatives, the decision-makers often encounter tangible and intangible conflicting criteria (i.e., environmental, social, and governance) due to real-world complexities [22]. Therefore, multicriteria decision-making (MCDM) techniques have been widely used to evaluate different factors or criteria. In MCDM techniques, a numerical value is assigned to highlight the importance. The analysis of weight and interpretation of results depends on the selected technique, as each technique has a different basis and assumptions. The utility-based methods, i.e., analytical hierarchy process, multi-attribute utility theory, and weighted sum method (WSM), give a single score for each alternative, requiring all the alternatives to be directly comparable. Among these utility-based methods, the WSM is preferred over other methods, as it is simple and less severe than other approaches [2].

The model for the WSM is provided in Eq. 1

$$WS = \sum_{i=1}^{N} W_i S_i \tag{1}$$

Where; WS = weighted score; N = number of indicators to be aggregated, S_i category value i;W_i = weight allocated for the indicator i. The weighted sum method was applied to interpret expert responses using the rank categories (defined Likert scale) as shown in Table 1.

Table 1
Likert scale.

Scale	Score	Description
Very Low	1	The component has a very low impact on overall risk
Moderate	3	The component has a moderate impact on overall risk
High	5	The component has a high impact on overall risk
Very High	7	The component has a very high impact on overall risk

Risk: refers to risk to ESG values.

3. Proposed assessment framework

Fig. 2 shows the proposed framework to identify and establish the relative importance of various ESG criteria and metrics. The framework is broadly comprised of a three-phase process, as discussed in the following paragraph.

In phase 1: Content analysis on global ESG pillars, criteria, standards, principles, and metrics was conducted to establish up-to-date knowledge. This is followed by a forensic review of an existing assessment tool (provided by ESSAFIN logic – a leading ESG consultant and service provider). Content analysis of global practices on ESG and review of existing industrial tools provide the lens of science and the on-ground situation.

In phase 2: Following the review in phase 1, a questionnaire was designed based on existing trends of ESG, industrial practices (using ESSAFIN's tool and expert support), and currently applicable domains, i.e., life cycle thinking, climate effects, natural hazards, risk characterization, regulatory settings, primary assessment, and community engagement. The questions were mapped in generalized and specific contexts to extract information from experts in different fields such as engineering, finance, government, health, social, etc.

Before proceeding with a survey, formal approval from the University of British Columbia Human Research Ethics Board was taken to protect the research participants' dignity, rights, and welfare. The Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans Course on Research Ethics (TCPS 2: CORE) was also completed by the individual(s) involved in the survey and communicating with the participants. Furthermore, *consent* and *recruitment letters* were prepared. The *consent letter* provides a brief study summary, including sponsor, study purpose and procedure, questionnaire, potential risks and benefits, confidentiality, and the contact details of the research team. This letter is evidence of a participant's agreement to be involved in the study. It describes that "*taking part in this study is voluntary. You have the right to refuse to participate in this study. If you decide to participate, you may choose not to answer any questions in the interview. You may withdraw from the study at any time without giving a reason and without any negative consequences to your employment or your relationship with the interviewer, UBC Okanagan, and/ or any other entity related to the study. If you withdraw from the study, the data you provided shall not be used. By completing the questionnaire, you consent to participate in this research*". Furthermore, the *recruitment letter* highlights the study's primary objective and the research team's contact details. It alerts the respondents that you have been recruited for this research by participating in the survey.

Following the research ethics board approval, the research team identified survey cohort represents a broad spectrum of professionals

