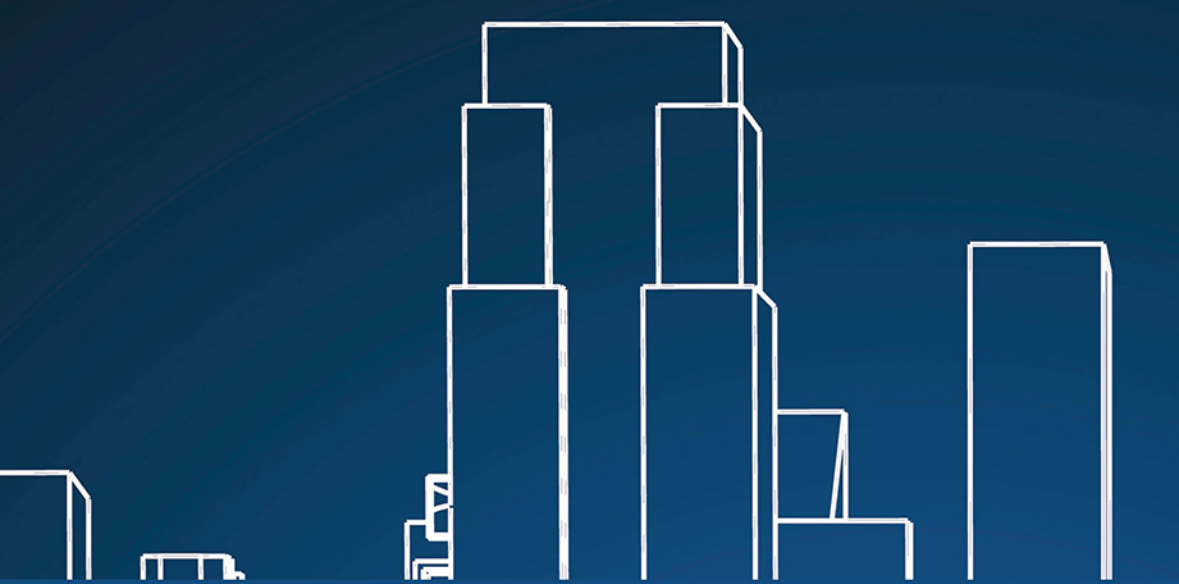




Banking, Money and International Finance

ESG RISK IN INVESTMENT FUNDS AND INSURANCE

REGULATORY PERSPECTIVES AND MARKET REACTION

Patrycja Chodnicka-Jaworska



 ROUTLEDGE

ESG Risk in Investment Funds and Insurance

This book provides a comprehensive analysis of the regulatory framework governing sustainability in the non-banking financial sector, with particular emphasis on insurance companies and investment funds. It examines the implications of environmental, social, and governance (ESG) and climate-related regulations for ESG risk to management practices and market behavior within these institutions. While existing literature predominantly focuses on the banking sector, this book addresses a significant research gap by offering an in-depth examination of non-banking financial institutions.

This book is structured into two parts. The first part outlines the general sustainability framework applicable to insurance companies and investment funds, focusing on key concepts, regulatory developments, and emerging trends in ESG risk regulation across the non-banking sector. It explores how insurance companies and investment funds design and implement ESG risk management strategies in major jurisdictions, including Europe, the United States, and other global markets. The second part assesses the impact of ESG regulatory frameworks and their ongoing evolution on market behavior, considering factors such as geographical location, industry characteristics, firm size, and the level of market development.

By integrating an analysis of existing regulatory initiatives with practical insights into ESG risk management, this book offers both theoretical and applied perspectives. It is intended for academics and students in financial law, economics, and sustainable finance, as well as for policymakers, regulators, and practitioners seeking to understand, assess, and manage ESG risks in financial institutions.

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Abbreviations

AIFM	alternative investment fund manager
AIFM Directive	Directive 2011/61/EU of the European Parliament and of the Council of 8 June 2011 on Alternative Investment Fund Managers (AIFMD)
CRA	credit rating agency
CSDDD	Corporate Sustainability Due Diligence Directive, i.e. Directive (EU) 2024/1760 of the European Parliament and of the Council of 13 June 2024 on corporate sustainability due diligence and amending Directive (EU) 2019/1937 and Regulation (EU) 2023/2859
CSR	corporate social responsibility
CSRD	Corporate Sustainability Reporting Directive, i.e. Directive (EU) 2022/2464 of the European Parliament and of the Council of 14 December 2022 amending Regulation (EU) No 537/2014, Directive 2004/109/EC, Directive 2006/43/EC and Directive 2013/34/EU, as regards corporate sustainability reporting
ESG	Environmental, Social, and Governance
ESG Rating Regulation	Regulation 2024/3005 of the European Parliament and Council of 27 November 2024 on the transparency and integrity of Environmental, Social and Governance (ESG) rating activities, and amending Regulations (EU) 2019/2088 and (EU) 2023/2859
EIOPA	European Insurance and Occupational Pensions Authority
ESMA	European Securities and Markets Authority
ESRS	European Sustainability Reporting Standards
FMP	financial market providers
Green Bond Standard	Regulation (EU) 2023/2631 of the European Parliament and of the Council of 22 November 2023 on European Green Bonds and optional disclosures for bonds marketed as environmentally sustainable and for sustainability-linked bonds

GRI	Global Reporting Initiative Standards
IRR D	International Restructuring and Development Directive
ISSB	International Sustainability Standards Board Standards
MIFID II	Markets in Financial Instruments Directive, i.e. Directive 2014/65/EU of the European Parliament and of the Council of 15 May 2014 on markets in financial instruments
NFRD	Directive 2014/95/EU of the European Parliament and of the Council of 22 October 2014 amending Directive 2013/34/EU as regards disclosure of non-financial and diversity information by certain large undertakings and groups
ORSA	Own Risk and Solvency Assessment
RTS	regulatory technical standards
SCR	Solvency Capital Requirement
SEC	Securities and Exchange Commission
SFDR	Sustainable Finance Disclosure Regulation, i.e. Regulation (EU) 2019/2088 of the European Parliament and of the Council of 27 November 2019 on sustainability-related disclosures in the financial services sector.
Solvency II	Directive 2009/138/EC of the European Parliament and of the Council of 25 November 2009 on the taking-up and pursuit of the business of Insurance and Reinsurance
SRI	socially responsible investing
Taxonomy	Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088
UN PRI	UN Principles for Responsible Investment
UCITS	undertakings for collective investment in transferable securities
UCITS Directive	Directive 2009/65/EC of the European Parliament and of the Council of 13 July 2009 on the coordination of laws, regulations and administrative provisions relating to undertakings for collective investment in transferable securities (UCITS)

Introduction

In recent years, the global financial sector has taken part in a transformation in which responsible investment and ESG (Environmental, Social, and Governance) are playing significant roles in business decisions. The presented decision is a result of the changes in the structure of the risk and the increasing role of the environmental and climate risk in the financial sector. As a result, investors and regulators expect financial institutions to pay attention not only to the financial measures but also to the non-financial indicators. In this context, the concept of ESG risk has become an important element of both investment strategies and risk management practices.

From the perspective of insurance companies and investment funds, ESG risk started to be a significant category of risk, especially in Europe, which is an effect of the changes in regulations. The ESG risks influence the stability and long-term value of assets. It may be due to the direct physical impacts of climate change (physical risk) as well as the economic transition toward a low-carbon economy (transition risk). The physical risk may mostly materialize over extended time horizons. This type of risk is difficult to estimate by using traditional models because of its catastrophic nature. In the case of the transition risk, it is mostly an effect of the changes in regulations.

In the case of the insurance companies, the most significant risk to which they are exposed is the climate risk, which is an effect of the catastrophic events and changes in the environmental conditions. This risk has a direct impact not only on the structure of insurance products and underwriting risk assessment but also on the investment portfolio. For investment funds, ESG risk influences are observed mostly in investment decisions, particularly capital allocation.

An increasing number of regulations has drawn attention to the need for the ESG risk assessment process in both insurance companies and investment funds. In practice, the significant role has regulations related to non-financial reporting like CSRD (Directive (EU) 2022/2464 of the European Parliament and of the Council of 14 December 2022 amending Regulation (EU) No 537/2014, Directive 2004/109/EC, Directive 2006/43/EC and Directive 2013/34/EU, as regards corporate sustainability reporting), the SFDR (Regulation (EU) 2019/2088 of the European Parliament and of the Council of 27 November 2019 on sustainability-related disclosures in the financial services sector), and

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the EU Taxonomy (Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088), because the lack of data related to ESG measures increases the uncertainty during the ESG risk assessment process, which is related to the lack of data. The correct estimation of ESG risk requires the use of high-quality ESG data and correct methodologies. In some cases, the significant impact in this area is played by ESG data providers and ESG ratings and scorings presented by them. To increase the quality of the ESG ratings and scorings, the European Commission introduced the ESG Ratings Regulation (Regulation (EU) 2024/3005 on the transparency and integrity of Environmental, Social and Governance (ESG) rating activities), which should be helpful in reducing the asymmetry of information between ESG data providers, assessed companies, and investors. It should also help in reducing problems with the lack of information about methodologies presented by ESG rating agencies, understanding the terms used by them, and reducing problems with the quality of data.

The significance of ESG risk is also underscored in Europe by the introduction of direct regulations that incorporate ESG risks into the business activity of insurance institutions and investment funds. There are adopted directives and regulations, such as the MIFID II Directive (Directive 2014/65/EU of the European Parliament and of the Council of 15 May 2014 on markets in financial instruments), the UCITS Directive (Directive 2009/65/EC of the European Parliament and of the Council of 13 July 2009 on the coordination of laws, regulations and administrative provisions relating to undertakings for collective investment in transferable securities), the AIFM Directive (Directive 2011/61/EU of the European Parliament and of the Council of 8 June 2011 on Alternative Investment Fund Managers), and the Solvency II Directive (Directive 2009/138/EC of the European Parliament and of the Council of 25 November 2009 on the taking-up and pursuit of the business of Insurance and Reinsurance), and recommendations by the European Insurance and Occupational Pensions Authority (i.e. EIOPA, 2024) and the European Securities and Markets Authority (i.e. ESMA, 2024), that draw attention to the need to identify, assess, and manage ESG risks and to disclose information about the impact of these factors on their business activity. The mentioned recommendations also put attention on the need for the reduction of the risk of “greenwashing” in offering financial products, which can mislead investors.

In the United States, the growing importance of ESG factors was observed. The situation changed in 2025, when in January 2025, President Donald Jr. Trump decided on the second withdrawal of the United States from the Paris Agreement. However, the American regulatory system is characterized by a different structure, in which both federal authorities (e.g., the Securities and Exchange Commission (SEC)) and state regulators (e.g., state insurance departments) play significant roles. As a result, ESG regulations vary for particular states. Despite everything, the changes in the regulatory dynamics at both federal and state levels cause the high volatility of the impact of the ESG

risk on the financial institutions' business activity. The presented situation also has an indirect impact on the significance of the ESG risk and changes in the European regulations. The mentioned situation created pressure for regulatory responses, including the adoption of the EU's Omnibus package. The presented situation can create problems with the varied regulations in particular regions and geographical bias. It can also be observed in the reduction of the harmonization of the non-financial standards, with different regions pursuing divergent ESG policy paths. A great example is right now the comparison of decisions of EBA, ESMA, and EIOPA with the SEC.

This uncertainty can have an impact on the valuation of assets, like green bonds and stocks, but also on investment strategy. In the United States, changes in the investors' sentiment can be observed in the outflows of financial sources from green investments to conventional financial instruments. This situation can have an indirect impact on the market in Europe. The problem mentioned will be tested in this book. Market data suggest that European ESG funds experienced significant outflows and revenue declines in 2025. The mentioned reaction can suggest the existing problem of the contagion effect between these markets and cointegration markets.

The purpose of this book is to present and analyze ESG risks in the operations of insurance institutions and investment funds – both theoretically and practically. The author seek to answer key questions about how ESG factors affect financial stability, which methods and tools are used to identify and manage ESG risk, and what consequences these developments have for financial institutions. The growing role of sustainable development in these institutions' business models is underscored throughout. This book adopts an interdisciplinary approach, combining economic, legal, and managerial perspectives to provide a comprehensive analysis of ESG issues in finance. This book aims to provide a comprehensive analysis of ESG risk, focusing on the impact of regulations and initiatives related to ESG risk estimation on non-banking financial institutions, especially investment funds and insurance companies, and their business strategies. In the case of the insurance companies, particular attention is put on capital adequacy. The investment funds are tested by considering the investment portfolios they take. Also presented are tools adopted in risk management. The study presents the main trends and challenges for insurance companies and investment funds in ESG risk management. The analysis is prepared for European and American financial markets. The relationship between European and American changes in regulations is analyzed. There are testable geographical, sectoral, time, and size biases. ESG and climate factors are significant in risk management, but there is a lack of standardized tools, methods, and regulations that can be helpful in this process. Incorporating ESG factors into business strategies will continue to present considerable challenges in the coming years.

The following hypotheses are put forward: The European financial market is sensitive to US market decisions related to ESG risk (H1). Geographical bias influences ESG risk measurement and the capital levels of insurance

companies (H2). Size bias affects the ESG risk measurement and capital adequacy of insurance companies (H3). Sectoral bias impacts the ESG risk measurement and capital adequacy of insurance companies (H4). Changes in US regulatory policy under the Trump administration affected the activity of investment funds (H5). Changes in ESG risk regulation influence the greenium and the size of the green bond market (H6).

For testing the presented hypotheses, some research methods are used, i.e., literature review, document analysis (regulations and reports presented by regulatory authorities), and statistical analysis (descriptive statistics, correlation analysis, linear models, static and dynamic panel models, machine learning, and event study). The empirical analysis is based on the macro, sectoral, and micro datasets. The macroeconomic dataset is based on the data received from the World Bank, EUROSTAT, IMF, and Transparency International. Sectoral data are received from the LSEG database, regulatory authorities, and national and local supervisors. The microeconomic dataset is collected from the LSEG database and quarterly financial and non-financial reports of insurance companies and investment funds.

This book includes an introduction, a conclusion, and five chapters with theoretical and practical characteristics. This book has been divided into two parts: ESG Risk and Regulations; and Market Dynamics and ESG Risk Impact.

The first section provides the main definitions of ESG risk and climate risk. The main sources of the ESG and their impact on the insurance and investment funds' activity are presented. The main ESG data providers are presented, along with indicators like ESG ratings and scores. The stages of the ESG risk assessment process are described in Chapters 3 and 4. The main challenges related to the ESG risk assessment process are presented, like a lack of methods of ESG risk assessment, problems with the quality of ESG data, the instability and frequent revisions of regulations, the absence of global standards, and the problem of greenwashing, which are significant for the investment funds and insurance companies. At the end of the chapter, the implications of ESG ratings on the financial market are presented.

Chapter 2 presents current international initiatives that consider ESG risks in investment funds and the insurance sector activity. ESG rating regulations, IOSCO recommendations, ESMA and EIOPA recommendations, and solvency and investment regulations are presented. Regulatory ideas have been presented in the United States, the United Kingdom, Switzerland, and other countries. The effectiveness of the aforementioned regulations and ideas has been analyzed, considering the results and previous observations.

Chapter 3 analyzes ESG risk management in investment funds, beginning with the impact of regulations and initiatives in Europe and the United States. It highlights problems in portfolio construction and trends in portfolio restructuring after reporting periods and evaluates fund exposure by considering asset type, where ESG risks are most pronounced. It describes related problems with the type of funds, geographical location, and regulatory impact on their

activity. Geographical location bias is related to the variance in investment fund activity in particular regions. Differentiation between types of funds helps to assess their effectiveness. This chapter discusses the reasons for each bias in this situation. The interaction between ESG risk and portfolio allocation and asset liquidity is discussed, showing problems related to the window dressing and implications for risk management. There are also underlying problems with the quality of the portfolio of the green funds and the green-washing phenomenon. A literature review about each of the mentioned phenomena is presented.

Chapter 4 describes ESG risk management in the insurance sector. It looks at how ESG-related regulations, solvency requirements, and initiatives affect investment portfolios and insurance risks. Particular attention is given to climate-related risks, such as large compensation payouts. Using data from LSEG Workspace (2020–2025), the analysis explores risk minimization strategies through financial instruments and their impact on capital adequacy in insurance companies.

Chapter 5 describes the impact of ESG-related regulations on the financial market: stock prices and greenium. A literature review has been made. The analysis covers data from 2015 to 2025. Using the event study method, the impact of US decisions on the financial market is tested, considering sectoral factors, size effects, and geographic differences. There are interdependencies between the US and EU markets, systemic effects, and sectoral correlations in the presence of ESG shocks.

Each chapter integrates a literature review, regulatory analysis, and empirical evidence, ensuring both theoretical depth and practical insights. This book concludes with a synthesis of findings and their implications for financial institutions, regulators, and policymakers.

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- Directive 2009/138/EC of the European Parliament and of the Council of 25 November 2009 on the taking-up and pursuit of the business of Insurance and Reinsurance.
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Regulation (EU) 2019/2088 of the European Parliament and of the Council of 27 November 2019 on sustainability-related disclosures in the financial services sector.

Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088.

Regulation (EU) 2024/3005 on the transparency and integrity of Environmental, Social and Governance (ESG) rating activities.

Part I

ESG Risk and Regulations



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1 ESG Risk – Main Problems

Defining ESG Risk

The first ideas related to environmental, social, and governance (ESG) were presented in the 1960s and 1970s in the form of **ethical investing**, which primarily involved the exclusion of certain sectors or companies from investment portfolios on moral, religious, or social grounds. During this period, environmental and social issues did not pose a threat to financial risk. Next references to ESG factors appeared within the framework of ethical and **socially responsible investing** (SRI) in investment funds. Until the 1990s, these practices were marginal and primarily based on the exclusion of specific sectors, such as the tobacco, arms, or fossil fuel industries. The growth of the CSR concept and the increasing availability of non-financial data cause ESG to be a potential source of risk and investment opportunities. A turning point for insurance companies and investment funds was responsible investment principles, especially after the publication of the **UN Principles for Responsible Investment (UN PRI)** in 2006 (described more widely in Chapter 2). This initiative contributed to the institutionalization of ESG factors in investment fund processes and in the asset management of insurance companies. Since then, ESG risk has been included in the analysis of credit risk and market risk during the portfolio construction.

The global financial crisis of 2007–2009 further reinforced the importance of corporate governance. In response, investment funds and insurance companies started to incorporate ESG factors – especially G measures – as part of long-term risk management. The last decade has seen further integration of ESG risk into risk management frameworks in both sectors, particularly in the context of climate and regulatory risk.

ESG risk has been defined in numerous formal and informal sources, including regulations, guidelines, and academic literature. Given its nature, ESG risk can be understood as:

- Potential threats to a company's profitability, reputation, and stability resulting from neglecting ESG issues, which may lead to financial, operational, and legal losses, while also creating opportunities to positively influence performance.

- The risk of financial, operational, or reputational losses arising from the negative impact of ESG factors on the operations of a business entity, an investment portfolio, or a financial institution.
- The probability of adverse financial or non-financial consequences resulting from inadequate management of ESG factors, which may affect financial stability, market value, and long-term value creation.

From the perspective of financial institutions, ESG risk refers to risks arising from exposure to entities, sectors, or assets that are vulnerable to environmental, social, and governance factors and which may materialize through credit, market, operational, or reputational risk (Table 1.1).

Within the framework of European Securities and Markets Authority (ESMA) regulations, the term ESG risk is not explicitly defined. Rather, it refers to the framework and requirements for disclosing and managing ESG factors. ESMA defines ESG risk as financial and reputational risk arising from ESG factors that may:

- affect the value of assets and the financial condition of entities;
- alter the risk profiles of issuers and investments;
- lead to losses or unexpected events (e.g., natural disasters, regulatory changes, social scandals, or poor governance);
- affect the liquidity, valuation, and stability of financial markets.

Table 1.1 ESG risk definitions in regulations.

<i>Regulation/standard</i>	<i>Definition</i>
UN PRI	ESG risk is understood as an element of the investment process that requires integration with risk management and investment analysis (no formal legal definition).
IOSCO	ESG risk is related to methodological and informational risks, including greenwashing and inconsistency of ESG assessments. It presents the need for ESG assessment in the context of the ESG ratings and scorings.
SFDR	Sustainability risk means an environmental, social or governance event or condition that, if it occurs, could cause a negative material impact on the value of the investment.
CSRD	ESG risk is addressed through the materiality lens, focusing on the impact of ESG factors on the financial performance and position of the company.
EU Taxonomy	Non-compliance with sustainability criteria as a source of regulatory and market risks.
ESMA/EBA/EIOPA	ESG risk is treated as part of financial and operational risks, aligned with SFDR and integrated into risk management.
Solvency II	ESG risk should be included in ORSA as a factor affecting solvency and the risk profile. It is a defined climate and sustainability risk.

In the regulatory context and in the operation of investment funds, particular attention should be given to ESG risk arising from the following sources:

- MiFID II, under which ESG risk can be understood indirectly as the risk that:
 - a product does not meet the stated ESG criteria (so-called “greenwashing”);
 - an investment is unsuitable for the client due to their ESG preferences;
 - ESG information is insufficient or misleading.
- SFDR, which requires disclosure of how funds and advisors incorporate ESG risks into their investment process. ESMA interprets this requirement as:
 - an obligation to identify and manage ESG risks that may impact investment performance;
 - a risk that missing or inaccurate disclosures may mislead investors.
- EU Benchmark Regulation, which highlights the following concerns in relation to ESG risks:
 - the benchmark methodology is unclear or inconsistent;
 - the benchmark does not reflect actual ESG characteristics (greenwashing);
 - the benchmark is susceptible to manipulation.
- UCITS/AIFMD, under which ESMA emphasizes that managers must incorporate ESG risks into their overall investment risk framework and disclose how these risks affect strategies and performance.

EIOPA primarily uses the ESG definition as a framework for identifying and managing risks, as well as for supervisory and reporting requirements for insurers and pension institutions. EIOPA focuses mainly not on ESG risk *per se* but on climate risk and sustainability risk, which it defines as environmental, social, or governance-related situations or conditions that, if they occur, could have an actual or potential negative impact on the value of an investment or liability. Both ESMA and EIOPA classify ESG and environmental risks as follows:

- physical risk (direct effects of extreme events such as floods, droughts, or long-term changes, such as sea level rise, divided into acute and chronic risks); and
- risk related to the transition (transformational) to a low-emission economy, which includes regulatory, technological, and market changes.

Reputation risk, related to loss of trust, and legal/liability risk are also distinguished.

Main Sources of ESG Risk

Financial institutions are exposed to ESG risks, although the nature and channels of their impact vary depending on the institution's core activities. The direct impact of ESG risk on insurance companies and investment funds differs due to the inherent characteristics of their operations. Insurance companies are particularly exposed to the direct consequences of physical risks, such as fires, floods, hurricanes, and earthquakes. These events directly affect actuarial risk estimation and the modeling of technical provisions. Consequently, the primary risk for this group of entities is **climate risk**, that is, the financial and operational risk arising from the effects of climate change and the implementation of adaptation and mitigation measures on:

- the occurrence and intensity of extreme events (e.g., hurricanes, floods, droughts, and fires);
- the value and frequency of insurance claims;
- the value of the insurer's assets and liabilities (e.g., investments and technical provisions);
- risk modeling and policy pricing;
- the stability of operations and financial liquidity of the insurer.

Therefore, the main sources of risk for insurance companies include increased catastrophe frequency, social conflict risk, and the improper assessment of these risks in valuation processes. In turn, this can lead to higher policy costs and problems in the underwriting process. Incorrect valuation can also contribute to rising reinsurance costs and a reduction in the availability of reinsurance in regions exposed to high climate risk.

Investment funds, by contrast, are typically exposed to ESG risk indirectly through their investment activities. Increasing ESG risk can affect the companies' capitalization and their financial condition, which may result in stock price declines or a higher probability of bankruptcy. It can also negatively impact the yields on green bonds. Rising ESG-related risk in financial markets tends to reduce liquidity, thereby increasing volatility. At the same time, the use of derivatives can raise hedging costs. The mentioned problems are also significant for insurance companies due to their investment portfolios.

A common risk for all entities is reputational risk. In the case of investment funds, reputational risk can lead to investor withdrawals if funds fail to meet ESG commitments. This issue is closely related to the quality of ESG data and portfolio construction, which is compounded by the lack of standardized ESG metrics and discrepancies in ESG ratings and scoring methodologies – issues addressed in the following subsection. This problem is common for both sectors.

Table 1.2 describes sources of ESG risk in investment funds and insurance companies.

Table 1.2 ESG risk description in insurance companies and investment funds.

ESG risk area	Insurance institutions	Investment funds
<i>Direct impact of ESG risk</i>		
Environmental Risk – Physical Risk	An increase in the frequency and severity of insured losses resulting from natural catastrophes; risk of underpricing premiums and underestimating technical provisions.	An indirect impact through a decline in the value of assets issued by entities affected by climate-related events; increased valuation volatility.
Environmental Risk – Transition Risk	A decline in the value of investment assets and changes in demand for insurance products resulting from the transition toward a low-carbon economy.	The risk of value erosion in investments in carbon-intensive companies; the need to reallocate portfolios in line with evolving ESG standards.
Social Risk	Risk of misselling, disputes with policyholders, discriminatory pricing practices, labor-related issues, and human rights violations within the supply chain.	Risk of investing in entities that violate labor or social standards, potentially leading to financial losses and investor capital outflows.
Governance Risk	Insufficient oversight by the management board and supervisory board over ESG risks; inadequate integration of ESG factors into the risk management system and ORSA process.	Exposure to investments in companies with weak corporate governance, deficiencies in internal decision-making processes, and conflicts of interest in fund management.
<i>Greenwashing risk</i>		
Product Greenwashing Risk	Relatively lower, but present in the case of “green” insurance or investment-linked products (e.g., unit-linked insurance).	High, due to the risk of declaring ESG-oriented strategies without effective integration of ESG factors into the investment process.
ESG Data Quality Risk	Limited availability of data on clients’ climate exposures and insured losses; difficulties in calibrating actuarial and underwriting models.	A lack of standardization, inconsistencies among ESG ratings, and delays in issuer disclosures, leading to suboptimal investment decisions.
<i>Indirect impact of ESG risk on other risks</i>		
Compliance Risk	A high risk of non-compliance with regulatory frameworks (e.g., Solvency II, CSRD, EU Taxonomy); exposure to litigation related to climate liability.	The risk of breaching SFDR, EU Taxonomy, and ESG disclosure requirements; potential regulatory sanctions and reclassification of funds (Articles 6/8/9 SFDR).
Operational and Model Risk	Inadequate adaptation of underwriting and actuarial models to emerging ESG risks; insufficient ESG-related expertise within the organization.	Errors in the integration of ESG criteria into the investment process; risk of improper asset selection and insufficient portfolio monitoring.