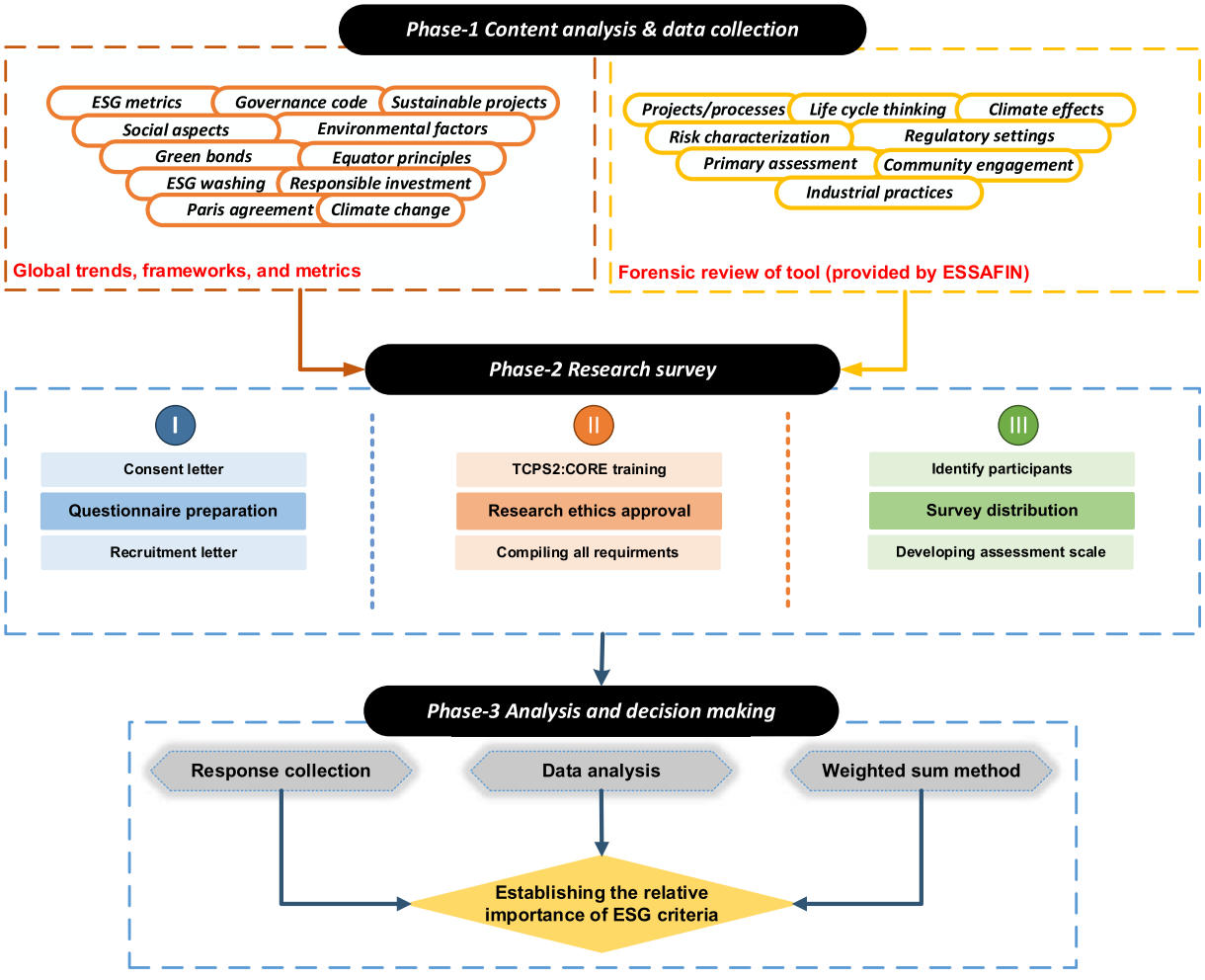

Fig. 2. Proposed assessment framework.

working in academia, consulting, government, manufacturing, health and safety, and the business development industry. Among these sectors, the participants selected have expertise in finance, supply chain, risk and toxicology, marketing and investments, engineering, and environmental governance. The survey was distributed to 62 experts from the above-mentioned sectors and backgrounds. The professional experiences of selected participants ranged between 5 years to 40 years, with the average cohort experience being 19 years. 52 % of participants have ≥20 years of performance experience, whereas 48 % have <20 years of experience. The participants were contacted via email or a Qualtrics survey tool and given the option to have a telephonic, one-on-one interview. The questionnaire was designed to take 10–12 min to complete. The questionnaire consisted of 16 questions mapped to evaluate different pillars and criteria for ESG risk analysis. A Likert four-point scale was also established for the respondents to evaluate various ESG pillars and criteria, as shown in Table 1. The sample questionnaire for the survey is provided in Appendix A1.

In phase 3: The individual results were collected and analyzed, and the responses for each question were mapped using 100 % stacked bar graphs. Furthermore, a WSM method was applied to generalize the responses and establish the relative importance of assessed ESG criteria by assuming two scenarios. The scenario-based analysis was applied only in situations where multiple aspects or criteria were considered altogether. In scenario 1, the response received considering all rank scales *(i.e., very low, moderate, high, and very high)* and their respective percentage were collectively assessed. Whereas in scenario 2, the responses of only *high* and *very high* scales were analyzed. The results from both scenarios were combined using probabilistic analysis to establish the relative importance of ESG criteria. The relative importance was presented in range (minimum to maximum) instead of a single value. Furthermore, the 10th and 90th percentile values from a probabilistic analysis were considered as lower and higher end of the provided range, respectively.

The collected response and detailed analysis are provided in the following section.

4. Results and discussion

In total, 44 respondents provided feedback, showing that the results are statistically significant (sample size >30), reflecting high-quality, reliable, and accurate data to draw meaningful conclusions. Among the respondents, 50 % were from engineering and environmental governance backgrounds, 29 % were from financial backgrounds, and 21 % were from the social sector. Furthermore, ≈19 % of participants were from academia. Out of various ESG criteria and pillars assessed in the survey, the analysis of more critical ones (10 out 16) is presented in the main manuscript, whereas the remaining (6 out 10) are provided in Appendix A2.

4.1. Relative importance ESG pillars in investment decisions

Fig. 3 provides the response recorded from the survey.

>85 % of respondents ranked environment as *high* to *very high*, 75 % ranked social as *high* to *very high*, and ≈71 % ranked governance aspects as *high* to *very high*. The environmental component was ranked slightly more important compared to the social and governance components. Based on scenario analysis as discussed in Section 3 (phase 3), scenario 1 weight the social and governance criteria 5 % less than the environment. Whereas, in scenario 2 (considering only *high* and *very high* scale), the social and governance components were identified as 12 % — 14 % less important than the environment. Table 2 provides a relative comparison of ESG components.

A variation in the importance of ESG components still exists as discussed in Section 2.1. Several studies have identified that the environmental component is more important, whereas studies have also identified the social and governance component as relatively more important.

4.2. Importance of life cycle stages in evaluating risk to ESG values

Fig. 4 provides the response recorded from the survey on the mentioned aspect.

As per Fig. 4, >89 % of respondents ranked the design as *high* to *very high* in evaluating risk to ESG values, 82 % of respondents ranked material sourcing and operational life as *high* to *very high,* and ≈68 % of respondents ranked project type as *high* to *very high*. Among the critical life cycle stages, i.e. 46.4 % of respondents ranked operational life as *very high*, whereas ≈39 % ranked design and material sourcing as *very high*. Table 3 provides the relative importance range of various life cycle stages using the considered scenarios.

The design phase is considered the most critical in evaluating the ESG risk, followed by operational life and material sourcing. It is important to note that except for the project type (relative importance

Table 2
Importance of individual ESG components.