(Continued)

Table 1.2 (Continued)

<i>ESG risk area</i>	<i>Insurance institutions</i>	<i>Investment funds</i>
Reputational Risk	Negative public perception resulting from claims disputes, unethical claims-handling practices, or investments in controversial sectors.	Loss of investor confidence due to greenwashing allegations, insufficient transparency, or investments inconsistent with the declared ESG strategy.
<i>Market and liquidity risk</i>		
Asset Valuation Risk in Investment Portfolio	Valuation of debt and equity assets may be adversely affected by ESG-related events (e.g., climate regulations and environmental sanctions). This may result in asset value decline and weakened capital position for the insurer.	Valuation of financial instruments in the fund portfolio may experience significant fluctuations in response to ESG factors (e.g., ESG disclosures, regulatory changes, and climate events).
Market Volatility Risk	Increased volatility of asset prices in the investment portfolio, especially in high-emission or poorly governed sectors, which affects financial performance and technical provisions' stability.	Increased volatility of asset prices, particularly in ESG-sensitive segments or in "green" assets with limited liquidity, which may lead to larger deviations in returns.
Market Liquidity Risk	In an ESG shock (e.g., sudden deterioration in the outlook for fossil fuel sectors), the insurer may face difficulties selling assets at fair value, limiting liquidity management capabilities.	High liquidity under normal conditions may be disrupted during stress periods, especially for ESG assets with a limited secondary market (e.g., green bonds and infrastructure projects).
Stranded Assets Risk	Assets related to fossil fuels or other sectors exposed to transition may become stranded, leading to permanent impairment of the insurer's investment portfolio.	Similar risk applies to funds investing in ESG-high-risk sectors; it may result in permanent value loss and difficulties in meeting benchmarks.
Sectoral and Geographic Concentration Risk	Portfolio concentration in sectors or regions exposed to ESG risks (e.g., areas affected by extreme weather events) increases the insurer's sensitivity to market fluctuations.	Funds with sectoral concentration (e.g., energy and mining) or geographic concentration (e.g., emerging markets) are more vulnerable to abrupt price changes driven by ESG factors.
Investor Preference Shift Risk	Changes in customer preferences (e.g., growing demand for ESG products) may force adjustments in investment strategy and asset allocation, affecting performance and liquidity.	Funds may experience capital outflows due to increasing ESG expectations, which may necessitate asset sales in unfavorable market conditions.
Regulatory Risk Affecting Market Prices	New climate regulations, carbon pricing, or restrictions on high-risk sectors may depress asset valuations in the insurer's portfolio.	ESG regulation may trigger market repricing in specific sectors, affecting fund returns and portfolio value.

Reputational Risk and Market Impact	Negative publicity about the insurer's activities (e.g., controversial investments or claims-handling practices) may reduce investor and customer confidence, affecting the insurer's equity valuation.	Reputational crises (e.g., greenwashing allegations) may lead to significant redemptions and declines in the net asset value, impacting the secondary market.
<i>Credit risk</i>		
Counterparty Credit Risk	Insurers face credit risk from counterparties such as reinsurers, brokers, and service providers. ESG-related deterioration (e.g., poor governance and environmental liabilities) can reduce counterparty creditworthiness and increase default probability.	Funds face credit risk from counterparties in derivative contracts, securities lending, and repo transactions. ESG deterioration of counterparties can increase default risk and margin calls.
Insured Entity Credit Risk (Underwriting Exposure)	In property and casualty (P&C) and commercial lines, insurers underwrite risks of corporate clients. ESG failures (e.g., environmental accidents and labor disputes) can increase the probability of loss and weaken the insured's ability to pay premiums.	Funds typically do not underwrite, but credit risk arises from investments in corporate debt. ESG deterioration of issuers (e.g., governance scandals and regulatory penalties) increases default risk and credit spread widening.
Asset Portfolio Credit Risk	Insurance companies hold large fixed-income portfolios to match liabilities. ESG transition risks can lead to downgrades and value loss in high-carbon or poorly governed issuers, affecting solvency and investment income.	Funds holding corporate bonds or credit instruments are directly exposed to ESG-driven downgrades, defaults, and widening spreads. ESG shocks may also trigger forced sales in stressed markets.
Reinsurance Counterparty Risk	Reinsurers may be affected by ESG events (e.g., catastrophic losses and climate litigation), which can weaken their capital position and increase default risk. This affects insurers' risk transfer and solvency.	Funds generally have limited direct exposure to reinsurance. However, ESG shocks affecting financial markets may indirectly impact fund counterparties and credit-sensitive instruments.
Concentration Risk in ESG-Heavy Sectors	Insurers with concentrated exposure to carbon-intensive industries (e.g., energy and mining) face higher credit risk if these sectors undergo rapid transition or regulatory pressure.	Funds with sector concentration (e.g., high-yield energy debt) are exposed to sector-specific ESG shocks and may suffer large credit losses.
ESG Data and Rating Risk	Poor ESG data quality may lead to misestimation of credit risk in investment portfolios and mispricing of insurance products for ESG-sensitive clients.	Inaccurate ESG ratings and lack of standardization may cause underestimation of issuer credit risk and misallocation of capital.
Regulatory and Litigation Risk Affecting Creditworthiness	ESG-related regulatory changes (e.g., carbon pricing and litigation) may impair the financial position of insured firms and bond issuers, increasing default risk and claims frequency.	Funds are exposed to credit risk from issuers facing ESG-related regulatory sanctions, fines, or climate litigation that may impair repayment capacity.

ESG Data Providers

The significant part of ESG risk assessment is the availability and the quality of ESG data. Such data are collected from several types of sources, including:

- **ESG data providers certified or registered by the ESMA**, which publish:
 - ESG ratings and scores, including sub-scores and sub-ratings;
 - raw ESG data;
 - sector-specific ESG data;
 - information on ESG-related controversies;
 - ESG indices;
 - screening tools;
 - advisory services;
 - second-party opinions and feedback;
 - regulatory reporting support; and
 - advisory services aimed at improving corporate ESG ratings.
- **Institutions that are neither registered nor certified by ESMA**, which primarily provide raw ESG data.
- **Institutions producing macroeconomic data and reports** related to climate change and environmental risks.

ESG data providers can be broadly classified into several categories:

- **Subsidiaries of credit rating agencies**, which offer a wide range of ESG ratings and scores, often based on proprietary data sets and typically covering large corporations. Examples include Cerved Rating Agency, Fitch Group, KBRA, Moody's Corporation, Morningstar, RAM Holdings Berhad (RAM Group), S&P Global, and Scope Ratings.
- **ESG scoring providers that are not affiliated with credit rating agencies**, which can be further divided into:
 - **ESG data providers offering ratings and scores**, such as FTSE Russell (including Beyond Ratings), ISS, MSCI, and Verisk Maplecroft.
 - **Reputation and controversy risk data providers**, which supply event-monitoring data used to identify controversies, social misconduct, and human rights violations. Examples include RepRisk and Truvalue Labs.
 - **ESG data integration providers**, which combine ESG data with market, fundamental, and portfolio-level data to support holistic investment analysis. Examples include Bloomberg ESG and LSEG.
 - **Industry-specific institutions specializing in ESG data collection.**
 - **Alternative data and big data providers**, which focus on natural language processing, web scraping, and the analysis of unstructured data from media sources, corporate reports, and social media platforms.

Most ESG data providers are large, for-profit companies offering a broad range of sustainability-related products and services, often alongside non-sustainability-related offerings. Examples include MSCI, S&P Global, Moody's, and Fitch Solutions. In addition, a group of boutique providers can be identified. These entities specialize primarily in sustainability-related products and services and typically focus on niche areas of ESG analysis (e.g., RepRisk, Sustainable Value Investors, and Carbon4 Finance). A further category comprises non-profit organizations that provide sustainability-related products and services, often with an emphasis on transparency, advocacy, or public-interest research (e.g., CDP and ShareAction).

As noted above, one of the principal products offered by these institutions is **ESG ratings and scorings**. They are frequently confused with credit ratings, although their scope and purpose are generally different. According to **Article 3(1)(a) of Regulation (EC) No. 1060/2009** of the European Parliament and of the Council of 16 September 2009 on credit rating agencies, a **credit rating** is defined as an **opinion regarding the creditworthiness** of an entity, debt or financial obligation, security, person, or financial instrument, or the issuer of such debt or financial obligation, prepared using a specific classification system. Consequently, a credit rating is an assessment of the creditworthiness of a particular entity (for example, a sovereign state, a corporation, or a financial instrument), presented by specialized rating agencies. It estimates the probability that an entity will be able to fulfill its financial obligations in a timely and complete manner. It should help investors in evaluating the risks associated with investing in specific securities or giving credit.

In contrast, **Article 3 of Regulation (EU) 2024/3005** of the European Parliament and of the Council of 27 November 2024 on the transparency and integrity of ESG rating activities and amending Regulations (EU) 2019/2088 and (EU) 2023/2859 distinguishes three terms related to ESG risk:

- **ESG rating**, which means an opinion, score, or a combination of both, that addresses the profile or characteristics of a rated item in terms of environmental, social, and human rights or corporate governance factors, or that addresses the exposure of a rated item to risks related to environmental, social, and human rights or corporate governance factors or impacts on such factors; and that is based on both an established methodology and a defined ranking system of rating categories, regardless of whether such ESG rating is designated as an “ESG rating,” “ESG opinion,” or “ESG score.”
- **ESG opinion**, which refers to an ESG assessment based on a rules-based methodology and a defined ranking system for rating categories, in which a rating analyst is directly involved in the rating process.
- **ESG scoring**, which refers to an ESG measure derived from data, using a rules-based methodology and based solely on a previously established statistical or algorithmic system or model without any additional significant analytical input from a rating analyst.

Accordingly, ESG scorings and ratings are assessments of an organization's performance in three dimensions: environmental, social, and corporate governance. They measure how a company manages risks and opportunities related to sustainability. The main characteristics of ESG scoring include:

- A score or rating related to ESG factors, namely environmental, social, and corporate governance dimensions.
- Reliance on data and a clearly defined methodology, without arbitrary analyst judgment; instead, a statistical or algorithmic system is used.
- Provision as a market product, made available to third parties (e.g., investors and rating agencies).
- Facilitation of ESG risk assessment and the comparison of entities based on their ESG profile.

An **ESG rating** is therefore often a broader concept than ESG scoring; it may incorporate an analyst's opinion or an assessment of the quality of ESG practices, as well as a categorical ranking. In contrast, an **ESG score** is a more technical numerical outcome generated algorithmically.

In practice, the metrics used in ESG scoring and ratings frequently overlap with those considered in credit rating assessments and may therefore contribute to credit rating upgrades or downgrades. Table 1.3 compares the differences between ESG scoring and ratings and credit ratings.

The lack of unified regulations regarding ESG ratings and scorings has contributed to several challenges. The main issues in ESG ratings include **inconsistent terminology and concepts**. Chodnicka-Jaworska (2025) demonstrates differences in terminology and types of ESG ratings and scorings even within the same ESG data providers. This has a direct impact on the extent of information asymmetry between ESG rating agencies and investors. Consequently, it can create problems in the correct interpretation and use of these ratings. Moreover, various approaches and methodologies have been developed for ESG ratings (Antolin-Lopez et al., 2016). These approaches share a common feature: they are multi-criteria and heuristic, encompassing multiple dimensions (Schaltegger & Burritt, 2005). This methodological diversity further amplifies discrepancies among ratings and may contribute to **rating inflation**.

The issue is also related to the **absence of standardized ESG reporting**, which increases firms' discretion to disclose information selectively. As a result, ESG ratings may be inflated due to incomplete or missing data. When companies exhibit weak ESG performance, they may choose not to publish sustainability reports, particularly when the sector median is higher (Sahin et al., 2022). Each ESG rating provider employs its own methodology for addressing data gaps. Approaches based on sector median estimation are problematic because they fail to accurately reflect the unique circumstances of individual firms (Berg et al., 2022). Investors often do not distinguish these differences (Chodnicka-Jaworska, 2025b). Consequently, this can lead to **ESG rating greenwashing**.

A further issue is the significant **differences between ratings and their underlying indicators**, as emphasized in the literature (Berg et al., 2022; Chatterji

Table 1.3 Differences between ESG scorings, ESG ratings, and credit ratings.

<i>Criteria</i>	<i>ESG scoring</i>	<i>ESG rating</i>	<i>Credit rating</i>
Object of assessment	The degree to which environmental, social, and governance (ESG) criteria are met	Qualitative and quantitative assessment of an entity's ESG profile	Creditworthiness of an issuer, security, or obligation
Purpose	Comparability and aggregation of ESG data	Evaluation of the quality of ESG risk management and impacts	Assessment of default risk
Nature of outcome	Numeric score, index, or ranking	Class/category or descriptive assessment	Rating category (e.g., AAA–D)
Methodology	Statistical or algorithmic model based on predefined weights	Mixed methodology (quantitative and qualitative)	Quantitative and qualitative analysis with a predominant expert judgment component
Role of analyst	Generally no significant analyst input	Significant analyst input	Central, decisive role of the analyst
Legal character	Informational/analytical product	Expert opinion on ESG matters	Regulated expert opinion
Regulatory effects	No direct legal consequences	No direct legal consequences	Direct legal consequences (e.g., capital and investment requirements)
Supervision	ESMA	ESMA	ESMA
EU regulatory framework	Regulation (EU) 2024/3005	Regulation (EU) 2024/3005	Regulation (EU) No 1060/2009 (CRA Regulation)
Scope of application	Non-financial analysis, benchmarking, reporting	ESG due diligence, investment strategies	Financial regulation, investment decision-making, risk management
Impact on investment decisions	Indirect	Indirect	Direct
Typical providers	Data vendors, fintechs, analytics platforms	ESG agencies, specialized research firms	Registered credit rating agencies

et al., 2016; Christensen et al., 2022). Chatterji et al. (2016) documented low correlations among ESG ratings, even after adjusting for differences in CSR definitions, indicating limited validity. Berg et al. (2022) attributed rating divergence to three factors: scope (varying variable sets), measurement (different indicators for the same phenomena), and weighting. They concluded that scope and measurement differences were most consequential, while weighting discrepancies were less significant. A “**rater effect**” was also observed, whereby firms rated highly in one category by a particular ESG data provider tend to receive similarly high scores in other categories from the same rater. Christensen et al. (2022) found that increased ESG disclosure leads to greater disagreement due to its subjective nature. In particular, non-disclosure of common industry issues is viewed negatively, whereas omission of less material issues typically results in average scores. As a result, it remains difficult to determine whether higher disclosure reflects superior or inferior performance, which increases subjectivity and potential misinterpretation.

The analysis highlights several key issues: diverging ESG assessment methodologies, difficulties in quantifying ESG measures, subjective evaluations by analyst teams, and challenges related to industry-based peer group selection. Simpson et al. (2021) demonstrated that ratings may increase solely due to peer group fluctuations, even in the absence of any company action. Despite these limitations, industry comparison remains necessary because it provides a more accurate assessment of risks for firms operating within the same sector. Nevertheless, peer group selection varies across rating agencies. Furthermore, methodological differences and the convergence of assessments remain problematic. A certain degree of standardization – particularly in industry classification – could enhance the comparability of indicators.

The next problem is related to the **scope of disclosures and missing data**. Key challenges include:

- **Differing data scopes:** Some agencies, such as LSEG, cover only historical data for companies mostly from the United States and Europe. As ESG disclosures are generally more advanced in Europe, European firms tend to receive higher scores.
- **Limited availability:** ESG data are primarily available for large-cap firms, as rating agencies focus on listed companies and the most relevant global and national indicators.

These limitations are exacerbated by data gaps in certain geographic regions and among smaller firms. To address missing data, some rating agencies employ imputation techniques, which may introduce methodological challenges, including:

- **Selection bias:** Only top-performing firms may disclose data for promotional reasons, leading to inflated industry averages.
- **Inconsistent imputation:** Varied imputation methods across agencies further contribute to rating discrepancies.

The influence of these data gaps is expected to decline as mandatory reporting expands.

The link between data sources and missing data poses a significant challenge for ESG ratings. Previous studies have highlighted persistent issues with data quality and coverage, including reliance on historical datasets spanning up to 25 years (Bennani et al., 2018; Li & Polychronopoulos, 2020). Several initiatives – such as the EU Taxonomy, ESAP, sustainability reporting frameworks, and regulatory oversight of rating agencies – have been proposed to improve data availability and comparability (Kotsantonis & Serafeim, 2019; Capizzi et al., 2021; Sipiczki, 2022; Rogge & Ohnesorge, 2022). Investors increasingly seek raw sustainability data for SMEs to construct green portfolios, and many develop their own assessment methodologies despite data gaps (Fernandez et al., 2021). Simplified reporting frameworks are also being promoted to engage SMEs in sustainability reporting (Barbagila et al., 2021).

Missing data are primarily driven by uneven disclosure practices. ESG information is often scarce in emerging markets and the Asia-Pacific region, resulting in geographic bias in rating products. Moreover, increased disclosure does not always reflect improved performance; some firms improve ratings merely by disclosing more information (Rogge & Ohnesorge, 2022). Disclosure rates and performance are particularly low among US firms. Thornton et al. (2022) found that only 57% of the largest Russell 1000 companies disclosed Scope 1 and 2 emissions, whereas EU regulations require full reporting by covered firms.

The absence of standardization in ESG reporting enables selective disclosure, potentially inflating ratings. Firms with poor ESG metrics may omit sustainability reports, especially when sector medians are higher (Sahin et al., 2022). Providers address missing data using different methods, such as sector median imputation, which may not reflect firms' specific circumstances (Berg et al., 2022). Sector and size differences also influence disclosure: some industries are less likely to report ESG information, and smaller firms have higher rates of missing data (Bams & van der Kroft, 2023; Gamerschlag et al., 2011; Jain & Winner, 2016).

The financial market analysis and related research highlight several factors that influence ESG rating inflation and deflation, particularly the **firm size bias**, which remains largely unresolved (Akgun et al., 2021; Dobrick et al., 2023). Larger companies generally receive higher ESG scores than mid-cap or smaller firms, not necessarily due to better sustainability performance but because they have more resources to produce extensive disclosures and engage with rating providers (Born et al., 2020; Tamimi & Sebastianelli, 2017). This bias is also linked to firm maturity and market capitalization (Lopez & Bendix, 2020). Consequently, SMEs and other smaller entities often remain unrated, which can create the misleading impression that they are less sustainable.

The size bias is driven by resource availability: large firms can allocate more funds, staff, and expertise to non-financial reporting, and they frequently use

consultants to manage ESG risks and reporting (Drempetic et al., 2020; Gregory, 2024). However, the volume of disclosures may improve ESG ratings without reflecting actual performance (Baumann-Pauly et al., 2013). This creates legitimacy effects that favor large companies, while the complexity and cost of ESG reporting can disadvantage smaller firms (Hughey and Sulkowski, 2012).

Economic explanations include the **slack resources hypothesis**, suggesting that larger firms have the financial capacity to invest in ESG activities with delayed payoffs (Bansal, 2005; Gallo & Christensen, 2011). Conversely, ESG activities may be viewed as costly or even value-reducing, especially under political pressures such as recent restrictions on ESG considerations in US state investments (Bissoondoyal-Bheenick et al., 2023). This can create agency costs and stakeholder conflicts, potentially reducing firm value (Barnea & Rubin, 2010).

While larger firms may improve financial conditions through ESG performance (He et al., 2023), high ESG risks can disproportionately affect smaller companies' stability (Cohen, 2023). The size bias appears in both aggregated and pillar-level scores, although some evidence suggests it may be decreasing in recent years (Akgun et al., 2021; Gregory, 2024). Sector-based comparisons can reduce variance and sometimes reverse the size effect. Ownership connections, such as "sister company" relationships, also contribute to rating inflation, especially in cases of high institutional ownership, though this effect is smaller among ESG-focused investors (Tang et al., 2026).

Geographical bias represents a significant challenge in ESG ratings, particularly favoring firms located in regions with stricter reporting requirements. European companies, for example, are subject to the CSRD and the EU Taxonomy, which mandate detailed sustainability disclosures. This regulatory environment enhances data availability and partly explains why ESG ratings are more prevalent and comprehensive in Western Europe, while firms in regions with delayed or weaker ESG regulations – such as Central and Eastern Europe – are underrepresented. Empirical evidence confirms this data gap, as only a limited number of companies from countries such as Poland, Czechia, and Hungary have been assessed by ESG rating providers (Czerwińska & Kaźmierkiewicz, 2015; Iamandi et al., 2019). Consequently, the coverage and quality of ESG ratings are closely linked to regional regulatory frameworks.

Persistent deficiencies in non-financial reporting further reinforce this bias. Global data indicate that only about half of listed companies achieve a high level of ESG disclosure, which directly affects the reliability and comparability of ESG scores. Limited disclosure reduces the informational basis for rating providers and weakens rating quality.

Geographical bias is also shaped by the interaction between firm location and industry characteristics. Studies show that companies in Asia and the Americas tend to exhibit higher ESG risks, whereas European firms generally face lower risks (Gyönyöróvá et al., 2021; Pillai et al., 2024). In addition, ESG outcomes depend on national context and sectoral composition, with evidence

suggesting that environmental performance improves when firms adopt social policies, conditional on location (Sáez-Martínez et al., 2016). Finally, the country of origin of ESG rating providers may influence methodological priorities, as regulatory developments – particularly in Europe – encourage greater transparency and stricter standards, potentially shaping the dimensions emphasized in ESG assessments.

The national culture further contributes to location bias, as business practices and disclosure norms vary across countries (Galan & Sanchez-Bueno, 2009). In Mexico, for example, a lower propensity toward public disclosure results in poorer data quality, reducing the reliability of ESG ratings in Latin America (Meyskens & Paul, 2010). In developing countries, ESG engagement among SMEs is often driven by cultural or religious philanthropy rather than institutionalized CSR practices (Jamali, 2010; Jamali & Neville, 2011).

Level of economic development also shapes geographical bias. Developing economies frequently exhibit weaker social and environmental regulations and less institutionalized CSR frameworks (Barin Cruz et al., 2015; Yakovleva & Vazquez-Brust, 2012). CSR strategies in these contexts tend to be less politically embedded and more dependent on local stakeholder pressures (Jamali & Neville, 2011). Overall, the institutional environment plays a critical role in determining ESG disclosure practices and the resulting geographical bias in ESG ratings (Martínez-Campillo, 2016; Mayer & Whittington, 2003; Vu & Ha, 2021).

Diverse and often unclear ESG rating methodologies, combined with data limitations, lead to varied and sometimes contradictory assessments of firms' ESG performance. These inconsistencies may produce a **halo effect**, whereby strong performance in one ESG dimension translates into higher scores across other dimensions from the same rater. Structural deficiencies – such as limited transparency, weak data standards, insufficient industry verification, and regulatory gaps – further amplify rating divergence (Kotsantonis & Serafeim, 2019).

Industry bias emerges when composite ratings fail to reflect differences in business models, disadvantaging certain **sectors**. Empirical evidence shows that environmental factors are most strongly correlated with overall ESG scores, while governance exhibits the weakest association, with divergence particularly pronounced in the financial sector (Gibson et al., 2019). Sectoral and regional differences are also evident, with higher ESG risks observed in Asia and North America than in Europe (Pillai et al., 2024). Additionally, data scarcity among non-listed SMEs reinforces quantity bias, favoring service-oriented industries over resource-intensive sectors (Chen et al., 2021). Industry-specific weighting schemes improve the long-term relevance of ESG ratings, underscoring the need for more granular, sector-sensitive methodologies (Giese et al., 2021).

The next group of issues concerns the **lack of transparency in ESG methodologies**. Each ESG rating agency employs its own methodology, encompassing algorithms, indicators, principles, imputation techniques, and definitions, many of which are not publicly disclosed. Consequently, the rating process and methodologies are not published, with no regulatory body overseeing or

verifying them (Simpson et al., 2021). Additional regulation could significantly enhance transparency by using clear standards, similar to the annual review of credit ratings by ESMA.

The first study examining ESG rating methodologies was conducted by Escrig-Olmedo et al. (2010), who highlighted a lack of standardization and significant methodological diversity. Subsequent research confirmed substantial discrepancies across providers (e.g., Berg et al., 2022; Chatterji et al., 2016). These divergences stem from two primary issues: **theorization** (differences in definitions and weightings of ESG factors) and **commensurability** (differences in measurement methods) (Abhayawansa & Tyagi, 2021; Hawley, 2017). Furthermore, heterogeneous data sources (public disclosures, questionnaires, and third-party provider data) and varying imputation techniques increase inconsistencies. The lack of transparency regarding methodologies and weightings complicates investors' ability to assess true ESG performance and compare ratings.

Aggregation may obscure meaningful differences between firms, and social dimension scores generally show lower agreement than environmental scores (Berg et al., 2022; Dorfleitner et al., 2015). Additional challenges include the failure to distinguish between performance and disclosure, inconsistent time horizons, and unclear definitions, all of which can result in misleading assessments (Giese et al., 2021; Hawley, 2017; Kotsantonis & Serafeim, 2019).

Consequently, ESG ratings are often unclear, and the absence of standardized methodologies and verification can lead to erroneous investment decisions and data greenwashing. Although some argue that subjectivity is inherent (Stubbs & Rogers, 2013), increased transparency and standardization could mitigate these issues.

The variety of methodologies used in ESG ratings increases the risk of greenwashing. Two main forms can be identified:

- **Qualitative greenwashing** occurs when ESG ratings or corporate disclosures create a misleading impression of sustainability. This can involve deceptive marketing, selective disclosure of positive information, or the presentation of extensive ESG data that obscures negative performance (Bazillier & Vauday, 2009; Kim & Lyon, 2011; Lane, 2014; Yu et al., 2020). The “**crying wolf effect**” describes how large volumes of information can conceal adverse data, requiring significant resources to detect. Linguistic framing and unsubstantiated future claims also contribute to qualitative greenwashing (Crilly et al., 2016; In & Schumacher, 2021).
- **Quantitative greenwashing** refers to inaccurate or inflated ESG scores produced by rating providers. This may result from using sector averages for companies with missing data, assigning higher scores to large firms or clients requesting ratings, or issuing ratings without verifying the underlying information.

Both forms involve deliberate or selective actions by firms or rating agencies that distort ESG performance and mislead stakeholders.

ESG Risk Management Process

This section outlines the principal stages of ESG risk management in insurance institutions and investment funds, considering the specific characteristics of each sector.

The first stage involves defining the **context and scope of ESG risk management**. At this stage, the key areas in which ESG risks may affect the operations of these entities should be identified, along with their interrelationships with other categories of risk. In the case of insurance institutions, increasing ESG risk – particularly environmental and climate-related risk – may affect underwriting risk. It also influences product design, especially in regions exposed to natural catastrophes, as well as offerings for sectors affected by ESG-related regulatory changes, reporting requirements, or operational restrictions, such as the fossil fuel industry. In addition, ESG risk has implications for legal risk and regulatory compliance.

For investment funds, the primary areas of exposure relate to the construction of investment portfolios, including regulatory changes that affect asset allocation, as well as risks associated with price volatility and the liquidity of financial instruments.

The second stage is the **identification of ESG risks**. This involves recognizing material ESG risks and determining areas of exposure. ESG risks relevant to insurance institutions and investment funds were discussed in the previous section.