Environment	Social		Governance	
Maximum	↓	5–12 %	↓	5–14 %

Note: Environment has a relatively high importance, whereas the social and governance components are less important by 5–12 % and 5–14 %, respectively.

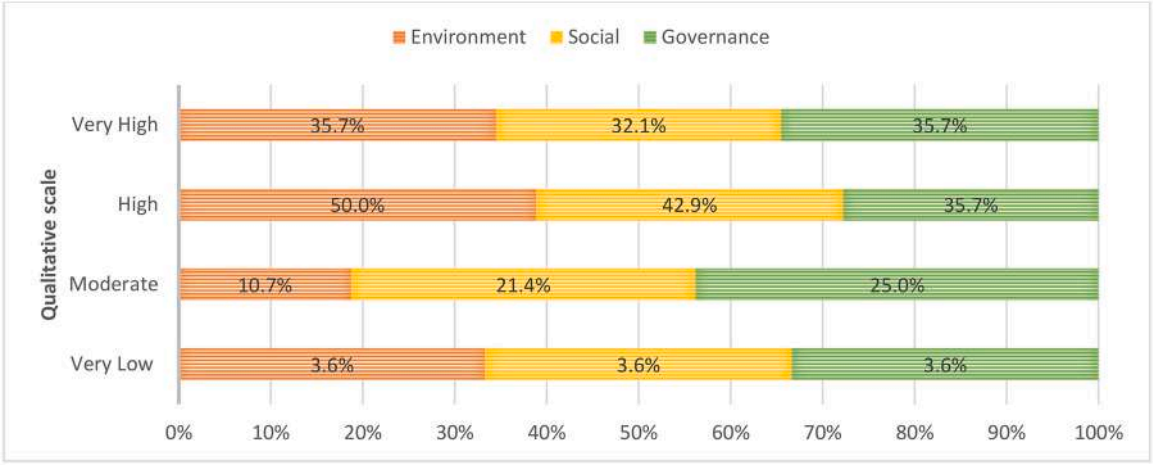

Fig. 3. Responses on the importance of ESG criteria.

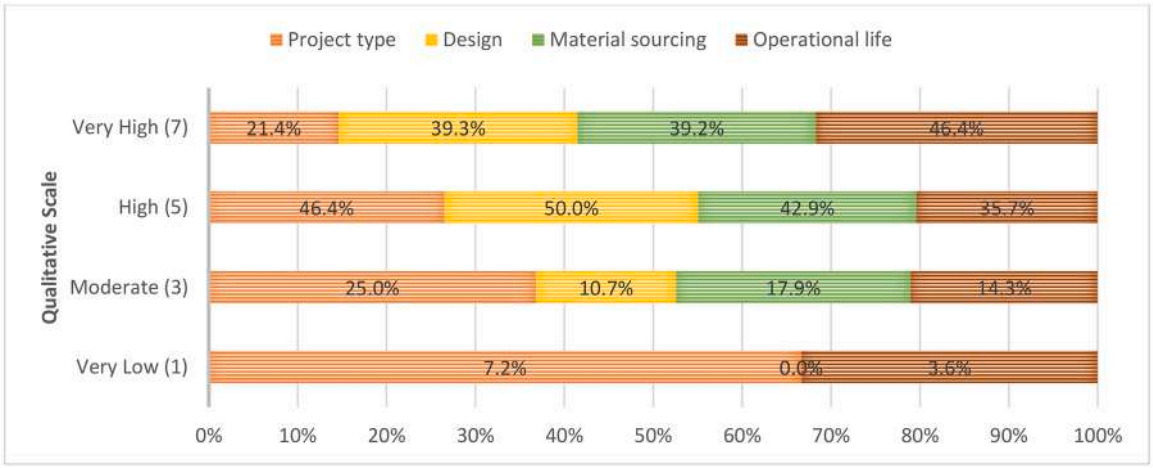

Fig. 4. Responses on the importance of life cycle stages.

Table 3
Importance of life cycle stages.

Design	Operational life	Material Sourcing	Project type
Maximum	1–4 %	3–7 %	17–27 %

Note: Design has relatively high importance, whereas operational life, material sourcing, and project type have lower importance by 1–4 %, 3–7 %, and 17–27 % respectively.

lower by 17–27 % compared to maximum). No prominent difference in the relative importance of other life cycle stages was observed. This indicates that design, operational life, and material sourcing are critical in assessing the ESG risk of the project or process.

4.3. *Effectiveness of available control technology to mitigate the impacts*

Fig. 5 provides the response recorded in terms of the effectiveness of control technology.

The results showed that ≈46 % of respondents believe that mitigation technology is effective (*high to very high*) in reducing the impacts and minimizing the ESG risk, whereas ≈43 % of respondents believe that control technologies are *moderately* effective in mitigating the ESG risks. Around 10 % of respondents believe that control technology is *less* effective in mitigating ESG risks. The scenario analysis was not applicable in this case.

4.4. *Relative importance of risk characterization factors in ESG*

The response to rank the various risk characterization factors, i.e., surface contamination, terrestrial habitat, aquatic habitat, and sensitive species impact, is provided in the following Fig. 6.

As per Fig. 6, ≈90 % of respondents ranked sensitive species as *high* to *very high*, whereas the aquatic and terrestrial habitats were ranked *high* to *very high* by 86 % and 82 %, respectively. Around ≈79 % of respondents ranked surface contamination as *high* to *very high*. Table 4 provides a relative comparison of different risk characterization factors based on scenario-based evaluation.