The third stage is the **assessment and measurement of ESG risk**. Its primary objective is to evaluate potential changes, the likelihood of their occurrence, and their impact on the operations of the entities. Various tools are used for this purpose. ESG risk measurement combines qualitative and quantitative methods, integrating data related to environmental, social, and governance factors to assess exposure and potential effects on financial performance, thereby supporting strategic decision-making and regulatory compliance. The main ESG risk assessment tools include:

- **Qualitative methods:**

- Impact–Probability Matrix, which visualizes and prioritizes ESG risks by mapping their probability of occurrence against their potential impact on the organization.
- Expert surveys, brainstorming, SWOT analysis, the 5 Whys method, and “what-if” analysis, which support the identification of risks and their root causes.

- **Quantitative methods:**

- **Scenario analysis**, which evaluates the impact of climate change and other ESG factors on financial performance using simulation models and scientific data (e.g., in line with EIOPA guidelines), including climate stress testing.

- **Sensitivity analysis**, which identifies key variables (such as energy costs) that have the greatest influence on risk levels.
- **ESG scores and ratings**, both external and internal. External ratings are provided by specialized ESG data providers, while internal ratings are developed by in-house analytical teams and are not publicly disclosed. Internal ratings may incorporate ESG indicators and raw data sourced from external providers.
- **Artificial intelligence and machine learning tools**, which are used to collect, structure, and analyze ESG data. In the case of insurance institutions, actuarial models incorporating climate change assumptions and catastrophe stress tests are also applied.

Risk probability and its impact may be assessed, for example, on a numerical scale from 1 to 10, where 1 represents the lowest level of risk and 10 the highest. A risk multiplier is then calculated as the product of impact and probability.

The fourth stage is **ESG risk management**, the objective of which is to design and implement risk mitigation measures. A dedicated risk mitigation strategy is developed and executed. In insurance institutions, such measures may include:

- Limiting exposure to areas with high climate risk (e.g., through regional exposure limits);
- Developing “green” insurance products and adaptive insurance solutions;
- Incorporating ESG criteria into underwriting processes.

In investment activity, commonly applied measures include:

- Adjusting investment strategies in response to emerging ESG risks, such as excluding investments in securities issued by entities operating in high-risk sectors (e.g., coal or tobacco), or adopting active ownership and engagement strategies;
- Integrating ESG tools and metrics into investment analysis.

The subsequent stage of ESG risk management involves **monitoring and reporting**. Its purpose is to ensure the effectiveness of implemented measures and to verify that ESG risks do not increase over time. ESG Key Risk Indicators (KRIs) are established for this purpose. Risk reporting is conducted in accordance with applicable regulations (e.g., SFDR and CSRD), and internal dashboards and alert systems are implemented. Insurance institutions primarily monitor climate-related events, losses, and changes in their insurance portfolios, while investment funds additionally report ESG-related information to investors and supervisory authorities.

The final stage is the **integration of ESG considerations into decision-making processes and continuous improvement**. ESG factors are increasingly becoming an integral component of strategic, operational, and investment decisions.

ESG risk should be embedded within the overall corporate and investment strategy, rather than treated merely as an “add-on.” Key activities in this area include:

- The establishment of ESG or responsibility committees;
- Training and capacity-building initiatives;
- The integration of ESG criteria into investment policies and underwriting procedures;
- Oversight of ESG-related risks and their escalation to the board level.

Continuous improvement refers to the ongoing validation and enhancement of processes related to ESG risk identification, assessment, measurement, and management, particularly in response to evolving regulatory requirements, climate-related developments, and changes in securities market behavior. Activities supporting continuous improvement include, for example:

- Periodic reviews of ESG policies and risk exposures (e.g., conducted on an annual basis);
- Regular updates of climate and transition risk scenarios;
- Benchmarking against market peers and recognized best practices.

Detailed activities related to ESG risk management in insurance institutions and investment funds are discussed in the following chapters.

Core Challenges in ESG Risk Analysis

A major challenge in ESG risk analysis is the **inconsistency and fragmentation of ESG disclosures**, which are scattered across annual reports, sustainability reports, and websites. This lack of standardization compromises data quality and availability, a concern echoed by IOSCO (2021, 2023), which emphasizes the need for more consistent, comparable, and credible sustainability reporting. Direct data from companies – typically via questionnaires and reports – is considered the most reliable. Interaction between rating agencies and firms varies by business model; some engage early, others rely on public data and later verify, and a few use AI/ML for analysis, though not generally for initial ratings. Publicly sourced data is usually aggregated and then subjected to quality control checks, including plausibility, consistency, statistical, and logical assessments and comparisons with government databases and historical data. Inconsistencies often trigger dialogue with the rated entity to confirm or adjust metrics.

Companies frequently report burden from multiple questionnaires, as providers use different standards (e.g., GRI, SASB, IIRC, and TCFD), which increases costs and reduces time for meaningful communication. The European Commission (2023) estimates that compliance requires at least 6–8 full-time positions. A **single international standard could reduce costs and improve data quality**. The EESC (2023) further argues that rating providers should

incorporate non-corporate information from consumer organizations, unions, and civil society groups. Some research also suggests a trade-off between ESG data validity and reliability (Giese et al., 2021). Finally, data availability and reliability remain critical concerns. ESG ratings depend on high-quality inputs, and providers may use thousands of data points, including governance, financial frameworks, strategy, and climate-related risks. Although direct engagement with rated entities can improve data accuracy, it may also reduce transparency, auditability, and fairness.

The complexity of ESG-related data gives rise to the problem known as the “**crying wolf**” phenomenon, which, in turn, obscures the process of data greenwashing (Chodnicka-Jaworska, 2025). The limited availability of historical data and the prevalence of short time series used in econometric modeling further compound these challenges. At the same time, the excessive volume of data required by institutions creates difficulties in effective data utilization and increases the costs of reporting and analysis. A strong reliance on corporate reports and disclosures represents an additional concern. ESG information provided by companies is frequently neither audited nor independently verified, thereby contributing to greenwashing or selective disclosure. The quantification of ESG risk also remains problematic as it is often measured using proxies (e.g., emissions intensity as a proxy for environmental risk) that fail to capture the full scope and complexity of the underlying risks.

ESG risk is inherently long-term in nature, whereas traditional risk models are primarily designed to assess short-term financial outcomes. This temporal mismatch complicates the development and implementation of scenarios and stress tests. Extreme events, such as catastrophic risks, are particularly difficult to model. Moreover, the application of classical econometric models presents additional challenges. Although models estimating the financial impact of ESG factors exist, issues related to correlation and causality persist. ESG performance may be correlated with financial performance, yet the direction and nature of causality remain unclear. Environmental disasters, labor strikes, corporate scandals, and governance failures often occur unexpectedly, and such ESG-related shocks tend to have non-linear effects.

Frequent regulatory changes in ESG risk further undermine the stability of risk estimation. Policy trends resulting from decisions taken during President Donald Trump’s administration, as well as the introduction of the Omnibus package, have contributed to reduced data availability and, consequently, additional modeling difficulties. The Omnibus framework narrows the scope of companies required to disclose non-financial information. As a result, investment funds and insurance institutions may face challenges in obtaining sufficient data for risk management, while other entities may struggle to ensure regulatory compliance across jurisdictions.

Another significant challenge arises from divergent stakeholder expectations. Investors typically seek financial insights, non-governmental organizations emphasize impact measurement, regulators prioritize compliance, and consumers expect ethical corporate behavior. These differing priorities can generate conflicts of interest. Governance and corporate finance theories

– such as stakeholder theory, agency theory, and legitimacy theory – provide interpretive frameworks for understanding how ESG factors influence corporate risk and value. However, depending on the financial instrument in question, these theories may imply divergent market responses to ESG-related risks.

Finally, ESG assessments and ratings produced by rating agencies are subject to notable limitations. Such data are often difficult to interpret and apply due to substantial divergence – and, in some cases, direct contradictions – among ESG metrics and scores. In addition, ESG data providers frequently rely on opaque assessment methodologies or fail to disclose their methodological frameworks, further reducing transparency and comparability.

Conclusions

Due to changes occurring primarily in environmental risk, but also in social issues and corporate governance, ESG risk has become a significant factor in the functioning of insurance institutions and investment funds. It affects many areas of operation of these entities but also existing risks, such as liquidity, market, credit, operational, and insurance risk. A significant challenge in estimating this risk is data quality and inconsistent reporting standards. Presented ESG ratings and scoring systems are also subject to a number of errors and problems, including methodological inconsistencies, significant variability among ESG data providers, rating inflation in the case of large companies, and difficulties in obtaining information on the assessment methodology used. Modeling this risk also poses significant challenges. Standard classical models are not always accurate. Problems with causality and the high randomness of observations arise. At the same time, estimating climate risk is subject to error. Climate disasters occur with low probability but have high payoffs. This risk is characterized by long tails. Inconsistent regulations and frequently changing legal frameworks also lead to difficulties in obtaining data and reporting problems. ESG risk is subject to trends resulting from political changes.

Despite significant shortcomings in ESG risk assessment, both insurance institutions and investment funds are experiencing its impact. This risk has recently become increasingly acute in climate risk, which translates into increased pressure on insurance institutions in this area. On the other hand, the emergence of new green financial instruments is impacting the operations and earning potential of investment funds. The next chapter therefore examines legal regulations and international initiatives aimed at investment funds and insurance companies.

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2 Regulations on ESG Risk in Non-Banking Financial Institutions

International Initiatives on ESG Risk

International initiatives on ESG risk are related to preparation, and they focus on implementing standards and guidelines to help financial institutions and companies manage, measure, and report the impact of ESG factors on their operations in line with requirements. The largest number of regulations has been presented by the European Union. Other regulations have also been presented by Canada, the United Kingdom, Japan, China, and other countries.

An overview of ESG regulations reveals alignment with the **United Nations Sustainable Development Goals (SDGs)** (United Nations, 2015), integrating global efforts to address climate change, reduce carbon emissions, and improve environmental health. These 17 goals¹ can be used as a basic document to analyze the ESG risk. Institutions could use them to mitigate physical and transition risks, for example, SDG 6-aligned investments in projects or firms providing sustainable water supply, water storage, water-efficiency improvements, or water treatment. Many investors, especially in Europe and the United States, are using SDGs as a tool to manage ESG risk, which can be useful to assess companies from different industries, regions, or types of classes. They can be used to create or assess a portfolio and its impact on the real world. In the UK International Development Committee's first report, we can locate tools based on the SDGs to benchmark corporate performance. The other example of using the SDGs in measuring ESG risk is the MSCI ESG Sustainable Impact Metrics, which groups them into five topics, that is, basic needs, empowerment, climate change, natural capital, and governance. Companies received a tool to manage their ESG risk exposure based on their revenues and expenses. Natixis Asset Management created a scoring methodology to assess the companies' contribution to the SDGs and exclude them or increase allocations accordingly.

The next document that is based on the grounds of the ESG risk regulations is the **Paris Agreement** (UNFCCC, 2016). The first signed document in 2015 drew attention to the changes in climate and its increasing risk for the economy. The major aim of the regulation is to make an effort to limit global warming and address its impacts. The agreement at the beginning was signed by

55 countries, accounting for at least 55% of global greenhouse gas emissions. The key points of the Paris Agreement were:

- Global average temperature increase should not exceed 1.5°C by the end of the century.
- Countries report to each other and the public on how well they are doing in reaching their targets to ensure transparency and oversight.
- Countries commit to climate action by submitting climate action plans to reduce their emissions.
- Climate finance is needed to help vulnerable countries reduce emissions and build resilience to climate change.
- Governments communicate their action plans every five years – each plan setting more ambitious targets.

The mentioned regulations focus on the increasing ESG risk, especially climate risk, and were a reason for creating the **European Green Deal** (European Commission, 2019). It aims to cut emissions by at least 50% by 2030, rising toward 55%, while legally binding the 2050 neutrality goal through the European Climate Law. It underlines the need to combat climate changes in all parts of economies and in all sectors. A major set of climate legislation is the **Fit for 55 package** (European Commission, 2023), comprising several pieces of legislation and setting rules and measures to reach the goal of cutting emissions by at least 55% by 2030. The main points of the European Green Deal are:

- Reduction of greenhouse gas emissions to become a climate-neutral area;
- Circular economy model that relies on reused, repaired, and recycled products in addition to reducing waste and conserving resources;
- The clean industry model relies on cleaner, more sustainable, and energy-efficient industries;
- Restoring nature and working toward zero pollution;
- Greener farming practices;
- Fair transition.

The main international regulations presented have influenced initiatives in the case of ESG risk that are related to:

- Regulations and politics;
- Standards and guidance; and
- Initiatives related to the database.

The European Union introduced the largest number of **regulations**. The group of regulations mentioned includes *directives related to non-financial reporting*. The European Union's primary regulation on non-financial reporting was the **Non-Financial Reporting Directive (NFRD)** (Directive 2014/95/EU of the European Parliament and of the Council of 22 October 2014 amending

Directive 2013/34/EU as regards disclosure of non-financial and diversity information by certain large undertakings and groups). It mandated non-financial reporting for large public-interest entities with over 500 employees in their annual reports commencing in 2018. The primary objective of the NFRD was to present reports that offer shareholders transparent information related to corporate sustainability. Reports have been published on policies, risks, outcomes, and KPIs related to key sustainability issues. The NFRD was replaced by the broader **Corporate Sustainability Reporting Directive – CSRD** (Directive (EU) 2022/2464 of the European Parliament and of the Council of 14 December 2022 amending Regulation (EU) No 537/2014, Directive 2004/109/EC, Directive 2006/43/EC and Directive 2013/34/EU, as regards corporate sustainability reporting), which expands reporting requirements to more companies and introduces more detailed, standardized reporting based on **European Sustainability Reporting Standards (ESRS)**. The CSRD focuses on evaluating all business activities that impact people and the environment. It also standardizes and simplifies ESG reporting. The cited regulation is beneficial for various sectors, adopts sustainable business practices, and addresses climate-related financial risks. The CSRD mandates comprehensive disclosures on ESG factors, which encompass carbon emissions data, waste management, diversity and inclusion, employee rights, and governance factors. This directive is helpful for investors, financial institutions, clients, and other stakeholders in making decisions by considering the sustainability investments and business strategies. Former users of the NFRD may regard the CSRD as a revision of existing NFRD regulations. The CSRD extends the range of the obligated institutions to include SMEs and, eventually, non-EU companies and subsidiaries operating within the EU. The regulations mentioned refer to changes associated with **Omnibus I**, which was presented on February 26, 2025. It aims to reduce the administrative burden on businesses in the European Union. The Omnibus I package comprises:

- The “**Stop-the-clock**” **Directive** postpones deadlines, as in the case of the CSRD.
- Substantive changes aimed at simplifying requirements for businesses.

The **Stop-the-Clock Directive** (Directive (EU) 2025/794 of the European Parliament and of the Council of 14 April 2025 amending Directives (EU) 2022/2464 and (EU) 2024/1760 as regards the dates from which Member States are to apply certain corporate sustainability reporting and due diligence requirements) has already been adopted and published on April 16, 2025. It provides for a postponement of the application date of the sustainability reporting requirements for the second and third waves of entities, as well as the deadline for transposition and application of due diligence provisions.

Regarding the substantive changes to sustainability reporting presented as part of Omnibus I on June 23, 2025, at the meeting of the Committee of Permanent Representatives to the EU (**COREPER II**), Member States reached

an agreement based on a compromise text presented by the Polish Presidency of the Council of the EU. This document will constitute the EU Council's mandate for negotiations with the European Parliament to reach an agreement on this project. The proposal presented by the Polish Presidency and approved by COREPER II includes, among other things:

- Narrowing the scope of entities required to prepare sustainability reporting to entities and groups with more than 1,000 employees and net sales exceeding 450 million EUR annually;
- Allowing Member States to exempt entities from the first wave (i.e., those preparing sustainability reporting for the first time in 2024) that will fall outside the new scope of entities required to report, relieving them from reporting for the 2025 and 2026 financial years (the condition for exercising this option is the finalization of work on the directive in due time);
- Exempting entities that are large issuers from the regulated market from preparing their own standalone or consolidated sustainability reporting if they are covered by consolidated sustainability reporting by their parent entity;
- Introducing a limit on the information that reporting entities can request from entities within their value chain for preparing sustainability reporting;
- Supplementing provisions enabling entities to omit from sustainability reporting, in particular, classified information, trade secrets, and sensitive information whose disclosure could adversely affect the entity's market position;
- Removing the planned assurance level for sustainability reporting by auditors at a reasonable assurance level and maintaining it at a limited assurance level.

The Omnibus I package is the result of the decision made by US President Donald Trump to withdraw the United States from the Paris Agreement in January 2025. The next reason was related to the high costs and efforts required for introducing regulations on non-financial reporting. Consequently, it was changed because of the need to maintain a level of competitiveness among European companies, which can be reduced by the increasing costs of non-financial reporting.

The next regulation directly related to the non-financial reporting by financial institutions is the **Sustainable Finance Disclosure Regulation – SFDR** (Regulation (EU) 2019/2088 of the European Parliament and of the Council of 27 November 2019 on sustainability-related disclosures in the financial services sector). It imposes mandatory ESG disclosure obligations for asset managers and other financial market participants with substantive provisions. It was introduced by the European Commission alongside the **Taxonomy Regulation** (Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088) and the

Low-Carbon Benchmarks Regulation (Regulation (EU) 2019/2089 of the European Parliament and of the Council of 27 November 2019 amending Regulation (EU) 2016/1011 as regards EU Climate Transition Benchmarks, EU Paris-aligned Benchmarks and sustainability-related disclosures for benchmarks) as part of a package of legislative measures arising from the European Commission's Action Plan on Sustainable Finance. The SFDR aims to bring transparency to non-financial reporting. It is helpful for financial market participants (FMP) and financial advisers, such as AIFMs and UCITS managers, in assessing and analyzing the sustainability risks and their impact on the investments. It can be useful in presenting and finding sustainability-related information with respect to financial products. The SFDR is applied by all asset managers, regardless of whether they prioritize ESG or sustainability. Non-financial information should be presented:

- on websites,
- in prospectuses, and
- in periodic reports.

The fund managers must submit detailed, quantitative data on behalf of their portfolio companies quarterly.

The SFDR has three main goals:

- Eliminating greenwashing,
- Eliminating false claims,
- Holding accountable the sustainability claims made by FMPs, and
- Improving transparency in sustainable investment products.

The SFDR will require two levels of disclosure regarding integrating sustainability risks and opportunities into their investment decision-making process, that is,

- FMPs must consider the existence and impact of the sustainability risks on their investment decision-making process and on the returns of the financial products they offer. It became mandatory in March 2021.
- FMPs must present the principal adverse impacts of their investments on sustainability factors. It requires adherence to the Regulatory Technical Standards (RTS) for ESG and was presented in January 2023. The Principle Adverse Impacts (PAIs) include specifics about sustainability risks such as greenhouse gas emissions, water usage, and human rights impacts, and they became mandatory in June 2023.

The **EU Taxonomy**, which came into force on July 12, 2020, is a classification system that defines criteria for economic activities that are aligned with a net zero trajectory by 2050 and broader environmental goals other than climate and aligns with the **European Green Deal** objectives. The EU Taxonomy

establishes a mandatory obligation to disclose information on the compliance of economic activities or investments with the criteria set out in the regulation for:

- Non-financial companies covered by the Accounting Directive
- Financial companies covered by the Accounting Directive

The requirements apply to all companies covered by the CSRD and previously the NFRD. The requirement stems from Article 8 of the Taxonomy Regulation. A business activity must meet four conditions to be considered environmentally sustainable:

- Making a significant contribution to at least one environmental objective,
- Causing no significant harm to any of the other five environmental objectives (DNSH principle),
- Compliance with minimum safeguards (which involves following procedures to ensure compliance with the OECD Guidelines for Multinational Enterprises and the UN Guiding Principles on Business and Human Rights, including the principles and rights outlined in the eight core conventions identified in the International Labor Organization's Declaration on Fundamental Principles and Rights at Work), and
- Compliance with technical qualification criteria.

The environmental objectives of the EU Taxonomy:

- Climate change mitigation,
- Adaptation to climate change,
- Sustainable use and protection of water and marine resources,
- Transition to a circular economy,
- Pollution prevention and control, and
- Protection and restoration of biodiversity and ecosystems.

The “Do No Significant Harm” (DNSH) principle also applies to projects applying for European funds (e.g., the National Recovery and Resilience Plan). Under the Taxonomy Regulation, the Commission had to come up with the actual list of environmentally sustainable activities by defining technical screening criteria for each environmental objective through a delegated and implementing act. Companies seeking green financing must align with EU Taxonomy criteria, which determine eligibility for green bonds, loans, and sustainability-linked investments.

The **Corporate Sustainability Due Diligence Directive – CSDDD** (Directive (EU) 2024/1760 of the European Parliament and of the Council of 13 June 2024 on corporate sustainability due diligence and amending Directive (EU) 2019/1937 and Regulation (EU) 2023/2859) mandates human rights and environmental due diligence across global supply chains. Large EU firms (and

non-EU companies with significant EU revenue) must identify, mitigate, and report on ESG risks in their operations, subsidiaries, and supply chains. Failure to comply can result in fines and liability for damages.

All the presented main regulations in Europe play a significant role in collecting data, which are required to estimate the ESG risk by financial institutions. The lack of data in this area or the low quality of data makes it impossible to correctly estimate the ESG risk.

The next group of regulations that are taken or presented by local regulations is the one presented by supervisors, which is the **regulatory framework**. Regulators such as the European Banking Authority (EBA), the European Securities and Markets Authority (ESMA), and the European Insurance and Occupational Pensions Authority (EIOPA) are developing guidance on integrating ESG risks into existing risk management frameworks at financial institutions. The presented regulations are described in the next chapters and subchapters.

The next group of significant initiatives is **reporting standards**, such as IFRS for financial reporting and Global Reporting Initiative (GRI) for sustainability, that provide guidelines for measuring, recognizing, and disclosing financial or non-financial information in a consistent, comparable, and transparent manner. These standards help investors and other stakeholders make informed decisions by ensuring that information about a company's performance and impact is reliable and understandable across different organizations and jurisdictions. We can distinguish the following types of sustainability reporting standards:

- **Global Reporting Initiative Standards (GRI Standards)**, which is a globally recognized system for reporting on an organization's economic, environmental, and social impacts.
- **International Sustainability Standards Board Standards (ISSB Standards)**, which have been developed by the IFRS Foundation. These standards aim to create a global baseline for sustainability disclosures to provide investors with comparable and decision-useful information.
- **European Sustainability Reporting Standards (ESRS)**, which is a set of standards to report on sustainability under the Corporate Sustainability Reporting Directive (CSRD).

The main purposes of the reporting standards are:

- **Transparency and Comparability:** Standards make it easier to understand and compare financial and sustainability information across different companies and countries.
- **Informed Decision-Making:** They provide investors and other stakeholders with reliable and accurate information to assess a company's performance and make informed investment decisions.

- **Efficiency in Capital Markets:** By ensuring consistent reporting, standards reduce barriers to capital flow and support the efficient operation of global capital markets.
- **Regulatory Compliance:** Companies must adhere to applicable reporting standards, such as IFRS, to meet legal and regulatory requirements.
- **ESG Risk Analysis:** The reporting standards are helpful in the transparency of non-financial reporting, which helps in estimating ESG risk and comparing between companies.

Table 2.1 presents the main reporting standards and differences between them.

The following sections comprise **initiatives presented by sectors**. The mentioned initiatives are specialized and pertain to the variant risk observed within specific sectors. These initiatives are instrumental in the identification, measurement, and management of specified ESG risk.

Initiatives in **management data and its analysis** are related to the quality of data and the ESG ratings and scores. The initiatives can be categorized as follows:

- **Data analysis:** companies are encouraged to invest in external solutions that facilitate data management and the analysis of ESG-related information, especially in the context of supply chains and among suppliers.
- **Transparency:** These initiatives promote transparency throughout the supply chain, helping companies understand and manage ESG risks at all stages.

Management data is directly associated with regulations related to ESG scoring and ratings used to analyze and estimate the ESG risk. The oldest standard for ESG is the **ARISTA**, established in 2004 with co-financial support from the European Commission and developed by the Association for Independent Corporate Sustainability and Responsibility Research. This standard, however, is now largely obsolete. The **Deep Data Delivery Standard (DDDS)** was developed in 2016 for all types of investors contracting third-party data providers; however, as in the case of the ARISTA, the DDDS is now rarely used. The initial initiatives related to ESG ratings and scorings were prepared by the **International Organization of Securities Commissions (IOSCO, 2021)** and then in IOSCO (2023). IOSCO has highlighted concerns regarding the quality of ESG ratings, issues with the raw data used to estimate the ESG risk, discrepancies between ESG measures, methodologies that are either insufficiently documented or unclear, and missing data. The IOSCO recommendations resulted in the **ESG Ratings Regulation (Regulation (EU) 2024/3005 of the European Parliament and the Council of November 27, 2024, on the transparency and integrity of environmental, social, and governance (ESG) rating activities and amending Regulations (EU) 2019/2088 and (EU) 2023/2859)**, which was the first regulation that presented terms related to ESG ratings and scorings and the ESG data providers (their obligations, registration process, methodology

Table 2.1 Differences between reporting standards.

	<i>GRI</i>	<i>ISSB</i>	<i>ESRS</i>
Voluntary or mandatory	GRI is a comprehensive set of global voluntary standards that companies can use to report sustainability information.	The ISSB Standards were developed to create a unified set of global principles for reporting information related to sustainability development. The ISSB Standards are not mandatory. National authorities will decide whether companies will be required to apply them.	The ESRS are regulatory standards applicable to certain companies in the EU. Companies subject to the CSRD are required to use the ESRS as the basis for preparing their sustainability disclosures.
Range	The 2021 GRI Standards cover a broad range of topics related to sustainability. In addition, GRI also provides sector-specific standards. In the longer term, GRI plans to develop 40 sector-specific standards, starting with those sectors that have the greatest impact.	The ISSB has published two standards so far: IFRS S1 - General Requirements for Financial Disclosures Related to Sustainability IFRS S2 - Climate-Related Disclosures Additional standards will be published in the future.	The ESRS currently comprises 12 standards –two cross-cutting standards and 10 sector-independent thematic standards covering environmental, social, and corporate governance issues. The set of standards will be expanded in the near future, including sector-specific standards and proportionate standards for SMEs.
Approach to materiality	GRI standards are based on the materiality of impacts, focusing on issues that impact the economy, the environment, and people.	The ISSB standards focus exclusively on financial materiality. This means that they prioritize those issues that are most important to financial performance and financial decision-making.	The ESRS obliges companies to apply the double materiality principle.
Main recipients	Various stakeholders	Financial stakeholders	Various stakeholders

presentation duties, separation of ESG ratings from other activities, conflict of interests, disclosure of information for users, and assessed institutions). The regulation presented herein was prepared based on the Credit Rating Directive.