The impact on sensitive species is most important, followed by aquatic habitat impacts (lower by 4–6 %). The terrestrial habitat and surface contamination impacts have relatively low importance i.e., 7–15 % in evaluating the ESG risk values. Different governments and states have developed best management practice documents to produce special and sensitive species, highlighting their importance during risk characterization [3,16,28].

4.5. *Importance of various ecological accounting indicators*

- Direct physical impact
- Indirect physical impact
- On-site compensation

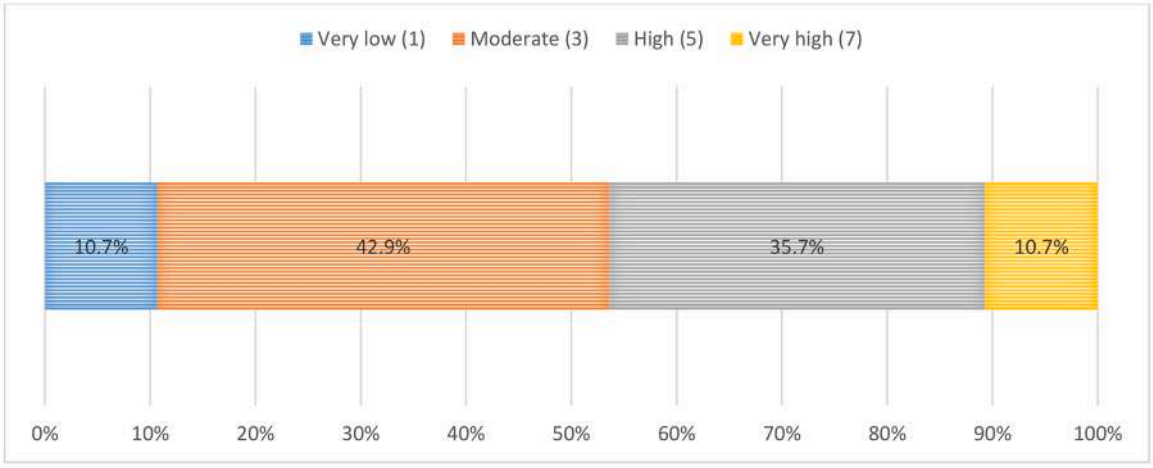

Fig. 5. Effectiveness of control technology in mitigating the risk.

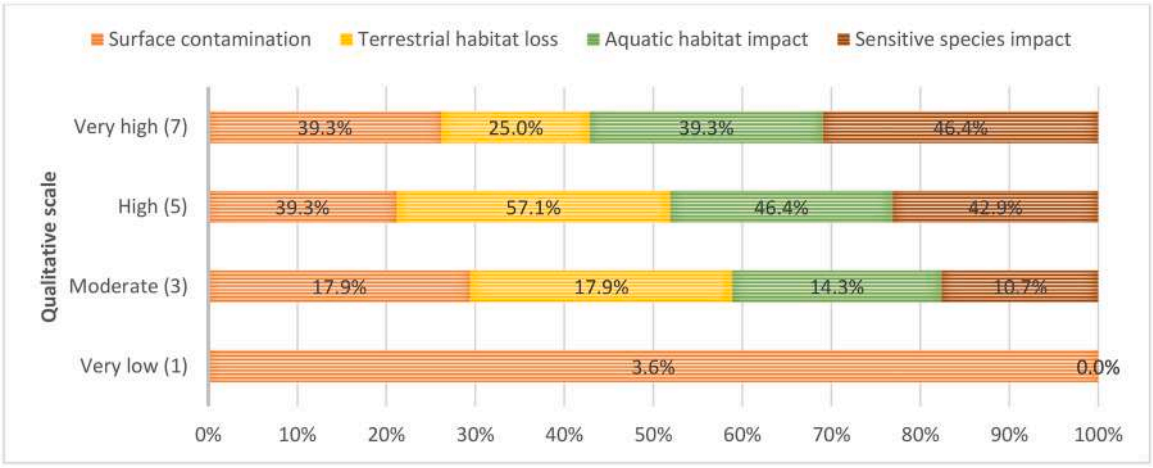

Fig. 6. Responses on risk characterization factor importance.

Table 4
Relative importance of risk characterization factors.

Sensitive species	Aquatic habitat	Surface contamination	Terrestrial habitat
Maximum	4–6 %	7–13 %	10–15 %

- Off-site compensation
- Financial compensation

Fig. 7 provides the response recorded on ecological accounting indicators.

According to the survey, ≈80 % of respondents ranked on-site compensation and direct physical impact as *high* to *very high*, whereas ≈70 % ranked indirect physical impact as *high* to *very high*, respectively. The other ecological accounting indicators considered were given relatively low importance in evaluating the risk to ESG values. The scenario-based comparison is provided in Table 5.

Overall, it was observed that direct physical impacts and on-site compensation are more important in evaluating the ESG risk of a project or a process. Other aspects, such as indirect physical impacts and financial and off-site compensation, were identified as relatively low on the importance scale. Therefore, on-site compensation and direct impact can play a major role in evaluating the risks and opportunities of the projects.