The Financial Conduct Authority (FCA, 2021) published a consultation paper on “Enhancing Climate-Related Disclosures by Standard Listed Companies,” that presents the significance of the ESG ratings and scorings on the capital market. It drew attention to the lack of knowledge in the methodology of ESG ratings and scorings, problems with return information from ESG ratings providers, and conflicts of interests. In 2022, FCA enforced regulations related to the ESG data and rating providers within the regulatory framework. In December 2023, the International Capital Market Association and the International Regulatory Strategy Group launched a voluntary code of conduct for ESG ratings and data providers. In 2023, the UK Treasury suggested that only ESG ratings would be under control. In 2024, the UK government drew attention to the need to regulate the mentioned area.

In the United States, ESG ratings are not regulated; however, the Securities and Exchange Commission (SEC) focused on the quality of reported non-financial data and its futility. The House of Representatives passed the ESG Disclosure Simplification Act in June 2021, which requires listed companies to disclose quarterly and annual ESG metrics and gives the SEC the authority to define the metrics and enforce the necessary disclosures.

The Technical Committee for ESG Evaluation and Data Providers published a report in Japan in July 2022, outlining a voluntary code applicable to all ESG evaluation and data providers involved in or providing services to participants in the Japanese financial markets. In Switzerland, Singapore, Hong Kong, Indonesia, Thailand, and China, measures have been taken regarding ESG data reporting by listed companies.

The final section comprises initiatives related to the **cooperation and stakeholders’ engagement**. Many initiatives emphasize the importance of engaging stakeholders such as customers, investors, and NGOs in the process of identifying and assessing ESG risks.

In the **United States**, no comprehensive federal ESG law is currently in place, and with the SEC climate disclosure rule on hold, several state-level ESG laws are emerging, including New York’s proposed climate disclosure rules and Colorado’s ESG reporting standards for financial institutions. The examples of the mentioned regulation include:

- California SB 253: The Climate Corporate Data Accountability Act mandates scope 1, 2, and 3 emissions reporting for companies with over \$1 billion in revenue operating in California. It is the strictest climate disclosure law in the United States and will likely influence federal regulations.
- Dodd-Frank Act (Conflict Minerals Rule): Requires US-listed companies to disclose sourcing of tin, tungsten, tantalum, and gold (3TG) from conflict-affected regions. A key part of supply chain ESG compliance, non-compliance can lead to penalties and reputational risk.

On March 6, 2024, the SEC adopted rules to enhance and standardize climate-related disclosures by publicly traded companies and in public offerings. Their aim is to present companies with more consistent, comparable, and reliable information about the financial effects of climate-related risks on a registrant's operations and the strategies employed to manage those risks, while also balancing concerns about mitigating the associated costs of the rules. On March 27, 2025, the SEC announced that it will no longer defend its rules requiring companies to disclose climate-related risks, greenhouse gas (GHG) emissions, and governance practices. The decision, approved in a 3–2 vote along party lines, marks a significant shift in the agency's approach to climate-related disclosures. It is a consequence of President Donald Trump's decision to withdraw the United States from the Paris Agreement.

The **United Kingdom** has moved ahead with mandatory ESG disclosures, particularly in climate risk reporting and sustainable finance. Meanwhile, **Canada** has introduced measures focusing on forced labor risks. The UK (2025) **Modern Slavery Act** requires companies with annual revenues above £36 million to publish an annual slavery and human trafficking statement. Businesses must assess forced labor risks across supply chains, detail mitigation efforts, and disclose actions to prevent human rights abuses. **Canada's Bill S-211** (An Act to enact the Fighting Against Forced Labour and Child Labour in Supply Chains Act and to amend the Customs Tariff) requires companies to report on forced labor risks in supply chains, similar to the UK Modern Slavery Act. The Act applies to public and private businesses meeting revenue and operational thresholds.

In 2015, the Financial Stability Board (FSB) created the Task Force to develop recommendations of voluntary disclosures for listed companies. However, ahead of the COP26 summit (2021), the United Kingdom became the first G20 country to mandate 1,300 of the United Kingdom's largest private companies to disclose climate-related data in line with the Taskforce on Climate-related Financial Disclosures' (TCFD) recommendations. Rather than the previous "comply or explain" regime, the UK Chancellor of the Exchequer announced a mandatory "comply and apply," whereby the government would "mandate climate disclosures by large, private companies and financial institutions by 2025." However, according to the Financial Services and Markets Act 2023, s.89A F2(1)(a), although the FCA may create new rules that impose disclosure requirements upon public limited companies, they do not have the statutory authority to impose such disclosure on private companies limited by shares.

The UK government is now consulting on the exposure drafts of the UK versions of IFRS S1 (UK SRS S1) and IFRS S2 (UK SRS S2). Then, it will be published as finalized versions of standards for voluntary use later this year. Subsequently, the government and the FCA will consider whether to introduce requirements for certain UK entities to report against these standards.

The next aspect of ESG risk pertains to **policies and initiatives associated with investments**. The ESG risks to which a company may be exposed, and the manner in which these risks are managed, can increase or decrease the cost of

capital or affect access to it. For example, with the growing popularity of sustainability-linked bonds and sustainability-linked loans, the cost of financing is more closely linked to performance on specific ESG indicators or goals. This gives investors the opportunity to support companies undergoing transformation, while also enabling such companies to receive better financing terms if they achieve defined results in areas related to sustainability. Another example is debt instruments used to finance projects with positive environmental or social impacts, such as green bonds or social bonds. The need for issuers to respond to the increased interest in ESG data, therefore, seems clear. By disclosing the data investors are looking for, issuers can reassure them that they are effectively managing business risks and are aware of the opportunities associated with sustainable development.

The most popular are initiatives like

- **PRI:** The UN Principles for Responsible Investment (PRI) is a global network of investors committed to incorporating ESG factors into their investment and ownership decisions to foster long-term sustainable performance and mitigate risks. Its six principles guide investors to integrate ESG into their processes, act as active owners, seek ESG disclosures from companies, promote responsible investment, collaborate to improve effectiveness, and report on their activities and progress. The PRI provides resources, reporting frameworks, and data to help its signatories understand and address complex sustainability challenges and manage ESG risks.
- **United Nations Sustainable Stock Exchanges Initiative (2015):** Promotes responsible investing. Responsible investment relies on the support of organizations such as
 - Principles for Responsible Investment (PRI)
 - United Nations Conference on Trade and Development (UNCTAD)
 - UN Environment Program Finance Initiative (UNEP-FI)
 - UN Global Compact

The initiative encourages sustainable investment and the integration of environmental, social, and governance (ESG) factors into investment decision-making. The initiative seeks to create a global network of stock exchanges that are committed to promoting responsible investment.

- **IOSCO** recommendations.

There can be distinguished some challenges in ESG compliance implementation because complying with ESG regulations and standards is no easy process. Regulations are also evolving fast, and organizations must adapt to new requirements while managing data inconsistencies, resource constraints, and supplier compliance gaps. The mentioned problems are related to

- **Data Collection and Standardization:** Lack of standardization of non-reporting standards creates problems with complexity. Organizations

must navigate the **CSRD, TCFD or GRI, SASB, and ISSB standards**, each with different disclosure requirements. This inconsistency makes data comparisons difficult and increases the risk of non-compliance when reporting across multiple jurisdictions.

- **Keeping Up with Regulatory Changes:** Governments are tightening ESG laws, introducing mandatory reporting. Consequently, institutions must focus on tracking regulatory changes. Efforts to harmonize global ESG standards can create a single global baseline for sustainability reporting. Transitioning to these standards requires investments in systems of risk analysis, data collection, training, methodology changes, etc.

On the contrary, the presented initiatives can bring positive effects because they:

- **Minimalize losses:** Proper ESG risk management helps companies avoid legal, financial, and reputational problems, especially in financial companies. Estimation, especially environmental risk in climate change, can help analyze the default risk or effectiveness of the investments. Analyzing the climate risk is especially significant for estimating the risk of catastrophes in the insurance sector.
- **Value Creation:** Effective ESG risk management not only protects against losses but also creates opportunities for innovation, improved operational efficiency, and competitive advantage.
- **Rising Market Expectations:** Customers, investors, and regulators increasingly demand that companies operate in a socially and environmentally responsible manner, making ESG risk management a key element of business strategies. The mentioned situation is observed especially in the analysis and estimation of the capital requirements and minimalization of capital by financial institutions.

ESG Risk and Investment Fund Regulations

International Initiatives on ESG Risk in Investment Funds

The recent changes in regulations and market conditions highlight the need to introduce some changes in the investment fund market. Most of them are related to the construction of the portfolio and reporting requirements. In the case of investment funds, most regulations are based on guidelines and principles of both international and national scope, which are directly related to the investment opportunities available to these funds and the conditions applicable to the securities involved.

One of the most popular investing standards is the **Principles for Responsible Investment (PRI)**. They have an international character and were developed in 2006 by the United Nations through the UNEP Finance Initiative and UN Global Compact to encourage the integration of ESG factors into their

investment decisions. Their primary objective is to formulate investment principles by using the appropriate level of ESG disclosure. Currently, over 5,000 financial institutions participate in PRI. The UNEP Finance Initiative and the UN Global Compact have also played a significant role in driving the growth of PRI. The PRI framework consists of six core principles:

- Incorporate ESG issues into investment analysis and decision-making: Investors actively include ESG factors in their investment processes.
- Be active owners and incorporate ESG issues into ownership policies and practices: Investors use their influence as owners to engage with companies on ESG matters.
- Seek appropriate disclosure on ESG issues by the entities in which we invest: Signatories request transparency from their portfolio companies regarding ESG performance.
- Promote acceptance and implementation of the PRI within the investment industry: The PRI network encourages broader adoption of responsible investment practices.
- Work together to enhance our effectiveness in implementing the PRI: Collaboration among investors strengthens their ability to apply responsible investment strategies.
- Each report on their activities and progress toward implementing the PRI: Signatories commit to transparent reporting on their ESG integration and stewardship efforts.

Implementing PRI in investment portfolios focuses on using the ESG integration techniques and participating in collaborative initiatives to promote responsible investing. Consequently,

- Investors can ensure that their investment choices align with their values and objectives while considering significant factors such as the environment and society.
- It can lead to better investment decisions, improved risk management, and more sustainable returns.
- Investors can demonstrate their commitment to responsible investing and contribute to a more sustainable global financial system.

ESG integration techniques help investors incorporate ESG factors into their investment processes, supported by resources such as the PRI guide. These techniques include:

- Screening;
- Impact investing;
- Shareholder engagement;
- ESG-focused funds.

This enables investors to make more informed decisions while considering the potential risks and rewards associated with their investments.

Focus on ESG risk management relies on:

- **Risk Mitigation:** Integrating ESG factors helps investors identify and manage a broader range of risks, such as climate-related risks and those stemming from social or governance failures.
- **Long-Term Performance:** The PRI views responsible investment not just as risk management but as a key driver of long-term value creation and sustainable financial performance.
- **Reporting Framework:** The PRI provides a reporting framework for its signatories to report on how they incorporate ESG factors and manage risks, building on previous analyses and providing insights into global trends.
- **Tools and Guidance:** The organization offers resources, such as Responsible Investment Due Diligence Questionnaires (DDQs) for private equity, to help investors evaluate and manage ESG risks in their portfolios.

It provides signatories with practical guidance, training, and data to navigate sustainability challenges and implement ESG principles effectively. The PRI acts as a vital platform for investors to share best practices, collaborate on initiatives like Climate Action 100+, and amplify their collective voice in promoting responsible investment.

The next significant regulation related to investment is the **Taskforce on Climate-related Financial Disclosures (TCFD)**, established in 2015 by the Basel-based Financial Stability Board (FSB), with a goal of promoting international financial stability. The TCFD's focus is on reporting on the impact an organization has on the global climate. It can be used by companies and investors to develop effective climate-related disclosures and to assess and manage exposures to climate-related risks and opportunities. The framework is based on four pillars: governance, strategy, risk management, and metrics and targets, supported by 11 disclosure recommendations presented in Table 2.2. The TCFD recommendations have become the leading global framework for climate-related disclosures. As of 2022, 3,960 organizations with a market capitalization of \$26 trillion have endorsed the TCFD, including over 1,500 financial institutions responsible for \$220 trillion in assets. The TCFD recommendations have been used by governments, regulators, and stock exchanges (in whole or in part) to develop regulations, policies, or guidelines for the disclosure of climate-related financial information. They have also been incorporated into sustainability reporting standards, including those of the ESRS and ISSB. The disclosure requirements under ESRS E1 Climate Change are largely based on the TCFD framework. Therefore, companies that already use the TCFD recommendations to shape their climate-related reporting should be well prepared to adopt the more stringent ESRS provisions. However, while the ESRS largely aligns with the TCFD recommendations, it is significantly more prescriptive and detailed. They also introduce additional disclosure

Table 2.2 Taskforce on climate-related financial disclosures main rules.

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

Source: TCFD (2017).

requirements. These additional requirements stem, among other things, from the double materiality principle required under the ESRS.

In January 2021, Switzerland officially became a supporter of the TCFD, although many major Swiss companies are already following its recommendations. The Swiss Federal Council has instructed the State Secretariat for International Finance (SIF), in close cooperation with the Federal Office for the Environment (FOEN), to develop a draft law this year in consultation with the private sector and industry associations with the objective of making the TCFD recommendations binding.

The TCFDs are important for businesses to improve their own understanding of their long-term climate-related risks and opportunities. Furthermore, they matter because of the growing pressure on companies from governments, consumers, and investors to respond to climate change. More governments will shift from recommending the TCFDs as guidance to enacting laws and policies to embed the recommendations into mandatory legislation and regulation. Beyond the fundamental questions of strategy and governance, several challenges remain. These include:

- Short-term data vs. long-term impact: Climate forecasting is not perfect. Historical data is insufficient to model the impact of climate change over the long term and to quantify its potential financial impact over a range of different scenarios.
- From scenario planning to financial impact: Companies are expected to take the results of the climate scenario modeling and translate these into financial impact and potential impact on business performance and to develop mitigating strategies, which must also be stress tested against various climate scenarios.
- Climate change beyond borders: Identifying and measuring physical risks, especially future risk, is difficult. Companies with complex global supply chains will need to take location-specific risk into consideration.

ESG in investment fund regulations aims to increase transparency and prevent “greenwashing” by requiring funds to disclose how they incorporate ESG factors into their strategies. Key regulations include the US SEC’s proposed ESG Disclosure Rules and the European Securities and Markets Authority (ESMA, 2024) guidelines on fund names, which set criteria for using ESG terms and require funds to meet certain investment thresholds or exclusions to justify those labels.

In the **United States**, the SEC proposed regulations to enhance transparency for funds and investment advisers regarding their ESG strategies. The rules presented in this regulation specifically target funds labeled as ESG integration, ESG-focused, and impact investment funds. Funds will be required to provide an overview of their ESG strategy and how they incorporate ESG factors into their investment decisions.

European Regulatory Framework on ESG Risk Management in Investment Funds

The European Union and ESMA introduced some significant regulations for investment funds and their activity. In the case of investment policies, ESMA published **Guidelines on funds’ names using ESG or sustainability-related terms**. They were related to using fund names or terminology that could imply the funds are used in sustainable investment activities, although in reality, some of them have nothing in common with it. These guidelines apply to UCITS management companies, including UCITS that have not designated a management

company; alternative investment fund managers, including internally managed AIFs, EuVECAs, EuSEFs, and ELTIFs, MMF managers, as well as competent authorities. They focus on terms related to “transition,” “environmental,” “social,” “governance,” “impact,” and “sustainable.” The main idea of these guidelines is to ensure that fund names accurately reflect the fund’s investment strategies and sustainability commitments. Funds using ESG-related terms must meet specific criteria, such as an 80% threshold for investments aligned with ESG characteristics and certain exclusions for companies in activities like fossil fuels or controversial weapons (Table 2.3). In the case of funds whose names combine few terms, all presented rules in Table 2.3 must be applied cumulatively, except transition-related terms. Funds that are designating an index as a reference benchmark should only use these terms in their name if the guidance under those paragraphs is fulfilled. These guidelines apply to new funds immediately, and existing funds have a transition period to comply. The regulations are expected to facilitate the comparison of ESG investment products for investors. By setting clear criteria for using ESG terminology, regulators aim to reduce misleading marketing of funds as sustainable when they are not. Fund managers must review their ESG practices and policies to ensure they are consistent with their disclosures and are in line with the new regulatory requirements. The terms related to “transition” or “impact” indicate a clear and measurable path to social or environmental transition or are aimed at producing a positive and measurable social or environmental impact in conjunction with financial returns.

Beginning in 2023, funds are required to provide standardized information on their sustainability strategy and disclose the principal adverse sustainability impacts of investments (PAIs). Different categories of funds, as outlined in Articles 6, 8, and 9 of the SFDR, determine the extent to which they promote sustainable investments. The SFDR divides funds into several categories based on their approach to ESG:

- Article 6 (other funds): Funds that address sustainability risks but do not aim to promote environmental or social aspects.
- Article 8 (light green): Funds that promote environmental or social aspects but do not have sustainable investing as an objective.
- Article 8 (light green plus): Funds that invest in promoting environmental and/or social aspects without having sustainable investments as a goal but engaging in such investments to some extent.
- Article 9 (dark green): Funds whose primary objective is sustainable investing.

The key disclosure obligations are:

- Sustainability Strategy Disclosure: From 2023, investment fund companies (IFCs) must provide detailed, standardized information on how the fund addresses its sustainability strategy.

Table 2.3 ESMA's guidelines related to the names of funds.

<i>Term</i>	<i>Portfolio building rules</i>	<i>Exclusions from investments</i>
Funds using transition-, social-, and governance-related terms	Meet an 80% threshold linked to the proportion of investments used to meet environmental or social characteristics or sustainable investment objectives in accordance with the binding elements of the investment strategy, which are to be disclosed in Annexes II and III of CDR (EU) 2022/1288	Exclusion investments in companies referred to in Article 12(1)(a) to (c) of CDR(EU) 2020/1818, i.e.: • Companies involved in any activities related to controversial weapons, i.e., referred to in international treaties and conventions, United Nations principles, and, where applicable, national legislation; • Companies involved in the cultivation and production of tobacco; • Companies that benchmark administrators find in violation of the United Nations Global Compact (UNGC) principles, or the Organization for Economic Cooperation and Development (OECD) Guidelines for Multinational Enterprises.
Funds using environmental- or impact-related terms	meet an 80% threshold linked to the proportion of investments used to meet environmental or social characteristics or sustainable investment objectives in accordance with the binding elements of the investment strategy, which are to be disclosed in Annexes II and III of CDR (EU) 2022/1288	Exclusion investments in companies referred to in Article 12(1)(a) to (g) of CDR(EU) 2020/1818, i.e.: • Companies involved in any activities related to controversial weapons, i.e., referred to in international treaties and conventions, United Nations principles, and, where applicable, national legislation; • Companies involved in the cultivation and production of tobacco; • Companies that benchmark administrators find in violation of the United Nations Global Compact (UNGC) principles, or the Organization for Economic Cooperation and Development (OECD) Guidelines for Multinational Enterprises; • Companies that derive 1% or more of their revenues from exploration, mining, extraction, distribution, or refining of hard coal and lignite; • Companies that derive 10% or more of their revenues from the exploration, extraction, distribution or refining of oil fuels; • Companies that derive 50% or more of their revenues from the exploration, extraction, manufacturing, or distribution, of gaseous fuels; • Companies that derive 50% or more of their revenues from electricity generation with a GHG intensity of more than 100 g CO₂ e/kWh.

Funds using sustainability-related terms	• Meet an 80% threshold linked to the proportion of investments used to meet environmental or social characteristics or sustainable investment objectives in accordance with the binding elements of the investment strategy, which are to be disclosed in Annexes II and III of CDR (EU) 2022/1288 • Commit to invest meaningfully in sustainable investments referred to in Article 2(17) of the SFDR.	Exclusion investments in companies referred to in Article 12(1)(a) to (g) of CDR(EU) 2020/1818, i.e.: • Companies involved in any activities related to controversial weapons, i.e., referred to in international treaties and conventions, United Nations principles and, where applicable, national legislation; • Companies involved in the cultivation and production of tobacco; • Companies that benchmark administrators find in violation of the United Nations Global Compact (UNGC) principles, or the Organization for Economic Cooperation and Development (OECD) Guidelines for Multinational Enterprises; • Companies that derive 1% or more of their revenues from exploration, mining, extraction, distribution, or refining of hard coal and lignite; • Companies that derive 10% or more of their revenues from the exploration, extraction, distribution, or refining of oil fuels; • Companies that derive 50% or more of their revenues from the exploration, extraction, manufacturing, or distribution of gaseous fuels; • Companies that derive 50% or more of their revenues from electricity generation with a GHG intensity of more than 100 g CO₂ e/kWh.
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Source: ESMA (2024).

- **Principal Adverse Impact Disclosure (PAI):** Funds are required to periodically disclose information on the principal adverse impacts of investment decisions on sustainability (e.g., negative ESG impacts). This information may be published in any manner, including in financial statements.
- **Reporting Standardization:** The purpose of these regulations is to facilitate investor comparisons of investment products.

Investment-related guidelines and directives constitute the next important section of the regulations. One of the most popular is the **Green Bond Standard** (Regulation (EU) 2023/2631 of the European Parliament and of the Council of 22 November 2023 on European Green Bonds and optional disclosures for bonds marketed as environmentally sustainable and for sustainability-linked bonds). This regulation is based on the Taxonomy regulation and is voluntary. Its main aim is to present clear market best practices and established supervision of companies carrying out pre- and post-issuance reviews at the European level.

According to the EU Green Bond Standard, the issuer must invest all of the financial sources from these bonds in sustainable economic activities in accordance with the EU Taxonomy before their maturity. The proceeds from these bonds can be invested in two ways:

- According to the portfolio approach, in a portfolio of fixed assets or financial assets; and
- According to the gradual approach, in fixed assets, capital and operating expenditures, as well as assets and expenditures of households.

Of the mentioned financial sources, 15% can also be invested in various activities that meet, but are not officially covered by taxonomy, thereby providing some flexibility.

The Green Bond Standard emphasizes certain formal procedures that must be undertaken by issuers of the green bonds. The responsibilities include:

- Completing the European green bond factsheet (Annex I) by the issuers of green bonds. This document should be subsequently approved by an external reviewer before issuing a bond (pre-issuance review).
- Providing an allocation report according to regulations included in Annex II every 12 months until the proceeds are fully invested. This report indicates where money was invested.
- Receiving post-issuance reviews from an external reviewer;
- Preparing and publishing an environmental impact report in accordance with the Annex III rules on the use of the funds. This report must be prepared at least once during the lifetime of the bond.
- Publishing a prospectus according to the rules presented in Regulation (EU) 2017/1129. The term “European green bond” or “EuGB” should be used throughout, except when referring to sovereign bonds.

- Presenting factsheets, prospectuses, reviews, and other significant information on the issuers' website at least a year after the bond matures.

In the case of the securitized bonds, some separate rules apply. If the bonds are issued in synthetic securitization, they cannot be treated as green bonds. The securitized exposures may:

- Not be used to finance fossil fuels and processes associated with their extraction and distribution.
- Be used for financing electric energy derived from fossil fuels, provided that no significant damage is caused.

They must include the term “European green bond” or “EuGB.” Their character must be described in the prospectus. The issuers of the securitized bonds are required to provide documentation affirming their responsibility for the allocation of funds. All information regarding the supported activity should also be described. The green bond templates will be published by the European Commission.

The European Green Bond Standard focuses on the requirements related to the external reviewers. Supervision of green bond issuers is conducted by competent national authorities.

ICMA (2024) presented its own **Green Bond Principles (GBP)**. Their objective aligns closely with that of the Green Bond Standard. They also have a voluntary nature and were updated in June 2025. The newest GBP includes a reference to the **Green Enabling Projects Guidance** that was published in June 2024. Furthermore, in addition to assets, investments, and other related and supporting expenditures, it includes “activities” in the definition of green projects.

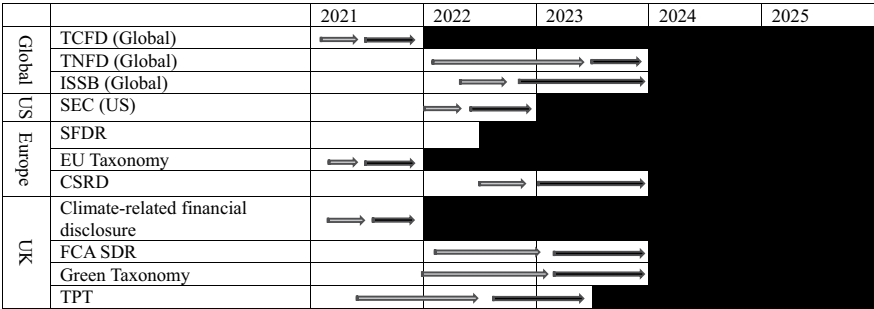
Another popular standard is the **Climate Bonds Standard**. This standard also involves third-party certification to ensure that bonds meet specific sector-based criteria outlined in the Climate Bonds Taxonomy, focusing on eligibility for climate mitigation or adaptation.

ESG Risk and Insurance Regulations

European Regulatory Framework on ESG Risk in Insurance

As a part of the financial sector, the insurance industry has been under intense pressure to estimate, assess, monitor, report, and reduce ESG risk. One of the first regulations related to the impact of this risk on the insurance sector was the Principles for Sustainable Insurance (PSI) introduced by the United Nations at the 2012 Rio+20 Summit. They focused on the integration of ESG risk in the management of insurance companies. Consequently, insurers have been working hard to introduce and market ESG practices during the last period. The largest insurers ratified the PSI. The main regulations related to ESG risk that are significant for the insurance sector are listed in Table 2.4.

Table 2.4 The sustainability regulatory landscape is rapidly evolving.



Note: ⇒⇒ consultation; ⇒⇒⇒ response and launch of standard; ■ moment of implementation.

In the case of the insurance companies, EIOPA develops guidelines to help insurance undertakings manage ESG risks, which pose prudential risks to the financial sector through climate change, policy shifts, and evolving market sentiment. These guidelines, a product of the amended Solvency II Directive, require insurers to develop and implement specific plans and monitoring processes for ESG risks. EIOPA also participates in joint initiatives with other European Supervisory Authorities (ESAs) to establish consistent ESG stress testing methods, ensuring effective and coordinated approaches to assessing these risks across the industry.