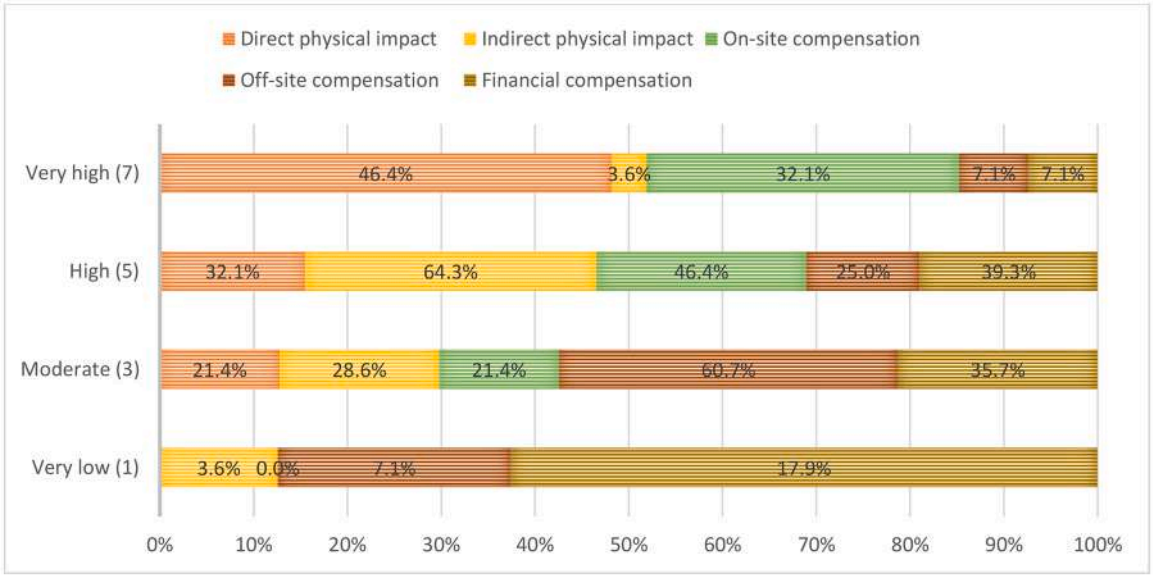

Fig. 7. Response on the importance of ecological accounting indicators.

Table 5
Relative importance of ecological accounting indicators.

Direct physical impact	On-site compensation	Indirect physical impact	Financial compensation	Off-site compensation
Maximum	5 %	20–29 %	32–49 %	33–64 %

4.6. Importance of consulting the local community

Fig. 8 provides the response recorded on the importance of consulting the local community.

75 % of respondents believe it is *very important* to consult with the local community, whereas 25 % of respondents believe it is *important* to consult with the local community. No respondent ranks this aspect as moderate or low, indicating the overall value of consulting the local community in evaluating the ESG risk when making decisions on projects and investments. The scenario analysis was not applicable in this case.

4.7. Importance of engaging the local Indigenous people

Fig. 9 provides the response recorded on the importance of engaging local Indigenous people.

>95 % of respondents rated consultation and engagement with local Indigenous people as *high* to *very high*, reflecting the importance of this aspect in conceptualizing the proposed project and assessing the ESG risk. The scenario analysis was not applicable in this case.

4.8. Importance of risk characterization factors

- Chronic air pollution
- Chronic water pollution
- Solid waste generation

Fig. 10 provides the response recorded on selected risk characterization factors.

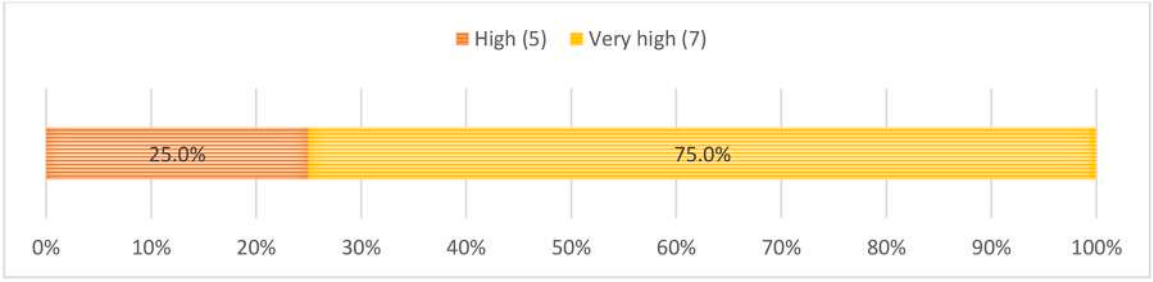

Fig. 8. Response on the importance of consulting the local community.

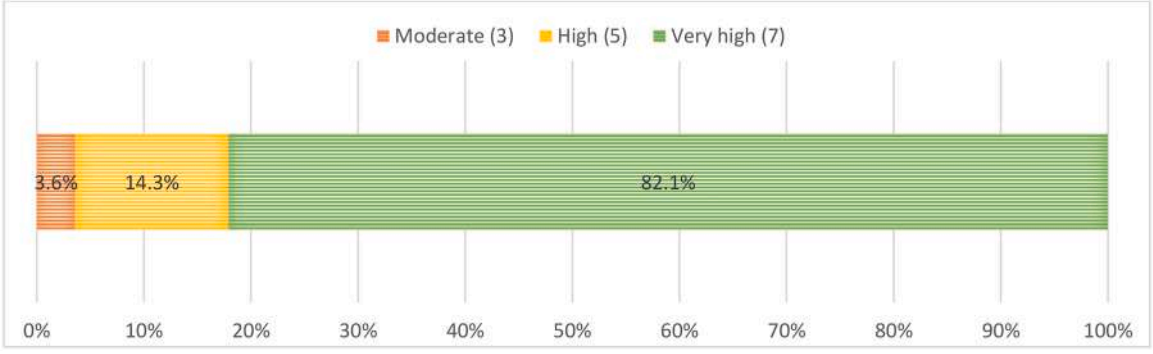

Fig. 9. Response to Engaging Local Indigenous People.

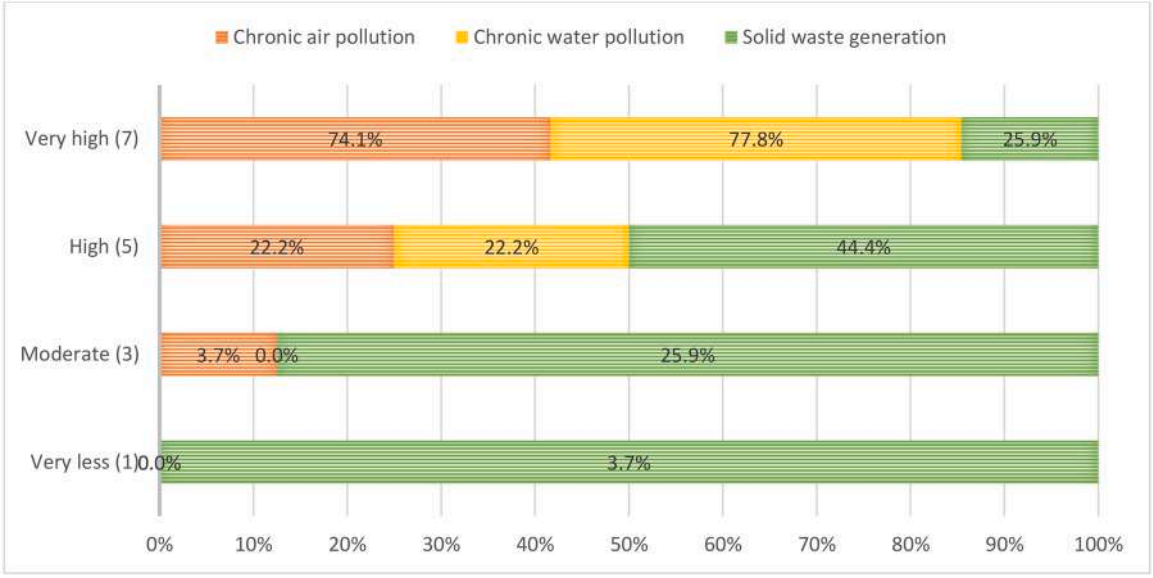

Fig. 10. Response of selected risk characterization factors.

Table 6
Relative importance of risk characterization factors (operational phase).

Water pollution	Air pollution	Solid waste
Maximum	4 %	38 %

All participants ranked water pollution as high to very high, indicating the importance of water pollution in evaluating the risk to a project or process. Similarly, ≈96 % of respondents ranked air pollution as *high* to *very high*. The solid waste generated was given relatively low importance compared to air and water pollution; it was ranked *high* to *very high* by 70 % of respondents. The scenario-based analysis provides the relative importance of risk characterization (operational phase) factors, as shown in Table 6.

In this case, the WSM results are given for the *high* and *very high* categories, as the respondents gave no to low weightage or response to *very low* and *moderate* impact categories. Therefore, single values were provided in the table instead of the range.

4.9. Importance of environmental and social guidelines in reducing the ESG risks

Fig. 11 provides the response recorded on the importance of having guidelines.

The survey results showed that ≈30 % of respondents ranked the environmental and social guidelines as *highly* important in managing ESG risks. At the same time, ≈45 % of respondents ranked environmental and social guidelines as *moderately* important. Therefore, environmental and social guidelines were recognized as moderately important in reducing ESG risks. The scenario analysis was not applicable in this case.

4.10. Importance of various assessment factors

- Baseline environmental studies
- Archaeological aspect
- Culture and heritage value
- Socio-economic aspect
- Consideration of alternatives

The Fig. 12 provides the response recorded various primary assessment factors.

According to the survey, ≈89 % of respondents ranked baseline environmental studies and socio-economic impacts as *high* to *very high*. Whereas ≈75 % ranked consideration of alternatives and culture and heritage values as *high* to *very high*. Archaeological aspects were ranked *high* to *very high* by ≈63 % of participants. The scenario-based analysis results are provided in Table 7.

The baseline environmental studies are identified as critical in

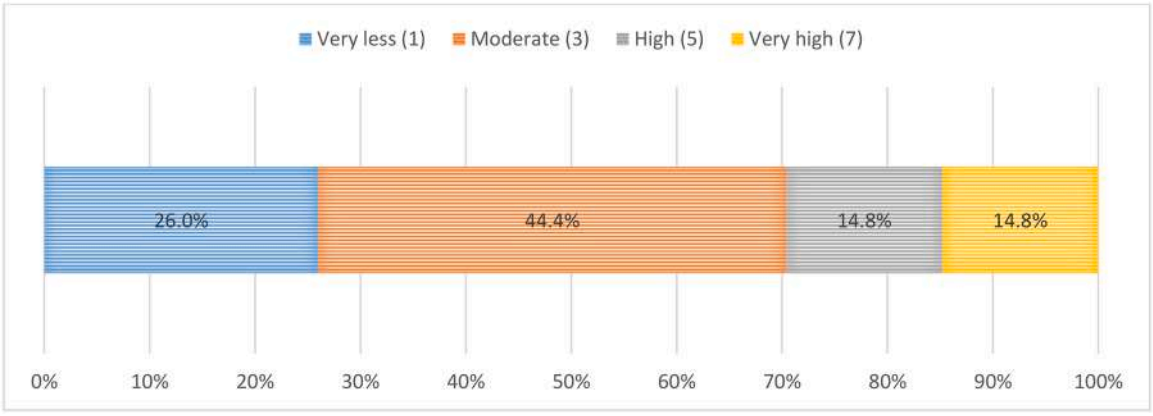

Fig. 11. Importance of having environmental and social guidelines.