As mentioned earlier, the most popular regulations belong to the **Updated Solvency II Directive** (Directive 2025/2 of the European Parliament and of the Council of November 27, 2024, amending Directive 2009/138/EC as regards proportionality, quality of supervision, reporting, long-term guarantee measures, macroprudential tools, sustainability risks, and group and cross-border supervision, and amending Directives 2002/87/EC and 2013/34/EU). This updated directive requires insurance to manage climate risk as one of the most important risks for this sector. It also drew attention to the need for some guidelines, technical standards, and other recommendations to be presented by EIOPA. Issuers are obligated to identify, measure, and manage climate risk over the short, medium, and long term. On November 5, 2024, the Council of the European Union adopted a revision of the **International Restructuring and Development Directive - IRRD** (Directive (EU) 2025/1 of the European Parliament and of the Council of 27 November 2024 establishing a framework for the recovery and resolution of insurance and reinsurance undertakings and amending Directives 2002/47/EC, 2004/25/EC, 2007/36/EC, 2014/59/EU and (EU) 2017/1132 and Regulations (EU) No 1094/2010, (EU) No 648/2012, (EU) No 806/2014 and (EU) 2017/1129). In the context of ESG risk, changes are planned in risk analysis and reporting. Consequently, especially in the case of the climate risk, the Standardized Capital Requirement (SCR) must be calculated by using a standardized method once every two years. It must also prepare the SFCR report as a separate document. The updated Solvency II

Directive does not directly mention ESG risk. It needs additional interpretation in the risk assessment process and investment strategies, especially by the **prudent person principle** and reporting requirements. The ESG risk can be observed in credit risk (as an effect of buying green bonds) and market risk (changes in prices of investment assets), but also in **own risk assessment and capital adequacy (ORSA)** in Pillar 2. The mentioned relationships can be noticed in:

- Pillar 1 (Quantitative Requirements): While Pillar 1 focuses on the valuation of assets and liabilities and capital requirements, the prudent investor principle (Article 132 of the Directive) provides the basis for incorporating ESG risks. Companies must invest in assets whose risks are known to them, which also include sustainability-related risks (climate, environmental).
- Pillar 2 (Risk Oversight and Management): ESG risks are a risk management element assessed under Pillar 2, particularly in the Own Risk and Capital Adequacy Assessment (ORSA) process. Insurers must integrate ESG factors into their investment strategies and risk management processes.
- Pillar 3 (Reporting): Pillar 3, which covers reporting requirements, requires the publication of information on the main adverse impacts of investment decisions on sustainability factors, which are directly linked to ESG.
- Prudent Person Principle: Implementation of this principle requires insurance companies to consider sustainability risks and customer preferences in the investment process.

In summary, updated Solvency II creates a baseline that allows, and even compels, the growing integration of ESG risks – specifically, climate risk – into insurance operations, particularly through governance, investment, and transparency requirements.

The mentioned updated Solvency II Directive focuses on climate risk that is observed in:

- Analyzing the climate change over a longer period in the solvency capital requirement.
- Analyzing the climate risk as a micro risk.
- In the case of the material exposure to climate change-related risks, the insurance and reinsurance companies are required to prepare long-term climate change risk scenarios. From these duties small, non-complex insurance and reinsurance companies are excluded.

The climate risk issuer's scenario analysis should be based on:

- Assessing the material exposure to climate change risks;
- Demonstrating the materiality of its exposure to climate change risks;
- Preparation of at least two long-term climate change scenarios for significant climate change risks, including:

- a long-term climate change scenario with an increase in global temperature below 2°C;
- a long-term climate change scenario with an increase in global temperature of more than 2°C;
- Presenting the climate risk assessment at regular intervals not exceeding three years by taking into consideration the scale, type (nature), and complexity of the climate change risks;
- Revision, analyzing results, and updating the long-term climate change scenarios at least every three years;
- Updating the tools and principles used for previous climate change scenarios.

The updated Solvency II defines the sustainability risk, which means an ESG situation or condition that, if it occurred, could have an actual or potential negative impact on the value of an investment or the value of a commitment.

The insurance and reinsurance companies need to prepare plans that should include:

- Measurable objectives in the short, medium, and long term from sustainability factors;
- Processes for monitoring and addressing financial risks in the short, medium, and long term from sustainability factors;
- Measurable objectives and processes from the adjustment process and transition trends;
- Reports and measures recommended by the European Scientific Advisory Committee on Climate Change;
- Actions for business model and business strategy; and
- Annually discloses measurable goals.

The methods and assumptions that underpin objectives, commitments, and strategic decisions and are publicly disclosed by facilities must be consistent with those included in the plans. If an insurance or reinsurance undertaking participates in another insurance or reinsurance company, the insurance holding company or mixed financial holding company established in the EU is required to draw a plan at the group level. Subsidiaries that are insurance and reinsurance undertakings covered by this plan and fall within the scope of group supervision are exempt from the obligation to draw a plan at the individual level.

As a result of the mentioned regulations, EIOPA, along with ESMA and EBA, presented joint regulations like:

- Final Report on Joint ESAs Guidelines on ESG Stress Testing (ESA, 2026);
- Proposal of Joint Regulatory Technical Standards on ESG disclosure standards for financial market participants (ESA, 2025).

EIOPA (2021) also provides guidance in its **Supervisory Handbook** to help supervisors understand how to assess a company's approach to climate change risks and its impact on business planning. This European authority also analyses the resilience of the insurance sector to climate change-related physical risks and plans to explore transition risks.

In the discussion paper on the **Prudential Treatment of Sustainability Risks**, EIOPA (2024) proposes that the Solvency II framework is conceptually well placed to capture sustainability risks. It explores the possibility of recognizing sustainability risks under existing elements of the Solvency II balance sheet. EIOPA's discussion paper does not consider adding new risk types to capital requirements – and, indeed, the capital requirements explored are not just in relation to holding “brown” vs. “green” assets. EIOPA examines both the Standard Formula's prudential treatment of assets with high sustainability risks, and potentially increasing capital based on the structure of insurance liabilities. The paper focuses specifically on:

- The method to recognize the risk exposures from insurers' investment portfolios;
- How climate change adaptation measures in the design of insurance products might reduce risk exposure; and
- How socially harmful activities might lead to financial losses and reputation risks for insurers.

The presented changes include:

- Assets' transition risk exposures – life and non-life insurers
 - Classifying assets: For stocks and bonds, two approaches are presented that would classify assets according to their transition risk exposure and helps to consider whether to incorporate differential risk charges into the SCR using historical price data, that is,
 - Sectoral, with an investee company's economic activity being the determinant of the level of transition risk – for example, identifying insurers' investments in steel or fossil fuel companies and using this classification to measure the level of transition risk.
 - Identify company-specific environmental variables that allow for classification. This could involve firms using an investee company's disclosed EU Taxonomy data, ESG ratings, or greenhouse gas (GHG) emissions data to determine transition risk.
 - For property assets, EIOPA discusses a risk classification system based on energy performance certificates (EPCs). It notes that 8% of EU insurers' investments are in real estate, meaning any potential changes to property values driven by energy efficiency could materially affect firms'

balance sheets. It considers the use of EPCs to assess transition risk for residential and commercial real estate and asks stakeholders to comment on whether they agree with this approach and have any quantitative evidence on the potential link between a building's energy efficiency and its market value in EU housing markets.

- Prudential risk assessment: EIOPA (2024) considers methodologies for a forward-looking prudential risk assessment that factors in the future materialization of climate-related risks. EIOPA notes existing assessments from other European regulators and explores:
 - The different types of scenarios available to firms (e.g., Network for Greening the Financial System (NGFS) and International Energy Agency (IEA)).
 - The utility of transition vulnerability factors (TVFs) – sector-specific climate risk measures introduced by De Nederlandsche Bank opens in a new tab in 2018.
 - How to express transition risk differentials in terms of the 0.5% value at risk (VAR), and the Monte Carlo simulations that firms can apply.
- Underwriting and climate change adaptation – non-life insurers: EIOPA has focused on climate adaptation measures and how these might reduce physical risk arising in non-life insurers' liabilities. It considers measures such as water-resistant walls, windows and doors, non-return valves on main sewer pipes against flood risk, and sandbags or domestic flood protection walls against flood risk. EIOPA seeks views on the use of quantitative analysis to observe any significant differences in the prudential risks for insurance products with and without climate adaptation measures, and whether insurers should recognize any such differential when calculating their capital requirements. The adaptation measures could smooth the claims distribution by reducing the frequency or intensity of climate-related losses. Therefore, the absence of climate-related adaptation measures could suggest premium mispricing – and thus require capital to be held for premium risk. This idea is significant as it focuses specifically on sustainability risk capital requirements for underwriting – not investment – decisions, and it does so using a risk type that is already on the Solvency II balance sheet. EIOPA also proposes to assess the potential for a new calibration of the non-life SCR parameters for premium risk in the Solvency II Standard Formula, using the Undertaking Specific Parameter (USP) methodology. Climate adaptation measures may also impact other elements of the SCR, for example, through natural catastrophe risk, where expensive adaptation measures could increase the value of a property, thereby raising the sum insured and increasing the corresponding capital requirements. However, this is not a primary focus for now, and EIOPA's priority appears to be the consideration of premium risk.

- Social objectives and risks from a prudential perspective – life and non-life insurers: It maps social risks to existing Solvency II risk types:
 - Underwriting risk – through workers’ compensation, increased mortality or morbidity, increased losses under directors and officers (D&O) liability claims, etc.
 - Market risk – through asset price volatility, stranded assets owing to investee reputational risk, equity or bonds in economic activity that damages health or housing, etc.
 - Operational risk – through inadequate or failing internal processes that do not allow insurers to act on previous signals of social risk.

It suggests that social objectives and risks should be conceptually similar to the treatment of climate-related risks – a recognition that “ESG” goes beyond climate change, and perhaps a nod to the European political landscape where social objectives are increasingly being discussed. However, EIOPA recognizes the challenges around social objectives and risks, including the level of public debate about what these should be and how they can be measured and disclosed. It seeks feedback on this, and on how corporate governance measures, such as remuneration and board composition, can help reduce the potential level of social risks. EIOPA urges insurers to use their ORSAs as a starting point to investigate potential exposure to social risks. It also notes the need for both qualitative and quantitative analysis. If they are not already doing so, insurers should consider how social risks could affect their solvency ratios.

Solvency Regulations and ESG Risk in Insurance

The insurance sector and its activity is mostly regulated by Directive **Solvency II**. It is significant for all licensed EU insurance companies and reinsurers, and is related to

- Capital adequacy requirements;
- Management requirements;
- Risk management; and
- Reporting and public discourse.

The mentioned rules are also related to the estimation of the ESG risk, and they rescue the insurance companies from the default risk. The risk-based approach helps in estimating the overall solvency by using qualitative and quantitative measures. The insurance and reinsurance companies must analyze and assess the climate risk by using scenario analysis and taking them into consideration during risk modeling and assessing the default risk. The increasing number of claims and loss ratio related to climate risk leads to increasing insurance premiums and contractual insurance restrictions or limitations. Solvency II requires

the integration of the ESG risk in the corporate governance and risk management domain. In the case of corporate governance, it includes:

- the composition, roles, and responsibilities of the board of directors, both collectively and individually;
- the roles and responsibilities of the internal control functions;
- the roles and responsibilities of the actuarial function;
- training their key function holders and relevant employees in new concepts and their implications; and
- adapting their internal policies, procedures, and processes.

The modified Solvency II Directive, which focused on reporting in the sustainable development domain went into effect on January 28, 2025. Member states must implement it into their local law on January 29, 2027. The revised directive introduces some simplifications and modifications, in accordance with the proportionality principle, introducing the term “small and non-complex undertakings,” which refers to insurance or reinsurance undertakings (including captive insurance or reinsurance undertakings) that meet certain risk-based criteria specifically provided for in the new Article 29a of Solvency II for the two consecutive fiscal years immediately preceding classification. Companies using an approved partial or full internal model to calculate the SCR and parent firms of a financial conglomerate or insurance group (except for small, non-complex groups) are excluded from this group. Insurance companies are required to include sustainability in their investment and underwriting strategies, monitored by their risk management as well as their actuarial function. They are also obligated to assess the potential long-term impact of the ESG risk, especially the climate risk impact of their investment strategies and decisions on sustainability factors.

Solvency II focused on:

- Assessment and management of the loss risk and unprofitable change of the value of liabilities that are related to incorrect assumptions taken during the creation, pricing, and provisioning assumptions owing to internal or external factors, including sustainability risks.
- Taking correct decisions related to the correct identification, assessment, and management of the sustainable risk for the investment portfolio.
- Placing the sustainable risk in the risk assessment, technical and insurance reserve policies, investment risk management policies, as well as assets and liabilities management policies.
- Including the sustainable risk in the opinion presented by the Actuarial Function in respect of the underwriting policy.

The new sustainable risks and their changes in the risk profile are the main features of the Solvency II, especially if they are the result of the business strategies, as well as the economic and financial environment. The sustainable risk

can also be observed in the salary policies, which should present information on how this policy includes the integration of the sustainable risk in the risk management system. The **Commission Delegated Regulation (EU) 2021/1256** of 21 April 2021 amending Delegated Regulation (EU) 2015/35 as regards the integration of sustainability risks in the governance of insurance and reinsurance undertakings requires the actualization and approval of policies by the Board of Directors in line with the CDR.

In April 2021, EIOPA issued an **Opinion on the Supervision of Use of Climate Change Risk Scenarios in ORSA**, also called the EIOPA Opinion. This opinion underlines the significance of the time analysis that relies on:

- Varied time horizons, that is, the short term (5–10 years), medium term (30 years), and long term (75–80 years). In practice, insurance companies analyze the climate risk in the short term.
- Testing the global temperature changes scenarios, that is, 1.5°C or less, 2°C or less, and more than 2°C.
- Analyzing and testing the climate change risk and the prudential risk categories (underwriting, market, credit and counterparty, operational, reputational, and strategic risk).

The EIOPA Opinion focuses on:

- **Transition Risks**, which are risks that arise from the transition to a low-carbon and climate-resilient economy, including:
 - Policy risks, arising from energy efficiency requirements and carbon pricing mechanisms, which increase the price of fossil fuels, or policies to encourage sustainable land use.
 - Legal risks, resulting from the risk of litigation for failing to avoid or minimize adverse impacts on the climate or failing to adapt to climate change.
 - Technology risks when a technology with a less damaging impact on the climate replaces a technology that is more damaging to the climate.
 - Market sentiment risks, resulting from the choices of consumers and business customers shifting toward products and services that are less damaging to the climate.
 - Reputational risks, for example, the difficulty of attracting and retaining customers, employees, business partners, and investors if a company has a reputation for damaging the climate.
- **Physical risks** are risks that arise from the physical effects of climate change, including:
 - Acute physical risks, which arise from particular events, especially weather-related events such as storms, floods, fires, or heatwaves that may damage production facilities and disrupt value chains.

- Chronic physical risks, which arise from longer-term changes in the climate, such as temperature changes, rising sea levels, reduced water availability, biodiversity loss, and changes in land and soil productivity.

EIOPA recalibrates the natural catastrophe (Nat Cat) standard formula (SF) parameters. It has proposed over 20 new country risk factors for flood, hail, earthquake, windstorm, and subsidence, and has also proposed options for the potential inclusion of wildfires, coastal floods, and drought in future recalibrations of the Nat Cat SF. Insurers need to review their exposures (both by territory and by perils insured) to understand how the proposals affect their balance sheets and whether this could trigger any commercial decisions on product scope and wording.

According to the **Insure Our Future 2021 Report**, 35 global insurance and reinsurance companies reduced the insurance on fossil fuels, especially coal (in 2018, it was only three companies). The analysis reveals that the share of insurance company premiums limiting carbon insurance in the global property insurance market is 14%, and that of reinsurance companies is 55%. The higher levels of physical risk can influence the companies' operations and even their solvency. The climate risk pricing can be indirectly reflected through updated market data in insurance policies (not just insurance against extreme weather events), and additional ongoing costs of environmental protection.

Globally, the insurance industry is in a unique situation, as climate risk impacts both sides of the balance sheet: on the active side, investments, and on the passive side, technical insurance reserves, especially in the real estate sector. It is also important to recognize emerging threats.

Consequently, the insurance companies are obligated to:

- Identify the most significant risks related to climate change by using qualitative and quantitative data;
- Measure the identified risks by using the stress tests and scenario analysis;
- Assess the significance of climate risks according to the Solvency II Directive;
- Reduce the climate risk in the company and by offering specific products;
- Justifying why the specific climate risk is not significant for the insurance or reinsurance company.

The scope and methodologies that are used to estimate the qualitative and quantitative methods to estimate the climate risk will still be developed, especially in the scenario analysis and stress tests. It is related to the growing datasets and experience in measuring this risk. The estimation of the climate risk should be appropriate to the size, character, and complexity of the insurance and reinsurance firms.

The discussion document that was presented by EIOPA about approaches to assess the prudential treatment of insurers' sustainable assets and activities,

presents scope, methodologies, and sources of data that can be used for this assessment in three areas:

- Assets and transition risk exposures for the insurers' investments, especially in the area of transition to a less carbon-intensive economy and its impact on the prudential risks related to stocks, bonds, and real estate.
- Underwriting risk and climate change adaptation by non-life insurance companies, and examines the potential effect of climate-related adaptation measures on underwriting risk and related loss exposures from a prudential perspective.
- Social risks and objectives transferred to the prudential treatment in the requirements on governance, risk management, reporting, and disclosure.

The social risks transferred by the EIOPA Opinion on the risk presented by Solvency II are:

- Underwriting risk – through workers' compensation, increased mortality or morbidity, increased losses under directors and officers (D&O) liability claims, etc.
- Market risk – through asset price volatility, stranded assets owing to investee reputational risk, equity or bonds in economic activity that damages health or housing, etc.
- Operational risk – through inadequate or failing internal processes that do not allow insurers to act on previous signals of social risk.

EIOPA focused on the impact of corporate governance measures related to remuneration and board composition, which can reduce the social risk.

EIOPA urges insurers to use their ORSAs to investigate the exposure to social risks. It also notes the need for both qualitative and quantitative analysis. If they are not already doing so, insurers should consider how social risks could affect their solvency ratios.

EIOPA (2024) has focused on climate adaptation measures and how these might reduce physical risk associated with non-life insurers' liabilities. Water-resistant walls, windows and doors, non-return valves on main sewer pipes to reduce flood risk, and sandbags or domestic flood protection walls against flood risk are some of the solutions suggested. EIOPA also proposes to assess the potential for a new calibration of the non-life SCR parameters for premium risk in the Solvency II Standard Formula, using the Undertaking Specific Parameter (USP) methodology. These measures can influence other elements of the SCR, for example, through natural catastrophe risk, where expensive adaptation measures could increase the value of a property, thereby raising the sum insured and increasing the corresponding capital requirements, thus proving that EIOPA focuses on the premium risk.

In the Prudential Treatment of Sustainability Risks EIOPA (2024) funds, such as bonds and equities linked to fossil fuels present a higher risk.

The industry can expect the introduction of differentiated SCR for bonds and equities linked to fossil fuels. A Commission Delegated Regulation presents:

- Equity risk module: A dedicated supplementary capital requirement to the current equity risk calibration for fossil fuel-related stocks (+17%);
- Credit spread risk: A dedicated supplementary capital requirement to the current spread risk calibration for fossil fuel-related stocks.

Pillar 2 presents the significance of the impact of climate change, pandemics, other mass-scale events, and catastrophes that can influence the insurance sector in macroeconomic and financial market developments.

According to the **Commission Delegated Regulation EU 2021/1256** and the taxonomy for the quantitative reporting templates (QRTs), the sustainability risk is in:

- The underwriting and reserving policy;
- The investment risk management policy;
- The risk management function's tasks when assessing overall solvency needs;
- The actuarial function's opinion on the underwriting policy;
- The remuneration policy; and
- The application of the prudent person principle.

The EIOPA reporting taxonomy published on March 17, 2023, introduced the identification of investments exposed to climate change risk (S.06.04).

The **International Association of Insurance Supervisors (IAIS)** has released the third paper, which opens in a new tab in a four-part consultation on managing climate-related risk, and the FSB's 2024 work plan opens in a new tab continuing its work on coordinating international efforts to address climate-related financial risk. The **Bank of England's (BoE's) 2023 report on climate-related risks and capital** concluded that research was required on the regime gap in the macroprudential framework. Future consultations will be required on the best way to address it before mandating any capital requirements. Alternatively, the Prudential Regulation Authority (PRA) may continue to place the onus on firms to manage their capital levels appropriately via the principles-based supervisory framework, with robust SMF responsibility, and, in some cases, capital add-ons. In the United Kingdom, the PRA indicates that effective practice would include having a well-defined quantitative risk appetite statement (RAS) that aligned with the overarching risk management framework (RMF). Supervisors will expect firms to have made progress in embedding climate-related risk into their RMFs, and insurers should be prepared to demonstrate this if asked for evidence as part of their BAU supervision. On April 30, 2025, the PRA published the consultation paper **CP10/25 – Enhancing banks' and insurers' approaches to managing climate-related risks – Update to SS3/19**. Key points included:

- The enhancements to the existing expectations did not represent a change of direction in the PRA's approach to climate risk.
- The rigorous use of scenario analysis.
- The need for further integration of climate risk into firms' governance frameworks.
- The need for a clear statement of risk appetite that cascades down from the top of the firm to individual business lines, as well as robust risk management frameworks to allow firms to balance the risks they face when setting their business strategy.
- The support of the International Sustainability Standards Board and the development of a framework for UK Sustainability Reporting Standards.

While not specific to financial services, the updated **UK Corporate Governance Code** will require boards to not only monitor a company's risk management and internal control framework but also explain how they have measured its effectiveness through a declaration in their annual reports. Insurers will want to consider how these requirements will encompass their work on climate-related risks. Globally, the IAIS proposes to strengthen its expectations on the role of the board. The IAIS emphasizes that boards should be competent in understanding the physical and transition risks for insurers. Additionally, senior management and board remuneration should be aligned with prudent risk-taking – including the sound management of climate-related risks.

In the United Kingdom, authorized insurance companies or companies carrying on insurance market activity (among other types of in-scope companies) must prepare, as part of their annual strategic report, a non-financial and sustainability information (NFSI) statement (section 414CA, **CA 2006**). The required climate-related disclosures in the NFSI statement broadly align with the TCFD recommendations (and these disclosures should have been incorporated into insurers' 2022 financial statements). Much of this is supported by piecemeal guidance from various governmental and non-governmental sources. Life insurers offering specific investment products (among other types of regulated firms) are required to make mandatory disclosures aligned with the TCFD recommendations, both at the entity-level and the product-level, pursuant to the **FCA's ESG Sourcebook (ESG)**. Broadly, this requires:

- At an entity level: in-scope insurers must provide an annual TCFD entity report that:
 - includes climate-related financial disclosures regarding the overall assets managed or administered by the firm in relation to its TCFD in-scope business (which includes, among other things, providing insurance-based investment products (IBIPs));
 - explains where its approach to a particular investment strategy, asset class, or product is materially different to its overall entity-level approach

- to governance, strategy or risk management under the TCFD recommendations; and
- briefly explains how the firm’s strategy under the TCFD recommendations has influenced decision-making and the process by which it delegates functions.
- At a product level: in-scope life insurers are required to make disclosures (including on specific climate-related metrics) in relation to the identified products that are provided or operated by an in-scope insurer, accompanied by relevant contextual information to explain how the metrics should be interpreted.

The **FCA Sustainability Disclosure Requirements** (the SDRs) sets certain minimum standards and requires in-scope firms to, among other things:

- Make climate-related product disclosures under the TCFD recommendations.
- Arrange plans to supply broader sustainability disclosures in addition to the SDR reporting.
- Label retail products into four categories based on the sustainability of investments.

The core elements of the regime apply to asset managers and their UK-based fund products and portfolio management services. Additionally, all FCA authorized firms are required to reinforce that sustainability-related claims must be fair, clear, and not misleading. The FCA has also indicated that it will consider extending the scope of the regime in due course to include pension products and other investment products marketed to retail investors, such as IBIPs. However, in February 2025, the FCA announced an additional delay to the application of its SDR to portfolio managers. The FCA had been expected to publish a policy statement on this proposed application of the regime during Q2 2025.

Solvency II, similar to the US “**Insurance Financial Solvency Framework**” presents many different perspectives that are related to the activity of the insurance sector.

Underwriting ESG risks affect both the underwriting and investment businesses of an insurer. The incorrect estimation of risk during the underwriting process, and not including the ESG factors, or failure in this area, can create problems related to the estimation of potential outcomes and risk estimation of the particular policy. Consequently, it can create an increasing number of claims and reduce insurers’ profits. The presented situation can also create the reputational risk connected with being publicly recognized as non-socially or non-environmentally aware. It can cause an increase in lapse rates (that is, non-renewals) and a fall in new business. The incorrect assessment of the ESG risk or not considering it can have an impact on the investment portfolio. Accidents related to oil or gas leakage, problems with extreme weather, events, or protests influence the insurer’s revenues, market value, or profits significantly. The long-term climate trends are especially significant, because it has a

direct impact on investments. It can also become a problem with obtaining financing from investors, such as investment from socially responsible investment funds, especially if they cover socially undesirable risks (tobacco and energy companies). A significant problem is noticed in the “protection gap” for social and environmental risk. The increasing probability of natural catastrophes related to climate change results in higher premiums. Consequently, the insurance coverage may become unaffordable for the policyholder, widening the insurance protection gap. These problems are also reported in pension, cyber, and health insurance. Certain insurers have publicly committed to underwriting restrictions to help minimize ESG risks. For example, in 2021, AXA announced it would stop underwriting new upstream oil greenfield exploration projects, except where they are carried out by companies with extensive and credible transition plans. In the United Kingdom, in 2022, the Global Risk Modeling Alliance was launched, whose main idea was to help public authorities and insurers analyze risks, prepare risk management tools, and provide data and access to operational risk finance. The United Kingdom also introduced “Flood Re,” which is a system of levies with UK insurers offering home insurance, which helps ensure appropriate and affordable flood insurance for UK homeowners at the highest risk of flooding. Aviva has publicly indicated that it has integrated ESG considerations as a central pillar in its investment process.

In conclusion, climate changes have had a direct influence on the insurance industry. The challenges vary and are contingent upon the nature of the risk and type of insurers, such as:

- Climate-related value creation and preservation:
 - General insurance:
 - New products related to new types of insured items and risks;
 - Pricing impacts related to electric cars, solar panel, etc., and modeling the capacity and data; and
 - Changes in business strategy and risks.
 - Life insurance:
 - Impact on long-term asset valuations and returns;
 - Impact on long-term assumption changes;
 - Influence on solvency capital modeling;
 - Changes in methodology; and
 - Increasing demand for climate-rated data.
- Emissions reporting and targets:
 - Insured emissions:
 - PCAF Guidelines related to measuring insurance-associated emissions for motor lines; and
 - Disclosure Recommendations under TCFD.

- Financed emissions:
 - Challenges in sourcing data about private and public assets underpinning the investment portfolios of insurance funds;
 - More developed proxy methodologies, such as implied temperature rise (ITR) and portfolio warming potential (PWP); and
 - Clarifications for investors and analysts.

The presented regulation focuses on the need to analyze the ESG risk from a solvency perspective. Consequently, the analysis can be based on the micro prudential perspective, such as, **solvency capital requirements, structure of own funds, or quality of investment assets**. All presented regulations assume a certain market level. They should be more flexible and suited to the type and nature of the market. While a minimum harmonization approach is possible for regulation, maximum harmonization is considered to be the only option for micro prudential regulation. The same applies to ESG regulation. However, the reasoning may be somewhat different, and regardless of this issue, regulation may be excessive in some countries.