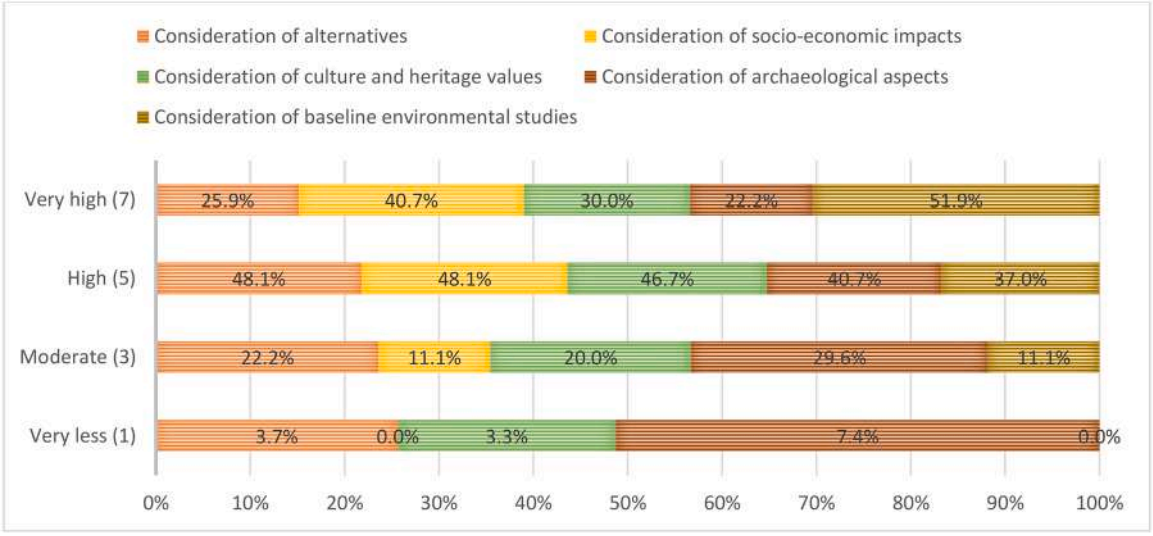

Fig. 12. Response to the importance of various primary assessment factors.

Table 7
Relative importance of primary assessment factors in evaluating the ESG risk.

Baseline environmental studies	Archaeological aspects	Cultural and heritage value	Socio-economic impacts	Consideration of alternatives
Maximum	17–28 %	13–19 %	3–4 %	15–23 %

decision-making during the early planning stage, followed by socio-economic impacts (lower by 3–4 % importance). The other factors were identified as relatively low, evaluating the risk to ESG values of projects.

The results of the adopted framework, survey research, and data analytics can facilitate establishing baseline ratings based on selected ESG criteria, depending on their significance for the given trades and stakeholders. The established relative importance of selected ESG criteria in this research needs to be further validated by applying them to diverse sectors and industries to gain valuable insights. These iterative validation processes can assist in refining the ESG rating systems.

5. Roadmap and future development

Companies and investors are inclined to adopt ESG practices and establish guidelines. ESG is likely to be driven by some critical factors, i.e., regulatory changes, investor demand, technological advancements, and societal expectations. There may be many other factors that will contribute to the development of the ESG industry. Accordingly, to the author's best knowledge and understanding, the ESG will be integrated into mainstream finance in three phases, i.e., near-term, mid-term, and long-term, as shown in Fig. 13.

In the near-term, the global inclination will be towards standardizing ESG reporting and disclosure frameworks. The Task Force has made developments on climate-related financial disclosures (TCFD) and the SASB to establish consistent metrics and guidelines for reporting. There will be more emphasis on enhanced data collection, validation, and analysis with the support of artificial intelligence, machine learning, and blockchain to generate accurate ESG trends. These trends and data will enable the decision-makers to develop and conduct reliable and applicable ESG rating mechanisms. Given the urgency of addressing climate change issues, a continued focus will likely be on transitioning to a low-carbon economy. This may involve increased investment in renewable energy, energy efficiency, sustainable transportation, and other climate mitigation and adaptation measures.

The mid-term developments, with some preliminary ESG rating systems and evaluations in hand, will likely focus on strengthening the existing regulations. Governments and regulatory bodies will focus on introducing more stringent regulations and mandatory reporting requirements. This could include addressing climate change, enhancing social governance, and encouraging responsible business practices. Diversity and inclusion, human rights, labour practices, responsible sourcing, and community impact will likely receive heightened attention within the ESG landscape. More investors and stakeholders will recognize the values of ESG criteria and rating. This will likely work towards developing a reputation in terms of the long-term sustainability