In the case of the insurance and reinsurance companies, Article 304c of the Solvency II Directive mandates EIOPA to assess the potential for a dedicated prudential treatment of assets or activities associated substantially with environmental or social objectives, or harm to such objectives, and to assess the impact of proposed amendments on insurance and reinsurance undertakings in the European Union. This regulation, in the ESG area, results in an expansion of the scope of information that must be disclosed on the website of insurance or reinsurance companies, provided before and during the process of selling insurance products, as well as presented in new or expanded reports and reports for internal and external purposes. Considering ESG aspects transfer into, among others, the remuneration principles, risk management principles, underwriting principles, and investment policy applicable in the insurance or reinsurance company, and consequently the Actuarial Function Report, the ORSA Report, the Solvency and Financial Condition Report (SFCR), and the reporting forms (QRT). As part of their Investment Policy, insurers are required to consider the potential long-term impact of their investment strategy and investment decisions on ESG factors, as well as customer preferences in this regard. ESG risks should also be considered when defining, measuring, monitoring, controlling, and assessing investment-related risks, in addition to managing and reporting on these risks. Furthermore, as part of their Risk Management Policy, insurers are required to identify and assess emerging and sustainability risks, and therefore appropriately incorporate them into the risk profile assessment in the ORSA Report. The ORSA Report is also expected to include:

- Macroeconomic changes and changes in financial markets, including at least climate-related changes, pandemics, other mass events, and catastrophes that may impact the insurer or reinsurer; and
- Analyses of long-term climate change scenarios.

As a result of the above changes, the SFCR is expected to include disclosures regarding the integration of ESG risks:

- in investments, as part of qualitative and quantitative information regarding the performance of the insurer's investments in the "Business and Results" chapter; and
- in the ORSA in the "Risk Profile" chapter.

Furthermore, the Actuarial Function Report requires the presentation of opinions on the principles of underwriting risk, considering ESG aspects. Additionally, EIOPA has proposed two new QRT forms dedicated to reporting ESG-related information on an annual basis, which will be mandatory for insurers from 2024:

- S.06.04.01.01 Climate change-related risks to investments,
- S.14.02.01.01 Non-Life obligation analysis.

The above data reported under the QRT is related to information currently disclosed by companies subject to the CSRD and the EU Taxonomy, where the following information should be published:

- Quantitative information on the share of investments eligible or compliant with the Taxonomy in relation to turnover and capital expenditures, as well as the share of insurance activities eligible or compliant with the Taxonomy in relation to gross written premiums or insurance revenues; and
- Qualitative information, including information on the compliance with the Taxonomy of business strategy, processes, and cooperation with customers and contractors.

In 2024, non-financial reporting under the NFRD was replaced by the CSRD. This expands the qualitative and quantitative information required by the NFRD regarding ESG strategy and objectives, the role of the board and management, the main adverse impacts associated with the company and its entire supply chain, and the method for identifying this information. In the context of product-level disclosure and the organization of the insurance distribution process and product management, the provisions of the SFDR and the Delegated Regulation to the Insurance Distribution Directive are crucial for insurers, as they provide for the assessment of customer preferences in terms of ESG aspects and the subsequent assessment of the availability and suitability of products tailored to the customer's needs.

Changes should begin with defining sustainability ambitions and priorities for product offerings, investment policies, risk appetite, and goals within the ESG strategy, which should include elements such as emissions targets, social goals, and employee well-being.

The next step is to adapt existing processes or implement entirely new processes within the organization at all levels, starting with modifying the sales and

product management processes, and then implementing necessary changes to the investment and risk management processes, with a particular emphasis on scenario analysis and the ORSA process. Meeting the new reporting requirements also entails collecting entirely new data, which necessitates the development of an appropriate architecture, as well as the implementation of systems for collecting and processing aggregated ESG data. As of August 2, 2022, insurance companies should collect information on customer ESG preferences as part of a customer needs survey. Most life insurance companies have introduced additional questions focused on sustainability in their customer needs surveys.

Ensuring adequate knowledge and understanding of ESG issues among distributors is particularly important, and requires appropriate training. Another crucial area is the collection of information on ESG factors for the investment portfolio, both at the unit-linked product level (to identify light and dark green products, as referred to in Articles 8 and 9 of the SFDR) and at the entire investment portfolio level to meet the requirements of the EU Taxonomy and Solvency II. Currently, most financial institutions collect the required data by collecting and analyzing reports published by individual securities issuers or using data collected by external providers from sources such as LSEG.

Because the data provided by external providers is not complete and free, plans are underway to develop free, centralized data sources at the European level (European Single Access Point – Carriages preview, Legislative Train Schedule (europa.eu)) and at the national level.

An even greater challenge than obtaining issuer data is obtaining data and models regarding climate change-related risks for the preparation of climate scenarios. However, these are crucial for improving the accuracy of climate change risk assessments. Unfortunately, external modeling tools or developing in-house tools are quite expensive, making such solutions inaccessible to all market participants. EIOPA (in its guidelines on assessing the significance of climate change and using climate change scenarios in ORSA) identified this as one of the main challenges companies will face. Therefore, EIOPA has decided to support the development of open-source models, believing they have the potential to reduce the costs of conducting climate change analyses, increase innovation, enhance the use of catastrophe models, and raise risk awareness, benefiting policyholders, the insurance industry, and regulators. EIOPA has launched initiatives such as the CLIMADA, GEM, OASIS, and DRMKC Risk Data Hub applications.

Additionally, the new regulations will require insurance companies to analyze and calculate new ESG indicators, including information such as greenhouse gas emissions, carbon footprint, and the share of renewable energy consumption. A significant challenge for insurance companies in this regard may be collecting data for their insurance portfolios, such as data at the individual insured entity level (for commercial lines) regarding its greenhouse gas emissions (GHG Scope 3 indicator) or meeting the “do no significant harm” criteria required by the EU Taxonomy.

Conclusions

The presented analysis of the regulations related with ESG risk reveals some interesting findings. At first, the significant impact of the ESG risk analysis, measurement, assessment, and minimalization for the financial institutions is observed. The most developed regulations in this area are presented for the European Union. Before the election of President Donald Trump, the mentioned regulations had also been introduced in the United States. Now, the SEC and other institutions have decided not to focus on non-financial reporting and analyzing the ESG risk. It is related to the withdrawal of the United States from the Paris Agreement. Consequently, in practice, the significance of the ESG risk can be lower in this area. Furthermore, in the near future, changes in the regulations related to policy investments in US funds can be observed. In the case of Europe, the most important regulations that have an impact on other rules and laws are the CSRD, the Taxonomy, and the SFDR. Other regulations refer to them, especially those related to the financial sector. A larger number of regulations, laws, and guidelines are presented for the banking sector.

In the case of the insurance sector, the attention is predominantly on climate risk, which is related to the specific character of this sector. Climate risk is significant as it is related to the Solvency II Directive. This directive is very important for the insurance sector because it clarifies the basic approach for ESG risk measurement. This risk is not presented directly but can be noticed in the insurers' policies, by testing and analyzing the climate and environmental risks. These risks are the most significant for this sector because they show the probability of catastrophes. In the near future, more regulations, especially those related to the ESG risk assessment in the mentioned sector, will be published. Because the revised Solvency II Directive is very fresh, we cannot find a lot of information about the measurement and level of the risk in this sector. A lot of attention will be paid to the type of products and the impact of the mentioned risk on the individual and group insurance portfolios.

In the case of investment institutions, most regulations are primarily based on the analysis of investment portfolio construction, similar to the case of investment funds. Attention was also drawn to the necessity of analyzing green bond standards and addressing issues with the assessment and classification of bonds as green, sustainable, and otherwise.

The current regulations indicate that a universal reporting standard beneficial for investors worldwide has not yet been established. Subsequently, emphasis is placed on the need to test the implementation of measures related to the ESG risk. Insufficient data, different regulations, and issues with non-financial reporting create challenges for financial institutions. The instability of policies related to ESG is not insignificant. Changes in the United States over its withdrawal from the Paris Agreement also impact the European market, as evidenced by the Omnibus I proposal.

Note

- 1 1. No Poverty; 2. Zero hunger; 3. Good health and well-being; 4. Quality education; 5. Gender equality; 6. Clean water and sanitation; 7. Affordable and clean energy; 8. Decent work and economic growth; 9. Industry, Innovation, Technology and Infrastructure; 10. Reduced inequality; 11. Sustainable cities and communities; 12. Responsible consumption and production; 13. Climate action; 14. Life below water; 15. Life on land; 16. Peace, justice and strong institutions; 17. Partnerships for the goals.

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Part II

Market Dynamics and ESG Risk Impact



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3 ESG Risk Management in Investment Funds

ESG Risk in Portfolio Management

Socially responsible investment (SRI) funds are characterized by their use of ESG portfolio analysis and engagement, with the primary long-term goal of impacting sustainable development (Eurosif, 2018; Renneboog et al., 2008; UN PRI, 2018). The investment funds lack a homogenous character. They present themselves as “sustainable,” “green,” “socially responsible,” or “ethical,” yet in practice they do not belong to the same group. They often focus on different ESG issues and use a variety of different methods to incorporate ESG concerns into the investment portfolio (Renneboog et al., 2011; Sandberg & Nilsson, 2015). A few common definitions continue to remain regarding the sustainability issues that need to be incorporated and the methods for their incorporation into mutual funds (Daugaard, 2020).

Current regulations suggest that investment funds must focus on the following ESG risks:

- The reference methodology for the identification and measurement of ESG risk. This area should consider data processes and methodology.
- Minimum standards and reference methodology for managing and monitoring the ESG risk. This area requires analysis of:
 - ESG risk management principles;
 - Strategies and business models;
 - Risk appetites; and
 - Monitoring.

The ESG risk associated with investment funds pertains to several factors. It influences the risks related to sustainable development, including financial, reputational, and operational risks. Sustainability risks themselves can be a risk or can have an impact on other types of portfolio risks and on general risks such as market risk, liquidity risk, credit risk, or operational risk. The assessment of sustainability risks, which are defined in Article 2.22 of the SFDR as ESG situations or conditions that could have an actual or potential material adverse effect on the investment value if they occur. This assessment

is incorporated into the investment decision-making process through the application of responsible investment criteria by the funds.

The **risk assessment process** is conducted as part of the investment analysis process and considers all relevant risks, including sustainability risks. This assessment includes, but is not limited to, assessing the issuer's ESG risk profile using data sourced from third-party providers, some of whom specialize in ESG data and assessing related risks, as well as calculations performed by the funds themselves. The mentioned situation is mostly connected with the size of the company and the types of investments undertaken. Some of the institutions, especially those with global investments, require in their investment portfolio the inclusion of ESG ratings or scorings, except for factors like credit ratings, correct financial indicators, etc., prior to making such decisions. The most popular ESG data providers used in investment funds are Bloomberg, LSEG, Sustainalytics, and MSCI. The approach to ESG risk integration is related to the following three steps:

- 1 Identification: The first step toward ESG risk integration is identifying material ESG risk issues at the company, sector, and country levels.
- 2 Assessment:
 - a For corporate investments, each company's performance on material ESG issues is evaluated, followed by an assessment of how effectively these issues translate into business strategy and the opportunities they present. Finally, this process discusses and analyzes potential controversies and their impact.
 - b For investments in government bond issuers, funds analyze and evaluate country performance based on ESG factors and potential controversial issues and use this information to compare different countries.
- 3 Integration: ESG analyses are incorporated into each investment case and considered throughout the investment process.

Although this approach always should encompass these three steps, the degree of integration is not the same across all strategies. ESG factor integration can vary significantly across asset classes for various reasons. Data availability, type, and quality vary depending on whether they pertain to public or private asset classes and between developed and emerging markets. ESG factor integration for government bond portfolios utilizes different data sources than those used for corporates. While ESG risk is always relevant, the focus on opportunities is typically stronger for equities, where the potential upside is greater, compared to debt instruments, where the downside potential is typically more pronounced. The type of investments that are made by investment funds influences the profitability.

The effectiveness of the fund depends on the investment strategy pursued. For example, conventional bond funds, albeit only government bonds, achieve weaker results than green bonds (Leite & Cortez, 2018). However, this is

influenced by the type of market and geographical scope or the type of sector (Chodnicka-Jaworska, 2025), but it depends on the level of disclosure (Madhavan & Sobczyk, 2020).

By identifying such material factors and carefully analyzing how companies intend to adapt in response, it can focus on responsible investing and strengthen our ability to achieve better investment outcomes. Material ESG factors are crucial to a company's business model and financial success, as they influence its **short-, medium-, and long-term** competitiveness. A set of factors has been identified as the most important, both for funds and their clients, namely,

- business model sustainability,
- governance factors,
- environmental factors, and
- social factors.

By defining the business model as a pillar alongside ESG factors, some funds emphasize the need for companies to consider environmental and social trends in the way they conduct business. The methodology is reviewed and updated at least annually or on an ad hoc basis as necessary.

Most ESG factors are “material” to each country. This is different from analyzing the materiality of factors for companies or industries, where sectors can vary significantly. Examples include the quality and availability of education and healthcare and the level of political stability. While the extent to which these factors may impact a given country's finances may vary, ultimately all of these factors matter across countries. Therefore, to determine how individual countries perform from an ESG perspective, they are all evaluated using the same factors.

Considering sustainability risks at the fund consists of the following main subprocesses:

- Preparing and training the fund's employees to consider sustainability risks in their ongoing activities during the investment and operational processes, as well as in servicing issuers and projects;
- Ongoing recording and monitoring of the sustainability risk situation of issuers and projects by management teams and the risk team;
- Conducting periodic sustainability risk assessment surveys, taking into account the specifics of the fund's product, asset class, and quality for all issuers or projects;
- Assessing the sustainability risk exposure of each issuer and project and the specifics of the fund's product;
- Determining the course of action in the event of a sustainability risk rating higher than negligible; and
- Conducting discussions with the issuer, based on existing corporate and contractual rights, and clarifying and consulting directly with the issuer on any concerns.

The next part of the risk assessment analysis focuses on the **type of investment strategies adopted by investment funds**. Consequently, there are several notable investment strategies, namely:

- **Negative selection** (negative screening and exclusionary screening), which is the process of excluding specific companies or sectors from a fund or portfolio (Sandberg & Nilsson, 2015). This is executed by determining the exclusion criteria upfront based on a specific goal. Some companies or entire industries perceived as harmful (such as gambling, tobacco, weaponry, or carbon dioxide over a set limit) are omitted from the investment universe. These goals can be related to the value of the ESG rating or scoring, particularly measures related to CO₂ emissions, excluding some types of sectors or subsectors like fossil fuel companies. In practice, this indicates that by investing in such a fund, the investor is assured that the fund is not investing money in companies active in sectors deemed to be bad from an ESG perspective. Funds invest in companies with engagement below a certain percentage in an unacceptable sector, as well as in companies that are only indirectly associated with the undesirable sector. The negative selection is partially observed in the context of ESMA's guidelines (ESMA, 2024).
- **Positive selection** (positive screening, best-in-class screening) involves the process of selecting a subset of top-performing companies from a defined industry and a set of characteristics to invest in (Renneboog et al., 2011; Sandberg & Nilsson, 2015). This process exhibits characteristics that are contrary to negative selection. In practice, they are criteria associated with the highest value of performance, the highest ESG rating or score, the lowest carbon footprint, etc. The inclusion strategy implies that a generally excluded company could still be invested in, given that the company was the most environmentally responsible within its industry (Höhnke & Homölle, 2021). This strategy is very costly because it creates the need to analyze each company separately, which reduces its popularity. In some cases, ESG ratings and scores can be helpful (De Spiegeleer et al., 2021), although they may not represent the best choice. Each ESG data provider employs their own methodology, resulting in significant differences between the ESG ratings and scores published by different agencies. The phenomenon of "ESG ratings inflation" has also been observed, which creates the risk of an inappropriate building portfolio.
- A **portfolio tilt strategy** is one in which the investor "tilts" the percentage of ESG investments in a portfolio to exceed that of non-ESG investments, while maintaining sector weights that match a target index. This strategy belongs to the group of strategies with the lowest risk.
- **ESG integration** is a strategic lens that positions companies with high material ESG ratings as investment opportunities that can increase a portfolio's return. This strategy embeds ESG considerations into a firm's existing investment process.

- **Shareholder action** referred to as engagement involves investors using their influence to encourage the companies in which they invest to pursue material ESG opportunities.
- **Activist investing** is when an investor buys equity in a company to change how it operates and influences it to pursue ESG initiatives. This strategy is closely related to, yet different from shareholder action. Shareholder action occurs when an investor already owns a company's shares, and activist investing involves pursuing an investment to influence a company's ESG strategy. This strategy can be achieved by using voting rights at the annual shareholders' meeting or through direct dialogue with the company (Barko et al., 2021). The issue also stems from the necessity of investing funds in the (problematic) company.
- **Sustainability-themed investing** is a strategy which involves identifying a specific issue relating to sustainability and investing in indices of companies that address it, such as those focused on waste management, which creates a special index. This strategy is related to a specific theme connected with the environment.

The presented strategies directly impact the fund's operations, the assets the fund invests in (Barko et al., 2021), and the kind of risk it takes. They are often combined and hence co-exist in the marketplace (Barko et al., 2021). The various funds focus on different issues and strategies. Sandberg and Sjöström (2021) contend that, from an investor's perspective, these different strategies reflect different moral motivations.

Some studies have examined investor behavior regarding SRI investments. Some of them focus on professional investors (e.g., García-Sánchez et al., 2020), whereas others examine retail investors (e.g., Brunen & Laubach, 2022; Diouf et al., 2016; Nilsson, 2009, 2015; Riedl & Smeets, 2017; Zwergel et al., 2019). Investment motivations vary depending on the type of investors. Retail investors primarily focus on pro-social attitudes and the desire to "do good," as well as the desire to "make money" (Nilsson, 2008, 2009, 2010). The first motivation is stronger in the case of retail investors compared to professional investors (Riedl & Smeets, 2017). McLachlan and Gardner (2004) found that the exclusion and engagement strategies were more frequently used by individuals already investing in ESG-profiled funds, whereas conventional investors preferred funds with an inclusion strategy. Capota et al. (2022) suggest that both individual and institutional investors in ESG and E funds are less sensitive to negative past performance, even during periods of market stress and fund illiquidity, suggesting greater resilience of these funds. The results are robust to alternative specifications and the inclusion of controls. In particular, the lower sensitivity of ESG fund flows to negative returns cannot be explained by the rapid growth of the ESG fund sector. Simultaneously, the sensitivity difference between ESG and non-ESG funds is found to be statistically different only for ESG equity funds.

Investors' return expectations regarding ESG funds present a mixed picture. Some studies report no marked difference compared to conventional funds (Nilsson, 2008), whereas in others, the expectations regarding the conventional funds surmount those of the ESG funds (Riedl & Smeets, 2017; Wins & Zwergel, 2015).

Portfolios applying negative screening aimed at avoiding “sin” stocks present a significantly lower risk-adjusted return compared with conventional portfolios (Geczy et al., 2021). The exclusion of companies or sectors results in a diminished investment universe, thereby serving as an impediment to diversification (Trinks & Scholtens, 2017). A higher risk-adjusted return has been presented in portfolios incorporating an activist policy (Renneboog et al., 2011). Carlsson and Nilsson (2023) analyzed financial and ESG factors among a group of retail investors (Nilsson, 2008, 2009) to test their impact on both perceived financial quality (such as risk and return) and perceived sustainable quality, both of which are defined as subsets of technical quality in the terminology of Nilsson et al. (2024). They also found that the impact on overall fund quality is mediated by perceived financial quality, not perceived sustainable quality. Implementing the strategy through in-house sustainability experts, as opposed to relying on external sustainability expertise, positively affects perceived quality through perceived financial quality.

The data analysis based on the LSEG database indicates that there are currently 24,863 responsible investment funds active in Europe and the United States, representing 35.5% of all open-ended investment funds in these regions. Within this group, 3,840 funds qualify as SRI funds, accounting for approximately 5% of total market share (Table 3.1). ESG funds constitute around 32% of the market.

The highest market share of these funds is observed in France, with significantly lower shares in the United Kingdom, Austria, Belgium, Germany, and Italy. Funds domiciled in the United States account for only 4.8% of responsible investment funds, 12.6% of SRI funds, and 3.4% of ESG funds. This suggests that investor interest in green and responsible investment funds in the United States is currently lower than in Europe. This divergence may be associated with regulatory changes and the United States' withdrawal from the European Green Deal framework and the Paris Agreement.

The most applied investment approach among the analyzed funds is **negative screening**. The primary exclusion criteria related to negative screening are:

- **adult entertainment:** 9,002 funds
- **alcohol or drugs:** 5,199 funds
- **fossil fuels:** 15,721 funds
- **genetically modified organisms (GMOs):** 1,851 funds
- **nuclear energy:** 6,570 funds
- **tobacco:** 15,325 funds
- **weapons:** 17,885 funds
- **other exclusions:** 5,523 funds

Table 3.1 Number of active opened funds by type of strategies in Europe and the United States (31.01.2026)

Country	Total		Responsible investment		SRI		ESG		Impact		Negative screening		Positive screening	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Austria	3,479	4.97	1,819	7.32	166	4.32	1,692	7.59	257	8.09	1,575	8.08	623	10.85
Belgium	1,864	2.66	1,197	4.81	356	9.27	1,039	4.66	204	6.42	898	4.61	458	7.98
Bulgaria	8	0.01	1	0			1	0			1	0.01		
Cyprus	30	0.04	1	0			1	0						
Czechia	246	0.35	50	0.2			48	0.22			37	0.19	4	0.07
Denmark	1,322	1.89	975	3.92	20	0.52	928	4.16	171	5.38	788	4.04	2	0.03
Estonia	18	0.03	6	0.02			6	0.03			5	0.03		
Finland	1,346	1.92	1,187	4.77			1,062	4.76	201	6.32	803	4.12	35	0.61
France	8,564	12.22	6,600	26.55	1,948	50.73	6,160	27.62	502	15.8	5,912	30.34	1,851	32.24
Germany	3,406	4.86	1,672	6.72	72	1.88	1,472	6.6	275	8.65	1,394	7.15	245	4.27
Greece	294	0.42	15	0.06			15	0.07						
Hungary	858	1.22	120	0.48	7	0.18	107	0.48	23	0.72	65	0.33	35	0.61
Iceland	37	0.05	4	0.02			4	0.02			1	0.01		
Italy	2,212	3.16	1,272	5.12	331	8.62	894	4.01	194	6.1	1,142	5.86	449	7.82
Latvia	12	0.02	1	0			1	0	1	0.03				
Lithuania	5	0.01												
Netherlands	706	1.01	548	2.2	39	1.02	540	2.42	48	1.51	470	2.41	72	1.25
Norway	1,383	1.97	1,302	5.24	20	0.52	1,256	5.63	66	2.08	1,216	6.24	82	1.43
Poland	834	1.19	63	0.25	2	0.05	60	0.27	4	0.13	18	0.09	5	0.09
Portugal	548	0.78	116	0.47	5	0.13	116	0.52	7	0.22	17	0.09	15	0.26
Slovakia	35	0.05	8	0.03			8	0.04			4	0.02	2	0.03
Slovenia	47	0.07	5	0.02			2	0.01			4	0.02		
Spain	3,394	4.84	911	3.66	232	6.04	894	4.01	224	7.05	754	3.87	493	8.59
Sweden	1,752	2.5	1,680	6.76	10	0.26	1,618	7.26	428	13.47	1,644	8.44	64	1.11
Switzerland	4,539	6.48	1,755	7.06	57	1.48	1,639	7.35	82	2.58	1,088	5.58	477	8.31
UK	11,725	16.74	2,352	9.46	90	2.34	1,979	8.87	366	11.52	1,050	5.39	556	9.68
USA	21,394	30.54	1,203	4.84	485	12.63	757	3.39	125	3.93	597	3.06	274	4.77
Total	70,058	100	24,863	100	3,840	100	22,299	100	3,178	100	19,483	100	5,742	100

Source: Author's own elaboration based on the LSEG Workspace.

In the case of weapons-related exclusions, the European Commission has indicated that merely excluding investments in military or dual-use sectors may be insufficient. This view reflects the current increase in geopolitical risk and changes in investment structures within the defense sector, including the introduction of new initiatives such as the SAFE program.

The second most prevalent strategy among European and US investment funds is positive screening. The most frequently observed positive screening approaches include:

- **best in class:** 4,179 funds
- **positive tilt:** 654 funds
- **thematic:** 1,625 funds

With regard to **impact investing**, the following investment categories are identified:

- **microfinance:** 89 funds
- **sustainable bonds:** 495 funds
- **Sustainable Development Goals (SDGs):** 2,905 funds

Importantly, investment funds typically **do not rely on a single investment strategy**. In practice, multiple strategies are often combined, both **within individual strategy groups** and **across different categories**, reflecting a hybrid and diversified approach to responsible investing.

There are three methodologies to **assess the ESG risk** across time horizons, supported by key risk indicators:

- The **exposure-based methodology** is significant in the context of debt securities. In practice, it aims to assess the exposure of the issuers and key assets to ESG factors. It incorporates ESG factors in the overall assessment of an issuer's default risk when justified by their materiality embedded in the risk indicators, internal credit scores, or ratings models, as well as the type of debt seniority.
- **Sector-based, portfolio-based, and portfolio alignment methods** can be explained as follows:
 - **Sector-based method** provides methodologies of assessment, such as heat maps, which highlight the ESG risk of individual economic sectors and subsectors in a chart or scaling systems.
 - **Portfolio-based method** uses at least one portfolio methodology to assess the degree of alignment of the institution's portfolios with climate-related sustainability targets.
 - **Portfolio alignment method** involves insights gained from climate portfolio alignment methodologies, such as:
 - Assessing and monitoring climate-related transition risk stemming from misalignments of portfolios with the EU or another country's

regulatory objectives and pathways consistent with applicable climate goals, as well as the potential related financial risks.

- Informing their decision-making process on the formulation and implementation of their risk appetite, business strategy, and transition planning.
- **Scenario-based method** that performs the climate or environmental scenario-based analysis.

The **ESG risk monitoring process** is related to the **investment's strategy** outlined by the investment fund. Investment strategies should be categorized into three types of portfolios: dark green, medium green, and light green, which must be monitored. In practice, it is made at least once in a month. Most investment funds use ESG ratings or scores and non-financial data provided by ESG data providers for this process. The process of monitoring the portfolio is based on diverse data and sources:

- Securities (bonds and stocks) should be analyzed on the data presented by each issuer, distinguishing between E, S, and G measures and controversies separately. Predominantly, it analyzes the whole ESG profile as well. This data should be prepared by certified ESG data providers in the European Union. Similar regulations are prepared by other countries. Consequently, the analysis is based on the ESG ratings, scores, and combined measures. Because the mentioned securities are listed on the stock exchanges, these data are available and commonly used. Therefore, assessing each issuer in a single portfolio and on a global scale becomes possible by aggregating all ratings of each issuer using a weighted average process, thereby assessing the profile of each of the three components (E, S, and G) as well as overall ESG performance of the entire portfolio. The ESG measures are then integrated in the final monitoring process with other risk measures like credit ratings, exposures to countries, sectors, currency, etc. Conscious monitoring of the dataset helps to assess the changes in the ESG profile of each issuer and the entire portfolio in different periods, helping to assess the effectiveness of investments during the analyzed period and financial goals and to globally assess (again, at the level of a single instrument and the entire portfolio) the impact of ESG risks on portfolio profitability.
- For funds (both traditional and alternative, both closed-end and open-end), two methods are used to assess the ESG profile, depending on data availability:
 - A **“bottom-up” process** involves using a “look-through” portfolio composition and applying the methodology used for the securities, which helps assess the target fund's ESG profile and its evolution over time.
 - A **“top-down” process** that involves analyzing the target fund's management company and portfolio manager, investment strategies, prospectus limits and characteristics, ESG considerations in the investment process, the use of an ESG-compliant benchmark, the use of whitelists and

blacklists, procedures, the fund's or management company's adherence to international standards, and other elements to assess the fund's overall ESG profile, regardless of the actual composition of its portfolio, which is the result of the elements listed above (European Commission, 2020).