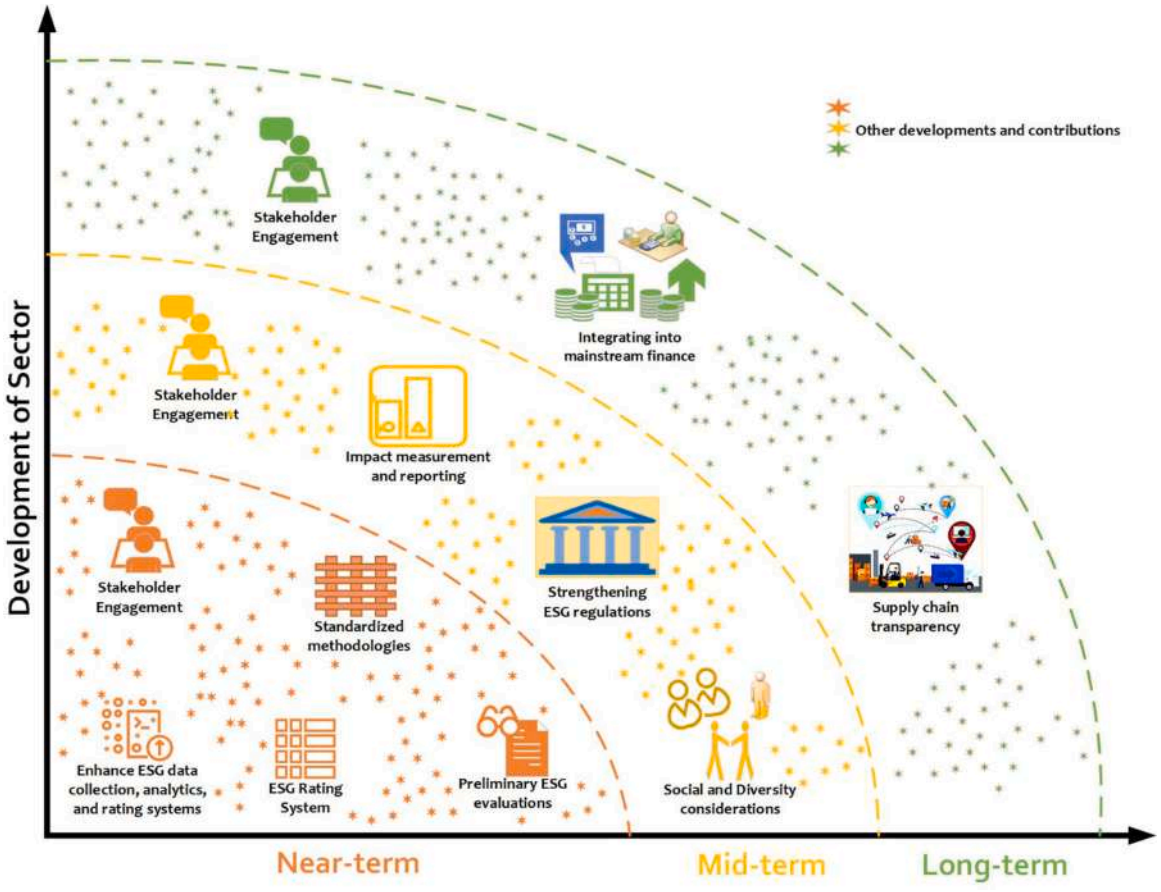

Fig. 13. ESG development roadmap.

of a company, government, or investment.

In the long-term, with prospective positive impacts of ESG initiatives, companies will aim to demonstrate their contributions to sustainable development goals, social progress, and environmental conservation beyond compliance. Therefore, a concept of ESG impact measurement will be featured, allowing all participating companies to stand out. With the impact measurement reporting, there will be more transparency in the businesses and supply chains. More attention will be given to responsible sourcing, fair labour practices, and sustainable supply chain management. This transparency will assist the ESG in completely integrating into mainstream finance. Investors, asset managers, and financial institutions will have ESG as a scrutiny criterion in investment decisions, planning strategies, risk management, and lending practices.

Stakeholder engagement will be common and critical in all development stages (near-term, mid-term, and long-term). Organizations will continuously seek to collaborate with stakeholders, including employees, customers, communities, and investors, to understand their expectations, incorporate their perspectives, and form real value for ESG in the development sector. The proposed developments are tentative and could vary due to many factors, including global events, pandemics, societal changes, and the collective actions of businesses, investors, policymakers, and civil society.

6. Conclusions

The growing global attention to the ESG movement is fueled by investors' increasing demand for responsible financing. Organizations and governments are developing ESG criteria and metrics to meet desired environmental, financial, and social outcomes. The present study conducted a three-phased approach, i.e., a comprehensive review of existing content, a forensic review of the ESG risk analysis tool, and a research survey to collect experts' opinions and priorities in the decision-making process. In total, 62 experts from various sectors were identified to evaluate different ESG criteria and metrics identified through the reviews. The environmental component of ESG is ≈5–14 % more important than the social, and governance components. Furthermore, the design, operational life, and material sourcing are ≈14–20 % relatively more important than the project type in a project's life cycle. Engaging stakeholders, particularly the local and Indigenous was recognized as highly important (>95 %). Direct impacts and on-site compensations are ≈15–59 % more important compared to their counter alternatives. Water and air pollution-related aspects are considered more important (≈34–38 %) in characterizing the risk during the project's operational phase compared to solid waste.

Some limitations of this research include (1) the selection of experts for the survey may not represent the entire population. The experts were selected by the author's best judgment, which could potentially overlook certain groups with varying perspectives and biases. (2) Respondents may not always provide accurate answers as individuals provide socially acceptable responses rather than expressing their true opinions, leading to potential biases in the data. (3) The established weight of ESG criteria and pillars has not been validated beyond the survey participants. Therefore, it's essential to conduct cross-validation of these weights by applying them to different sectors or evaluating them with diverse populations. The cross-validation will increase the generalizability and applicability of developed ESG criteria in various sectors. Nevertheless, this study provides a basis to further establish the importance of various ESG criteria and metrics when considering different projects and investments. This information can be instrumental in conducting comprehensive ESG risk analysis and making informed decisions which can align with responsible and sustainable practices. As the ESG movement continues to gain traction, standardized evaluation tools and criteria are essential for effective comparisons and assessments across various industries and regions.

CRediT authorship contribution statement

Haroon R. Mian: Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Kasun Hewage:** Writing – review & editing. **Rehan Sadiq:** Writing – review & editing, Project administration.

Declaration of competing interest

There are no conflicts of interest to declare.
Haroon R. Mian on the behalf of all co-authors.

Data availability

The authors are unable or have chosen not to specify which data has been used.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.sftr.2024.100246.

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