The **monitoring process** in the case of the investment funds is also based mostly on the investment guidelines set out in the prospectuses or in the Investment Management Agreement (if applicable) for each fund, with particular emphasis on the dark green and medium green portfolios, where ESG factors play a key role in the portfolio management process. Investment funds must monitor the portfolio's adherence to precise investment limits related to ESG aspects. The range of limits in this case can be wide; however, a few examples of the limits include:

- Minimum ESG rating for each issuer;
- Minimum ESG rating at the portfolio level (weighted average);
- Maximum allocation to issuers without an ESG rating;
- Use of a pre-approved list of issuers and maximum allocation to issuers not on the list;
- Use of external funds with ESG limits in their investment guidelines;
- Investments in external funds with ESG-aligned benchmarks; and
- Investments in external funds with investment managers affiliated with the UN PRI.

Funds monitor these ESG-related limits and implement all procedures and provisions applicable to all other investment limits, including the breach procedure.

The next aspect of ESG risk monitoring is related to **monitoring the investment management** company. It may conduct additional monitoring of the delegated investment manager during initial and ongoing due diligence, as well as during ongoing supervision. In particular, the following elements may be monitored:

- Investment manager's compliance with internal policies and procedures that comply with nationally recognized ESG standards, such as the UN PRI.
- Procedures implemented at the investment manager level for managing dark green, medium green, and light green portfolios, considering the management team's experience, internal organization, procedures, implemented controls, and availability of data on issuers and other investments.
- Reporting covering ESG data, factors, and analyses.
- Effectiveness of investment restriction controls applied to ESG factors.

Impact measurement in the context of sustainable investing can be defined as "the process of measuring and monitoring the amount of change brought about by an organization's or investor's actions" (OECD, 2020). Existing

measurement and reporting tools do not fully capture the direct contribution of financial investments to the SDGs (Busch et al., 2015; Kölbel et al., 2020; Schoenmaker & Schramade, 2019; Vörösmarty et al., 2018).

The next step is related to **reporting**. Depending on the type of each fund, as described in the Taxonomy and the investor characteristics, the fund is engaged in the preparation of various reports that include ESG factors:

- **Executive Report:** For each type of fund, a monthly executive report is prepared for the attention of the Management Committee and Board of Directors. This report provides full details of the fund, as well as the results of the implemented risk management, operational, and compliance controls. Depending on the fund type (which may also vary at the sub-fund level within each fund), the management report also includes the results of ESG monitoring conducted based on the criteria.
- **External Reporting:** Investment funds may also prepare ad hoc reports for investors or other external parties (such as investment committees, advisors, and investment managers) regarding the ESG profile of the funds based on data from underlying issuers and target funds and in accordance with the monitoring process. The purpose of this reporting process may vary: for information and monitoring purposes, to assess the impact of an investment's ESG profile on the overall portfolio performance, or to help competent authorities make informed investment decisions.
- **Audited Financial Statements:** The management reports included in the audited financial statements provide an update on the fund's ESG-related activities, including portfolio management and the process for monitoring and reporting ESG risks associated with each portfolio.

The next part of the ESG investment funds that need to be analyzed is the **relationship between risk and return**. Most current studies are related to the impact of the ESG measures on financial profitability (Friede et al., 2015; Geczy et al., 2005; Statman & Glushkov, 2016), developing new low emission strategies (Andersson et al., 2016; Bender et al., 2019), or data challenges and accounting choices (Thomä et al., 2018; Vörösmarty et al., 2018). Other studies suggested that funds with lower ESG ratings have higher profitability than those with higher ratings (El Ghouli & Karoui, 2017; Pavlova & de Boyrie, 2022). Primarily, mutual funds with higher ESG ratings consistently outperform their lower-rated peers in both absolute and risk-adjusted returns (Hasnaoui, 2025). In other studies, it was suggested that the level of the ESG ratings does not have a significant impact on the effectiveness of funds (Hartzmark & Sussman, 2019; Nofsinger & Varma, 2014). Empirical analyses of ESG investment funds use heterogeneous asset pricing models that utilize different factors such as investor cash flows (Bollen, 2007), fees (Gil-Bazo et al., 2010; Kreander et al., 2005; Raghunandan & Rajgopal, 2022), social responsibility indices (Renneboog et al., 2008), and investment styles (Chen & Scholtens, 2018).

Investment funds that raise high ESG concerns are characterized by a low level of controversy and achieve higher financial performance, regardless of the geographical area of investment (Petridis et al., 2023). Albuquerque et al. (2020) found that the most significant higher rates of return of SRI funds compared to conventional funds are observed for factors E and S. During crises, the publication of numerous news items related to environmental scandals creates a tendency toward investing in SRIs (Karoui & Nguyen, 2022).

Höck et al. (2023) demonstrated that balanced portfolios have lower exposure to credit risk than unbalanced portfolios. This suggests that ESG criteria in portfolio management provide a systematic way to manage credit risk.

Another factor considered by investment funds is **management costs**. These costs can be related to the **management fee**. Abate et al. (2021) found that higher-rated funds have lower fees despite more complex due diligence and associated operating costs, which also impacts the profitability for investors ultimately. The other costs are related to the **ESG outcry**, which can be mitigated by profits from declining, unprofitable companies (El Ghoul et al., 2023). Consequently, funds investing in companies with high ESG ratings are attracted to companies with strong financial fundamentals, stable performance, and improved performance (El Ghoul & Karoui, 2017).

The impact of ESG ratings on fund effectiveness is related to the **phase of the business cycle**. It is elevated during periods of recession and the COVID-19 pandemic (Abate et al., 2021; Becchetti et al., 2015a, 2015b; Fang & Parida, 2022; Omura et al., 2021; Pástor & Vorsatz, 2020). The profitability during crisis increases with rising ESG ratings and scores (Henke, 2016; Ruf et al., 2019), which means that investors attribute intrinsic value to ESG investments. Leite and Cortez (2018) revealed that, during the crisis, both SRI funds received similar financial profitability as conventional funds. However, during periods of financial stability, SRI funds have lower profitability. Ruf et al. (2019) demonstrated that following the global financial crisis, low-rated socially managed funds outperformed high-rated funds. The market's reaction is influenced by the financial effectiveness of investment funds because of the diverse types of funds. SRI funds, green bond funds, or ESG ETF funds react differently to ESG funds. Omura et al. (2021) observed that ESG ETFs yielded higher profits.

The next issue involves making investments based on green assets without accounting for fluctuations in ESG risk. Consequently, it creates the **green-washing funds problem**. According to Chodnicka-Jaworska (2025), ESG funds can realize this kind of policy by:

- Consistently maintaining holdings in companies with low ESG ratings, despite a market trend of increasing ESG ratings.
- Prioritizing marketing and attracting sustainable, responsible investors without adequately aligning their portfolios with true ESG considerations.

Wang (2024) found that the better the ESG performance of ESG funds, the lower their vulnerability. The aforementioned impact was examined through two channels:

- The investor attention channel posits that stocks with better ESG performance can attract more investors, thereby increasing the volume of stock trading. The increasing volume of trading stocks increases their liquidity, which reduces the impact of cash flows from investment funds on stock prices (El Ghoul & Karoui, 2017; Ferriani & Natoli, 2020).
- The fundamental channel indicates that stocks with better ESG performance have robust fundamental measures, and investment funds that have better ESG performance can reduce the investors' sensitivity to fund performance, thereby reducing the impact of the volatility of stock prices on investor redemption and subscription behavior.

As the ESG performance of the analyzed investment funds improves, portfolio liquidity increases, reducing the relationship between performance and inflows, thereby reducing the impact of related fund flows and decreasing their vulnerability. Wang (2024) also found that decreased network centrality, stronger ability to manage liquidity in a timely manner, and the introduction of “double carbon” targets amplify the negative impact of funds' ESG performance on their vulnerability. The obtained results suggest that the superior performance of the ESG investment funds can bring additional investors, increase the volatility of the investment fund's portfolio, and reduce the relationship between financial results and cash flows. Higher portfolio liquidity and a weaker performance-flow relationship reduce the mutual influence of fund flows, thereby reducing their vulnerability. The volatility of the stock prices and sensitivity of investors to the ESG performance are factors that significantly influence funds' risk. It can result in splitting the risk between funds. Consequently, investors exhibit diminished sensitivity to the performance of funds that achieve better ESG performance (Benson & Humphrey, 2008; Bollen, 2007), and stocks with better ESG performance are characterized by higher liquidity (Luo, 2022).

Fire sales resulting from investor redemptions create significant spillover effects between funds through shared asset ownership, which negatively impacts the performance and liquidity of related funds, triggering multiple rounds of fire sales (Choi et al., 2020; Coval & Stafford, 2007; Falato et al., 2021).

Compared to traditional funds, SRI funds display a weaker relationship between performance and cash flows, and their cash flows are not significantly dependent on their performance (Bollen, 2007; El Ghoul & Karoui, 2017). Furthermore, some studies indicate that the performance of ESG funds helps reduce their risk (Cerqueti et al., 2021; Zhang et al., 2023). In the case of green bond funds, investor sensitivity to poor performance (Chen & Qin, 2017; Goldstein et al., 2017) may have implications for financial stability. The illiquidity of bond fund assets may lead to a greater first-mover advantage in bond funds, which may lead to managers rushing to sell assets to return money to investors seeking to recover it in response to poor performance.

Raghu­nan­dan and Rajgopal (2022) found that funds that self-identify as ESG-oriented hold portfolio firms with higher average ESG scores but weaker ESG performance. Stocks with high ESG scores do not always have higher

(expected) future returns (Cornell, 2021; Di Giuli & Kostovetsky, 2014; Pástor & Vorsatz, 2020), and investors may not be willing to sacrifice returns for sustainability considerations (e.g., Larcker & Watts, 2020; Renneboog et al., 2008).

Research indicates that flows into SRI funds exhibit certain characteristics, including:

- Lower volatility: ESG investors are more committed to long-term investment horizons and therefore pose less risk in terms of demand volatility (Riedl & Smeets, 2017).
- Less sensitivity to negative past performance.
- Willingness to sacrifice financial performance for social preferences.

Klinkowska and Zhao (2023) demonstrated that SRI funds with higher ESG scores attracted more investment and generated higher inflows. Convexity between performance and inflows was observed for retail funds but not for institutional funds. Dolvin et al. (2019) observed a tendency for funds with high Morningstar Sustainability ratings to imitate SRI funds. Furthermore, using survey data, Krueger et al. (2020) demonstrate that institutional investors may also factor climate risk into their decisions based on considerations related to:

- Reputation;
- Moral/ethical issues; and
- Legal/fiduciary obligations.

One of the main problems that highlights the significance of the quality of regulations related to managing the green funds and problems with the green-washing of the financial products is the **green window dressing**. This phenomenon was tested by Kempf and Osthoff (2008), Muñoz et al. (2022), Parise and Rubin (2025), and Yuan et al. (2024). The window dressing is strictly related to the situation when conventional fund managers could be tempted to manipulate their portfolios to oversell their skills by replacing losing holdings with winners just before portfolio disclosures (Haugen & Lakonishok, 1988; Lakonishok et al., 1991). Infrequent portfolio disclosure is challenging because it opens up the opportunity for a fund to strategically buy ESG stocks just before disclosure, thereby achieving a high sustainability rating, and then switch to higher-yielding but less responsible assets when detection is unlikely. Ex ante funds cannot be inherently responsible and at the same time consistently outperform (Ceccarelli et al., 2024; Gantchev et al., 2022). SRI forces fund managers to avoid high-yielding but controversial assets, such as those issued by polluting companies or those operating in “sin industries” (Hong & Kacperczyk, 2009, Kacperczyk & Bolton, 2023).

This situation is related to the asymmetric relationship between flows and lagged performance (e.g., Berk & Green, 2004; Chevalier & Ellison, 1997; Sirri & Tufano, 1998) and the managers’ perception that disclosed portfolios have a

significant influence on calendar-based investments (e.g., Brown et al., 1996; Hu et al., 2011; Huang et al., 2007). Conversely, investment managers in the case of the green funds want to use the impact of the “green” reputation on the interest of their funds, which is related to the specific nature of the investors who are sensitive to the ESG standards aspects (e.g., Ammann et al., 2019; Bollen, 2007; Hartzmark & Sussman, 2019; Riedl & Smeets, 2017). In practice, different investment styles can exist in the “green funds” group that have been described before, creating higher profits, lower volatility, and higher liquidity in the case of the green securities, which could cast doubt on the actual restrictions of the investment universe of SRI funds. This doubt highlights the concern for potential portfolio manipulation by SRI funds before portfolio disclosures to provide an improved ESG image to investors. According to Kempf and Osthoff (2008), SRI funds have incentives to present better ESG portfolio scores at the end of the year than mid-year dates to attract money inflows. These funds buy (sell) stocks with high (low) ESG ratings just before portfolio disclosures, and the sensitivity of SRI funds’ returns to an ethical benchmark should be higher before disclosure dates than in other periods. Because they tested the presented phenomenon on semi-annual or quarterly portfolios, it can create a biased conclusion because of the intra-period round-trip trades (Elton et al., 2010). Next, investors are sensitive to ESG ratings, but there is robust evidence that exogenous shocks (Bialkowski & Starks, 2016) and high-visibility information (El Ghouli & Karoui, 2017) are more easily interpreted by investors.

Muñoz et al. (2022) presented an opposing viewpoint by testing the green window dressing in US SRI funds. They compared the disclosed and undisclosed portfolios by using a direct approach to overcome the limitations of window-dressing evidence based on price anomalies and low-frequency disclosed information (e.g., He et al., 2004; Ng & Wang, 2004). They have not used ESG ratings but the high-visibility ESG information and have analyzed separately E, S, and G measures. No evidence has been found revealing that the ESG portfolio image is significantly better in reporting months than in non-reporting months. They found residual signals of ethical window dressing, but none of them correspond to easy-to-interpret information. In their opinion, SRI funds do not manipulate the disclosed ESG image to attract money flows. The obtained results can be related to several factors, including the use of the US market, the period of analysis, and problems with the interpretation of significant measures related to ESG factors.

Parise and Rubin (2025) found that if a fund invests primarily in ESG stocks, its performance should be closely correlated with the leading ESG indices. When ESG stocks perform well, the fund should also perform well, and vice versa. However, they have revealed that correlation with ESG indices drops significantly immediately after mandatory disclosure, while a sharp increase in correlation occurs for stocks with high carbon emissions. This behavior suggests that some funds use “**green smokescreens**,” capitalizing on their performance and ability to attract investors. High ESG stocks generate

positive cumulative abnormal returns (CARs) in the days leading up to the fund's disclosure, consistent with the idea of the fund manager. Parise and Rubin (2025) found that in the ten days preceding a fund's disclosure, it tends to underperform its intended portfolio. During this period, funds incur significant transaction costs as they adjust their portfolio toward more environmentally friendly and sustainable assets. However, after the disclosure event, a shift in performance dynamics is observed. Funds begin to outperform their newly disclosed portfolio, indicating that they now hold higher-yielding assets than those they recently disclosed. This trend is consistent with the hypothesis that, following a disclosure event, funds may replace some ESG assets with higher-yielding, but less sustainable, assets. Fund managers arguably have a stronger incentive to always perform well than to be responsible all the time. They did not provide evidence that fund managers can generate alpha through green window dressing alone. Parise and Rubin (2025) found that expensive funds, funds at both extremes of the return distribution, and funds affiliated with signatories to the United Nations Principles for Responsible Investment are more likely to inflate ESG holdings prior to disclosure. The green window dressing is prevalent among funds that target institutional clients. The institutional investors might be relying on “**delegated window dressing**” as a way to comply with their ESG mandate while earning returns similar to the market portfolio.

Chen et al. (2024) analyzed the difference between fund returns and the returns on their disclosed portfolios. They found that the implied returns from funds' quarter-end holdings exhibit significantly higher ESG β than their actual returns. The increase in the ESG β gap between the two is greater in the period following higher ESG factor returns and among funds with poor past performance, experiencing outflows, surrounding rating thresholds, and bearing explicit ESG labels. They also found that funds with a higher ESG β gap are associated with higher ESG ratings, which tend to attract higher future fund flows. ESG window dressing also leads to predictable returns (Table 3.2).

The next part of the analysis examines the total expense ratio of investment funds according to investment strategy, asset type, and country (Table 3.2). For the analysis, data for open investment funds collected from the LSEG database for 1 January 2020 until 31 January 2026 were used. The analysis indicates that the expense ratio varies by asset type. The lowest expense ratios are observed for money market funds, while the highest are found for alternative funds (Figure 3.1). Considering investment strategy, the following patterns are distinguished:

- **Impact strategy:** Lower expense ratios compared to conventional funds are observed for alternative, bond, and money market asset classes. Conversely, higher expense ratios are found for mixed assets, real estate, and other asset classes. Funds investing in equities exhibit expense ratios like those of conventional funds.

Table 3.2 Value of total expense ratio of investment funds according to the investment strategy, type of assets, and country

Country	No Impact			Impact			No Negative Screening			Negative Screening			No Positive Screening			Positive Screening			
	Obs	Mean	Std	Obs	Mean	Std	Obs	Mean	Std	Obs	Mean	Std	Obs	Mean	Std	Obs	Mean	Std	
Austria	1	26	1.52	0.51	0		18	1.63	0.57	8	1.27	0.22	22	1.55	0.55	4	1.34	0.21	
	2	802	0.70	0.37	90	0.64	0.38	366	0.72	0.35	526	0.68	0.38	704	0.71	0.38	188	0.65	0.34
	3	9	1.43	0.42	0		6	1.61	0.35	3	1.08	0.34	9	1.43	0.42			0.00	
	4	682	1.43	0.59	103	1.45	0.53	301	1.42	0.63	484	1.44	0.55	569	1.42	0.60	216	1.46	0.52
	5	829	1.44	0.62	47	1.26	0.46	517	1.49	0.62	359	1.34	0.59	738	1.47	0.64	138	1.23	0.38
	6	12	0.36	0.23	0		0		0.00	12	0.36	0.23	12	0.36	0.23			0.00	
	7	279	0.72	0.49	1		0.54	258	0.72	0.48	22	0.63	0.61	261	0.74	0.49	19	0.34	0.19
	8	23	0.97	0.17	0			19	0.97	0.17	4	0.99	0.20	23	0.97	0.17			0.00
Belgium	1	74	1.19	0.32	0		68	1.19	0.30	6	1.17	0.48	74	1.19	0.32			0.00	
	2	198	0.61	0.32	3	0.66	0.10	128	0.60	0.30	73	0.62	0.35	163	0.60	0.29	38	0.66	0.41
	3	3	0.66	0.60	0		3	0.66	0.60			0.00	3	0.66	0.60			0.00	
	4	647	1.12	0.63	154	1.24	0.61	339	1.09	0.61	462	1.18	0.64	613	1.18	0.62	188	1.01	0.61
	5	533	1.44	0.41	46	1.83	0.53	256	1.51	0.38	323	1.44	0.47	365	1.47	0.42	214	1.46	0.46
	6	18	0.38	0.18	0		7	0.38	0.24	11	0.38	0.13	14	0.37	0.20	4	0.42	0.05	
Bulgaria	4	2	2.58	0.57	0		1	2.98	.	1	2.18	.	2	2.58	0.57			0.00	
	5		1.00	1.91	0		1	1.91	.			0.00	1	1.91	.			0.00	
Cyprus	2	5	0.92	0.62	0		5	0.92	0.62			0.00	5	0.92	0.62			0.00	
	4	4	1.70	1.31	0		4	1.70	1.31			0.00	4	1.70	1.31			0.00	
	5	10	1.71	0.70	0		10	1.71	0.70			0.00	10	1.71	0.70			0.00	
Czechia	1	3	2.12	0.62	0		3	2.12	0.62			0.00	3	2.12	0.62			0.00	
	2	36	0.89	0.44	0		27	0.87	0.38	9	0.97	0.61	36	0.89	0.44			0.00	
	3	3	1.50	1.47	0		3	1.50	1.47			0.00	3	1.50	1.47			0.00	
	4	44	1.68	0.80	0		32	1.75	0.80	12	1.48	0.81	44	1.68	0.80			0.00	
	5	62	1.73	1.22	0		51	1.75	1.33	11	1.61	0.54	58	1.73	1.26	4	1.60	0.52	
	6		1.00	0.39	0		1	0.39	.			0.00	1	0.39	.			0.00	
	8	6	1.16	0.93	0		4	0.76	0.88	2	1.98	0.00	6	1.16	0.93			0.00	

(Continued)

Table 3.2 (Continued)

Country	No Impact			Impact			No Negative Screening			Negative Screening			No Positive Screening			Positive Screening			
	Obs	Mean	Std	Obs	Mean	Std	Obs	Mean	Std	Obs	Mean	Std	Obs	Mean	Std	Obs	Mean	Std	
Denmark	1	13	1.72	0.54	0		10	1.66	0.59	3	1.95	0.28	13	1.72	0.54			0.00	
	2	347	0.58	0.35	29	0.70	0.24	121	0.53	0.39	255	0.62	0.31	376	0.59	0.34		0.00	
	4	411	1.05	0.58	110	0.80	0.51	123	1.13	0.69	398	0.96	0.52	519	1.00	0.57	2	0.80	0.00
	5	181	1.16	0.52	32	0.90	0.21	82	1.26	0.67	131	1.03	0.32	213	1.12	0.50		0.00	
	8	123	0.86	0.16	0			122	0.86	0.16	1	0.85	.	123	0.86	0.16		0.00	
Estonia	2	4	0.75	0.26	0			4	0.75	0.26			0.00	4	0.75	0.26		0.00	
	4	8	1.55	0.43	0			3	1.20	0.00	5	1.76	0.42	8	1.55	0.43		0.00	
	5	4	1.14	0.71	0			4	1.14	0.71			0.00	4	1.14	0.71		0.00	
	8			0.00	0			0		0.00			0.00			0.00		0.00	
Finland	1	45	2.04	0.66	0			28	1.80	0.68	17	2.43	0.42	42	2.05	0.68	3	1.94	0.26
	2	276	0.57	0.34	73	0.62	0.25	110	0.61	0.42	239	0.57	0.27	342	0.58	0.33	7	0.70	0.15
	4	560	1.18	0.64	93	1.27	0.48	264	1.19	0.65	389	1.20	0.59	633	1.18	0.60	20	1.62	0.96
	5	212	1.12	0.44	29	1.29	0.52	95	1.08	0.40	146	1.18	0.48	240	1.15	0.45	1	0.43	.
	6	3	0.17	0.02	0			3	0.17	0.02			0.00	3	0.17	0.02		0.00	
	7		1.00	1.70	0			1	1.70	.			0.00	1	1.70	.		0.00	
	8	43	1.98	0.64	6	1.57	0.29	37	1.99	0.67	12	1.75	0.42	45	1.97	0.62	4	1.51	0.65
France	1	407	1.35	0.95	0			195	1.37	0.91	212	1.34	0.98	383	1.36	0.94	24	1.31	1.08
	2	1,901	0.77	0.42	190	0.66	0.34	412	0.75	0.43	1,679	0.76	0.41	1,564	0.77	0.42	527	0.72	0.39
	3	18	1.15	0.61	0			11	1.19	0.67	7	1.09	0.53	18	1.15	0.61		0.00	
	4	2,617	1.42	0.69	203	1.31	0.61	662	1.54	0.78	2,158	1.37	0.65	2,078	1.44	0.70	742	1.32	0.61
	5	1,923	1.49	0.71	84	1.18	0.51	869	1.59	0.79	1,138	1.39	0.62	1,670	1.52	0.73	337	1.23	0.53
	6	334	0.22	0.17	4	0.23	0.19	28	0.41	0.27	310	0.20	0.14	212	0.22	0.18	126	0.21	0.14
	7	2	0.34	0.00	0			2	0.34	0.00			0.00	2	0.34	0.00		0.00	

Germany	1	188	1.13	0.49	3	1.83	0.29	145	1.13	0.53	46	1.19	0.37	191	1.15	0.50			0.00
	2	424	0.81	0.41	75	0.78	0.40	259	0.84	0.40	240	0.76	0.42	463	0.80	0.41	36	0.88	0.39
	3	18	1.17	0.34	0			18	1.17	0.34			0.00	18	1.17	0.34			0.00
	4	1,075	1.36	0.56	116	1.29	0.49	621	1.41	0.58	570	1.29	0.52	1,105	1.35	0.55	86	1.33	0.68
	5	1,144	1.37	0.60	73	1.34	0.52	756	1.44	0.64	461	1.24	0.47	1,109	1.38	0.60	108	1.21	0.43
	6	18	0.33	0.18	0			7	0.45	0.22	11	0.25	0.11	11	0.40	0.19	7	0.22	0.10
	7	2	2.16	0.91	0			2	2.16	0.91			0.00	2	2.16	0.91			0.00
	8	56	1.23	0.58	4	0.93	0.14	47	1.24	0.56	13	1.08	0.60	54	1.25	0.58	6	0.83	0.20
Greece	1	6	2.86	1.49	0			6	2.86	1.49			0.00	6	2.86	1.49			0.00
	2	112	1.26	0.45	0			112	1.26	0.45			0.00	112	1.26	0.45			0.00
	4	71	2.40	0.93	0			71	2.40	0.93			0.00	71	2.40	0.93			0.00
	5	58	1.73	0.89	0			58	1.73	0.89			0.00	58	1.73	0.89			0.00
Hungary	6	10	0.52	0.30	0			10	0.52	0.30			0.00	10	0.52	0.30			0.00
	1	21	1.64	0.75	0			20	1.61	0.75	1	2.40	.	21	1.64	0.75			0.00
	2	106	1.30	0.68	5	1.38	0.39	103	1.32	0.67	8	1.16	0.56	106	1.30	0.68	5	1.38	0.39
	3	17	1.56	0.71	0			17	1.56	0.71			0.00	17	1.56	0.71			0.00
	4	184	1.85	0.75	4	1.78	0.59	154	1.85	0.75	34	1.84	0.75	169	1.83	0.75	19	1.94	0.76
	5	241	1.79	0.80	5	1.69	0.19	234	1.78	0.81	12	1.85	0.35	240	1.79	0.80	6	1.76	0.25
	6	10	0.88	0.81	0			10	0.88	0.81			0.00	10	0.88	0.81			0.00
	7			0.00	0			0		0.00			0.00			0.00			0.00
Iceland	8	19	2.05	1.40	0			19	2.05	1.40			0.00	19	2.05	1.40			0.00
	2	16	1.02	0.17	0			16	1.02	0.17			0.00	16	1.02	0.17			0.00
	4	13	1.79	0.47	0			12	1.79	0.49	1	1.77	.	13	1.79	0.47			0.00
	5	4	2.31	0.48	0			4	2.31	0.48			0.00	4	2.31	0.48			0.00
Italy	6	4	0.43	0.07	0			4	0.43	0.07			0.00	4	0.43	0.07			0.00
	1	141	0.98	0.56	10	0.83	0.09	104	1.03	0.62	47	0.83	0.29	126	1.00	0.58	25	0.81	0.21
	2	667	1.01	0.45	41	0.89	0.33	346	0.99	0.48	362	1.00	0.41	627	1.01	0.45	81	0.93	0.34
	4	228	1.74	0.64	27	1.59	0.67	65	1.68	0.65	190	1.74	0.64	157	1.71	0.67	98	1.75	0.60
	5	823	1.67	0.72	116	1.59	0.29	427	1.81	0.87	512	1.54	0.44	700	1.71	0.76	239	1.52	0.34
	6	6	0.33	0.11	0			2	0.35	0.00	4	0.32	0.14	6	0.33	0.11			0.00
	8	3	3.58	1.10	0			3	3.58	1.10			0.00	3	3.58	1.10			0.00

(Continued)

Table 3.2 (Continued)

Country	No Impact			Impact			No Negative Screening			Negative Screening			No Positive Screening			Positive Screening			
	Obs	Mean	Std	Obs	Mean	Std	Obs	Mean	Std	Obs	Mean	Std	Obs	Mean	Std	Obs	Mean	Std	
Latvia	2	4	1.45	0.05	0		4	1.45	0.05			0.00	4	1.45	0.05			0.00	
	4	3	1.57	0.02	0		3	1.57	0.02			0.00	3	1.57	0.02			0.00	
	5	3	2.12	0.23	0		3	2.12	0.23			0.00	3	2.12	0.23			0.00	
Lithuania	1		1.00	2.00	0		1	2.00	.			0.00	1	2.00				0.00	
	2	2	1.29	0.34	0		2	1.29	0.34			0.00	2	1.29	0.34			0.00	
	4		1.00	3.50	0		1	3.50	.			0.00	1	3.50				0.00	
Netherlands	1	29	1.51	1.24	1	0.94		22	1.30	1.27	8	2.02	0.96	24	1.32	1.23	6	2.20	1.01
	2	132	0.41	0.36	11	0.43	0.47	57	0.47	0.49	86	0.38	0.25	135	0.42	0.37	8	0.38	0.30
	3	2	0.36	0.04	0			2	0.36	0.04			0.00	2	0.36	0.04			0.00
	4	302	0.51	0.52	27	0.38	0.30	64	0.77	0.70	265	0.43	0.43	275	0.44	0.45	54	0.79	0.67
	5	104	0.65	0.34	4	2.87	1.52	34	0.98	0.87	74	0.62	0.37	107	0.71	0.57	1	2.60	
	6	8	0.15	0.10	0			0		0.00	8	0.15	0.10	8	0.15	0.10			0.00
	7			0.00	3	2.28	0.12	0		0.00	3	2.28	0.12	3	2.28	0.12			0.00
	8		1.00	0.08	0			0		0.00	1	0.08		1	0.08				0.00
Norway	2	312	0.25	0.44	0			57	0.34	0.29	255	0.23	0.47	312	0.25	0.44			0.00
	4	740	0.64	0.49	66	0.82	0.42	56	0.83	0.48	750	0.64	0.48	735	0.65	0.50	71	0.77	0.36
	5	94	0.64	0.42	0			25	0.77	0.52	69	0.59	0.37	94	0.64	0.42			0.00
Poland	6	67	0.13	0.15	0			11	0.29	0.32	56	0.10	0.05	67	0.13	0.15			0.00
	1	24	4.98	3.10	0			24	4.98	3.10			0.00	24	4.98	3.10			0.00
	2	185	1.53	0.75	0			177	1.52	0.73	8	1.78	1.06	185	1.53	0.75			0.00
	3	11	2.09	1.16	0			11	2.09	1.16			0.00	11	2.09	1.16			0.00
	4	280	2.48	0.76	4	1.99	0.73	274	2.44	0.75	10	3.15	0.64	279	2.46	0.74	5	2.93	1.36
	5	182	2.31	1.05	0			182	2.31	1.05			0.00	182	2.31	1.05			0.00
	6	27	0.95	0.32	0			27	0.95	0.32			0.00	27	0.95	0.32			0.00

Portugal	1	11	1.37	0.60	0			11	1.37	0.60			0.00	11	1.37	0.60			0.00
	2	61	0.87	0.46	2	0.83	0.49	58	0.88	0.47	5	0.68	0.01	60	0.88	0.47	3	0.68	0.00
	4	60	1.95	0.58	2	1.35	0.90	60	1.92	0.59	2	2.24	0.61	60	1.92	0.59	2	2.24	0.61
	5	113	1.64	0.51	3	1.65	0.33	113	1.64	0.51	3	1.47	0.38	113	1.64	0.51	3	1.47	0.38
	6	19	0.51	0.22	0			19	0.51	0.22			0.00	19	0.51	0.22			0.00
Slovakia	8	117	1.23	1.42	0			117	1.23	1.42			0.00	117	1.23	1.42			0.00
	2	3	1.17	0.58	0			2	1.40	0.58	1	0.70		3	1.17	0.58			0.00
	4	3	2.28	1.33	0			2	2.57	1.75	1	1.72		3	2.28	1.33			0.00
	5	12	1.61	0.73	0			10	1.68	0.79	2	1.27	0.00	10	1.68	0.79	2	1.27	0.00
	6	1		0.51	0			1	0.51				0.00	1	0.51				0.00
Slovenia	8	3	1.86	0.43	0			3	1.86	0.43			0.00	3	1.86	0.43			0.00
	1	1		2.50	0			1	2.50				0.00	1	2.50				0.00
	2	2	1.04	0.12	0			2	1.04	0.12			0.00	2	1.04	0.12			0.00
	4	15	2.14	0.44	0			12	2.08	0.47	3	2.41	0.07	15	2.14	0.44			0.00
	5	1		2.08	0			1	2.08				0.00	1	2.08				0.00
Spain	6	2	0.23	0.05	0			2	0.23	0.05			0.00	2	0.23	0.05			0.00
	1	119	0.78	0.53	3	0.92	0.42	114	0.75	0.48	8	1.19	0.93	116	0.79	0.53	6	0.70	0.21
	2	616	0.71	0.43	48	0.74	0.34	513	0.71	0.43	151	0.75	0.40	570	0.70	0.42	94	0.80	0.42
	4	750	1.47	0.64	69	1.46	0.68	560	1.48	0.65	259	1.44	0.62	666	1.47	0.65	153	1.45	0.60
	5	1,361	1.29	0.56	91	1.27	0.49	1189	1.29	0.57	263	1.27	0.46	1,248	1.28	0.57	204	1.29	0.46
Sweden	6	123	0.43	0.26	7	0.36	0.18	97	0.42	0.26	33	0.43	0.26	105	0.42	0.26	25	0.42	0.23
	1	23	1.48	0.78	4	1.27	0.31	15	1.62	0.89	12	1.23	0.42	27	1.45	0.73			0.00
	2	238	0.48	0.27	82	0.54	0.30	17	0.51	0.26	303	0.50	0.28	313	0.50	0.28	7	0.49	0.10
	3	2	1.05	0.49	0			0		0.00	2	1.05	0.49	2	1.05	0.49			0.00
	4	683	0.98	0.55	283	0.84	0.49	35	0.96	0.49	931	0.94	0.54	913	0.96	0.54	53	0.57	0.35
	5	229	0.99	0.49	32	1.07	0.50	27	1.14	0.54	234	0.99	0.49	261	1.00	0.49			0.00
	6	29	0.16	0.10	10	0.15	0.05	0		0.00	39	0.16	0.09	39	0.16	0.09			0.00

(Continued)

Table 3.2 (Continued)

Country	No Impact			Impact			No Negative Screening			Negative Screening			No Positive Screening			Positive Screening			
	Obs	Mean	Std	Obs	Mean	Std	Obs	Mean	Std	Obs	Mean	Std	Obs	Mean	Std	Obs	Mean	Std	
Switzerland	1	62	1.76	1.49	0		62	1.76	1.49			0.00	60	1.81	1.49	2	0.46	0.16	
	2	837	0.33	0.34	13	0.29	0.22	643	0.33	0.36	207	0.34	0.26	768	0.34	0.35	82	0.28	0.25
	3	133	0.69	0.57	0		129	0.70	0.58	4	0.36	0.11	122	0.70	0.59	11	0.52	0.22	
	4	1,598	0.63	0.57	32	0.72	0.47	1193	0.60	0.58	437	0.71	0.52	1,428	0.62	0.57	202	0.69	0.53
	5	771	1.02	0.43	7	1.31	0.19	543	0.99	0.43	235	1.11	0.41	657	1.01	0.44	121	1.14	0.31
	6	111	0.18	0.13	25		0.23	84	0.20	0.14	52	0.18	0.11	122	0.20	0.13	14	0.14	0.12
	8	63	0.78	0.21	1	1.13	1.13	58	0.78	0.22	6	0.84	0.23	63	0.79	0.22	1	0.74	
	1	143	0.98	0.56	0		137	0.94	0.54	6	1.81	0.25	137	0.99	0.57	6	0.70	0.08	
UK	2	1,615	0.50	0.37	87	0.47	0.28	1518	0.51	0.37	184	0.46	0.31	1,590	0.50	0.37	112	0.47	0.29
	4	5,332	0.76	0.50	195	0.90	0.45	4974	0.78	0.50	553	0.67	0.51	5,206	0.77	0.50	321	0.74	0.49
	5	3,664	0.85	0.46	84	0.68	0.41	3516	0.86	0.46	232	0.65	0.42	3,637	0.85	0.46	111	0.74	0.40
	6	89	0.20	0.23	0			64	0.24	0.26	25	0.11	0.07	89	0.20	0.23			0.00
	7	2	1.40	0.64	0			2	1.40	0.64			0.00	2	1.40	0.64			0.00
	8	198	0.93	0.43	0			198	0.93	0.43			0.00	194	0.92	0.43	4	1.10	0.43
	1	973	1.45	0.64	0			965	1.45	0.64	8	1.42	0.17	970	1.45	0.64	3	1.42	0.52
	2	5,305	0.80	0.46	69	0.65	0.36	5246	0.80	0.46	128	0.74	0.39	5,322	0.80	0.46	52	0.65	0.38
USA	3	79	1.14	0.50	0			79	1.14	0.50			0.00	79	1.14	0.50			0.00
	4	9,571	1.05	0.50	45	1.00	0.40	9371	1.05	0.50	245	0.98	0.48	9,414	1.05	0.50	202	1.03	0.45
	5	3,764	0.63	0.50	10	0.70	0.51	3578	0.63	0.50	196	0.56	0.45	3,766	0.63	0.50	8	0.10	0.08
	6	852	0.40	0.29	0			850	0.40	0.29	2	0.29	0.19	847	0.40	0.29	5	0.53	0.45

Austria	1	18	1.63	0.57	8	1.27	0.22	18	1.63	0.57	8	1.27	0.22	26	1.52	0.51			0.00
	2	336	0.71	0.37	556	0.69	0.37	295	0.73	0.37	597	0.68	0.37	814	0.70	0.37	78	0.69	0.39
	3	6	1.61	0.35	3	1.08	0.34	6	1.61	0.35	3	1.08	0.34	9	1.43	0.42			0.00
	4	285	1.48	0.63	500	1.40	0.55	255	1.45	0.64	530	1.42	0.55	732	1.43	0.58	53	1.36	0.56
	5	444	1.50	0.63	432	1.36	0.58	430	1.51	0.63	446	1.35	0.58	854	1.44	0.61	22	1.03	0.29
	6			0.00	12	0.36	0.23			0.00	12	0.36	0.23	12	0.36	0.23			0.00
	7	250	0.74	0.48	30	0.55	0.55	249	0.74	0.48	31	0.55	0.54	280	0.72	0.49			0.00
	8	19	0.97	0.17	4	0.99	0.20	19	0.97	0.17	4	0.99	0.20	23	0.97	0.17			0.00
Belgium	1	67	1.19	0.31	7	1.20	0.37	64	1.19	0.31	10	1.19	0.36	72	1.18	0.32	2	1.53	0.02
	2	70	0.62	0.31	131	0.60	0.32	70	0.62	0.31	131	0.60	0.32	171	0.63	0.32	30	0.48	0.26
	3	3	0.66	0.60			0.00	3	0.66	0.60			0.00	3	0.66	0.60			0.00
	4	308	0.99	0.57	493	1.23	0.64	265	0.98	0.59	536	1.22	0.63	623	1.14	0.60	178	1.13	0.70
	5	247	1.46	0.36	332	1.48	0.48	150	1.47	0.37	429	1.47	0.45	443	1.46	0.41	136	1.50	0.50
	6	11	0.38	0.19	7	0.38	0.16	7	0.38	0.24	11	0.38	0.13	10	0.38	0.20	8	0.38	0.15
	4	1	2.98		1	2.18		1	2.98		1	2.18		2	2.58	0.57			0.00
	5	1	1.91				0.00	1	1.91				0.00	1	1.91				0.00
Cyprus	2	5	0.92	0.62			0.00	5	0.92	0.62			0.00	5	0.92	0.62			0.00
	4	3	1.68	1.60	1	1.77		3	1.68	1.60	1	1.77		4	1.70	1.31			0.00
	5	10	1.71	0.70			0.00	10	1.71	0.70			0.00	10	1.71	0.70			0.00
Czechia	1	3	2.12	0.62			0.00	3	2.12	0.62			0.00	3	2.12	0.62			0.00
	2	29	0.89	0.39	7	0.91	0.66	27	0.87	0.38	9	0.97	0.61	36	0.89	0.44			0.00
	3	3	1.50	1.47			0.00	3	1.50	1.47			0.00	3	1.50	1.47			0.00
	4	29	1.85	0.74	15	1.35	0.84	29	1.85	0.74	15	1.35	0.84	44	1.68	0.80			0.00
	5	48	1.77	1.36	14	1.58	0.49	48	1.77	1.36	14	1.58	0.49	62	1.73	1.22			0.00
	6	1	0.39				0.00	1	0.39				0.00	1	0.39				0.00
	8	4	0.76	0.88	2	1.98	0.00	4	0.76	0.88	2	1.98	0.00	6	1.16	0.93			0.00

(Continued)

Table 3.2 (Continued)

Country	No ESG			ESG			No Responsible Investment			Responsible Investment			No SRI			SRI			
	Obs	Mean	Std	Obs	Mean	Std	Obs	Mean	Std	Obs	Mean	Std	Obs	Mean	Std	Obs	Mean	Std	
Denmark	1	8	1.77	0.67	5	1.66	0.31	7	1.73	0.71	6	1.72	0.31	13	1.72	0.54			0.00
	2	59	0.60	0.42	317	0.59	0.32	52	0.60	0.44	324	0.59	0.32	366	0.58	0.34	10	0.79	0.30
	4	82	1.14	0.82	439	0.97	0.51	59	1.35	0.86	462	0.95	0.51	511	1.00	0.58	10	0.96	0.41
	5	49	1.27	0.82	164	1.07	0.34	33	1.46	0.93	180	1.06	0.34	213	1.12	0.50			0.00
	8	122	0.86	0.16	1	0.85		122	0.86	0.16	1	0.85		123	0.86	0.16			0.00
Estonia	2	4	0.75	0.26			0.00	4	0.75	0.26			0.00	4	0.75	0.26			0.00
	4	3	1.20	0.00	5	1.76	0.42	3	1.20	0.00	5	1.76	0.42	8	1.55	0.43			0.00
	5	4	1.14	0.71			0.00	4	1.14	0.71			0.00	4	1.14	0.71			0.00
	8			0.00			0.00			0.00			0.00			0.00			0.00
Finland	1	39	2.08	0.64	6	1.78	0.83	19	1.79	0.69	26	2.22	0.59	45	2.04	0.66			0.00
	2	42	0.81	0.45	307	0.55	0.29	18	0.94	0.62	331	0.56	0.29	349	0.58	0.33			0.00
	4	113	0.96	0.60	540	1.24	0.61	55	1.26	0.64	598	1.19	0.61	653	1.19	0.62			0.00
	5	73	0.96	0.40	168	1.22	0.45	54	1.05	0.41	187	1.17	0.46	241	1.14	0.45			0.00
	6	2	0.19	0.00	1	0.15		2	0.19	0.00	1	0.15		3	0.17	0.02			0.00
	7			0.00	1	1.70				0.00	1	1.70		1	1.70				0.00
	8	14	2.12	0.68	35	1.86	0.60	10	2.36	0.54	39	1.82	0.60	49	1.93	0.62			0.00
France	1	227	1.36	0.92	180	1.34	0.99	156	1.40	0.97	251	1.33	0.93	395	1.37	0.96	12	0.83	0.37
	2	349	0.75	0.43	1,742	0.76	0.41	263	0.74	0.44	1,828	0.76	0.41	1,655	0.78	0.41	436	0.66	0.40
	3	3	0.67	0.56	15	1.25	0.58	3	0.67	0.56	15	1.25	0.58	10	0.97	0.55	8	1.38	0.63
	4	519	1.50	0.76	2,301	1.39	0.66	430	1.52	0.78	2,390	1.39	0.66	1,961	1.46	0.71	859	1.30	0.60
	5	856	1.53	0.77	1,151	1.43	0.66	722	1.56	0.80	1,285	1.43	0.65	1,660	1.53	0.72	347	1.22	0.57
	6	27	0.39	0.24	311	0.20	0.15	17	0.50	0.21	321	0.20	0.15	150	0.25	0.20	188	0.19	0.13
	7	2	0.34	0.00			0.00	2	0.34	0.00			0.00	2	0.34	0.00			0.00

Germany	1	147	1.12	0.52	44	1.24	0.41	141	1.12	0.53	50	1.21	0.40	191	1.15	0.50			0.00
	2	247	0.86	0.44	252	0.75	0.37	211	0.83	0.38	288	0.78	0.43	486	0.80	0.41	13	0.70	0.36
	3	18	1.17	0.34			0.00	18	1.17	0.34			0.00	18	1.17	0.34			0.00
	4	635	1.40	0.58	556	1.29	0.52	537	1.42	0.58	654	1.29	0.52	1,168	1.35	0.56	23	1.59	0.43
	5	697	1.47	0.65	520	1.22	0.47	650	1.48	0.66	567	1.24	0.48	1,183	1.37	0.60	34	1.36	0.44
	6	8	0.44	0.21	10	0.24	0.10	7	0.45	0.22	11	0.25	0.11	18	0.33	0.18			0.00
	7	2	2.16	0.91			0.00	2	2.16	0.91			0.00	2	2.16	0.91			0.00
	8	24	1.33	0.68	36	1.13	0.47	22	1.36	0.70	38	1.12	0.46	59	1.22	0.57	1	0.72	
Greece	1	6	2.86	1.49			0.00	6	2.86	1.49			0.00	6	2.86	1.49			0.00
	2	108	1.28	0.44	4	0.88	0.57	108	1.28	0.44	4	0.88	0.57	112	1.26	0.45			0.00
	4	63	2.43	0.95	8	2.18	0.72	63	2.43	0.95	8	2.18	0.72	71	2.40	0.93			0.00
	5	56	1.73	0.91	2	1.67	0.21	56	1.73	0.91	2	1.67	0.21	58	1.73	0.89			0.00
	6	10	0.52	0.30			0.00	10	0.52	0.30			0.00	10	0.52	0.30			0.00
	8	20	1.69	0.74	1	0.70		19	1.65	0.74	2	1.55	1.20	21	1.64	0.75			0.00
Hungary	2	103	1.32	0.67	8	1.16	0.56	100	1.32	0.68	11	1.21	0.54	111	1.31	0.67			0.00
	3	17	1.56	0.71			0.00	17	1.56	0.71			0.00	17	1.56	0.71			0.00
	4	128	1.86	0.73	60	1.81	0.79	127	1.85	0.72	61	1.83	0.80	188	1.85	0.75			0.00
	5	221	1.80	0.82	25	1.71	0.54	218	1.80	0.82	28	1.70	0.53	246	1.79	0.79			0.00
	6	10	0.88	0.81			0.00	10	0.88	0.81			0.00	10	0.88	0.81			0.00
	8	19	2.05	1.40			0.00	19	2.05	1.40			0.00	19	2.05	1.40			0.00
	2	15	1.02	0.17	1	1.10		15	1.02	0.17	1	1.10		16	1.02	0.17			0.00
	4	11	1.85	0.47	2	1.47	0.42	11	1.85	0.47	2	1.47	0.42	13	1.79	0.47			0.00
Iceland	5	3	2.30	0.59	1	2.35		3	2.30	0.59	1	2.35		4	2.31	0.48			0.00
	6	4	0.43	0.07			0.00	4	0.43	0.07			0.00	4	0.43	0.07			0.00
	1	98	1.06	0.62	53	0.80	0.30	95	1.07	0.62	56	0.78	0.30	125	0.98	0.58	26	0.88	0.34
	2	457	1.00	0.48	251	0.99	0.37	301	0.98	0.50	407	1.01	0.40	638	1.01	0.45	70	0.90	0.37
	4	123	1.67	0.63	132	1.78	0.65	62	1.65	0.64	193	1.75	0.64	208	1.74	0.65	47	1.66	0.62
	5	499	1.75	0.84	440	1.56	0.43	358	1.85	0.92	581	1.55	0.45	751	1.69	0.75	188	1.57	0.31
	6	2	0.35	0.00	4	0.32	0.14	2	0.35	0.00	4	0.32	0.14	6	0.33	0.11			0.00
	8	3	3.58	1.10			0.00	3	3.58	1.10			0.00	3	3.58	1.10			0.00

(Continued)

Table 3.2 (Continued)

Country	No ESG				ESG			No Responsible Investment			Responsible Investment			No SRI			SRI		
	Obs	Mean	Std		Obs	Mean	Std	Obs	Mean	Std	Obs	Mean	Std	Obs	Mean	Std	Obs	Mean	Std
Latvia	2	4	1.45	0.05			0.00	4	1.45	0.05			0.00	4	1.45	0.05			0.00
	4	3	1.57	0.02			0.00	3	1.57	0.02			0.00	3	1.57	0.02			0.00
	5	3	2.12	0.23			0.00	3	2.12	0.23			0.00	3	2.12	0.23			0.00
Lithuania	1	1	2.00				0.00	1	2.00				0.00	1	2.00				0.00
	2	2	1.29	0.34			0.00	2	1.29	0.34			0.00	2	1.29	0.34			0.00
	4	1	3.50				0.00	1	3.50				0.00	1	3.50				0.00
Netherlands	1	22	1.30	1.27	8	2.02	0.96	22	1.30	1.27	8	2.02	0.96	30	1.49	1.22			0.00
	2	29	0.44	0.47	114	0.41	0.33	26	0.46	0.50	117	0.41	0.33	130	0.43	0.38	13	0.25	0.15
	3	2	0.36	0.04			0.00	2	0.36	0.04			0.00	2	0.36	0.04			0.00
	4	39	0.74	0.67	290	0.47	0.47	37	0.78	0.67	292	0.46	0.47	316	0.48	0.46	13	0.97	1.06
	5	17	1.08	1.10	91	0.67	0.42	16	0.83	0.38	92	0.72	0.62	101	0.75	0.60	7	0.41	0.31
	6	2	0.22	0.19	6	0.12	0.07			0.00	8	0.15	0.10	6	0.12	0.07	2	0.22	0.19
	7			0.00	3	2.28	0.12			0.00	3	2.28	0.12	3	2.28	0.12			0.00
	8			0.00	1	0.08				0.00	1	0.08		1	0.08				0.00
Norway	2	37	0.38	0.32	275	0.23	0.45	25	0.46	0.36	287	0.23	0.44	311	0.25	0.44	1	0.55	
	4	45	0.88	0.46	761	0.64	0.48	25	0.87	0.52	781	0.65	0.48	798	0.66	0.49	8	0.40	0.51
	5	23	0.81	0.53	71	0.58	0.36	11	1.26	0.35	83	0.55	0.35	83	0.66	0.42	11	0.41	0.38
Poland	6	12	0.28	0.31	55	0.10	0.05	11	0.29	0.32	56	0.10	0.05	67	0.13	0.15			0.00
	1	24	4.98	3.10			0.00	24	4.98	3.10			0.00	24	4.98	3.10			0.00
	2	170	1.51	0.73	15	1.87	0.83	169	1.50	0.73	16	1.89	0.81	185	1.53	0.75			0.00
	3	11	2.09	1.16			0.00	11	2.09	1.16			0.00	11	2.09	1.16			0.00
	4	250	2.46	0.74	34	2.56	0.87	248	2.46	0.74	36	2.56	0.85	282	2.47	0.75	2	2.47	1.34
	5	173	2.30	1.07	9	2.43	0.47	173	2.30	1.07	9	2.43	0.47	182	2.31	1.05			0.00
	6	27	0.95	0.32			0.00	27	0.95	0.32			0.00	27	0.95	0.32			0.00

Portugal	1	11	1.37	0.60			0.00	11	1.37	0.60		0.00	11	1.37	0.60		0.00
	2	39	0.93	0.55	24	0.77	0.23	39	0.93	0.55	24	0.77	0.23	63	0.87	0.46	0.00
	4	41	1.89	0.57	21	2.00	0.63	41	1.89	0.57	21	2.00	0.63	61	1.92	0.59	1 2.67
	5	64	1.70	0.57	52	1.57	0.42	64	1.70	0.57	52	1.57	0.42	115	1.64	0.51	1 1.84
	6	8	0.61	0.23	11	0.43	0.18	8	0.61	0.23	11	0.43	0.18	19	0.51	0.22	0.00
	8	117	1.23	1.42			0.00	117	1.23	1.42		0.00	117	1.23	1.42		0.00
Slovakia	2	2	1.40	0.58	1	0.70		2	1.40	0.58	1	0.70		3	1.17	0.58	0.00
	4	2	2.57	1.75	1	1.72		2	2.57	1.75	1	1.72		3	2.28	1.33	0.00
	5	8	1.91	0.72	4	1.03	0.29	8	1.91	0.72	4	1.03	0.29	12	1.61	0.73	0.00
	6	1	0.51				0.00	1	0.51			0.00		1	0.51		0.00
	8	3	1.86	0.43			0.00	3	1.86	0.43		0.00		3	1.86	0.43	0.00
	1	1	2.50				0.00	1	2.50			0.00		1	2.50		0.00
Slovenia	2	2	1.04	0.12			0.00	2	1.04	0.12		0.00		2	1.04	0.12	0.00
	4	15	2.14	0.44			0.00	12	2.08	0.47	3	2.41	0.07	15	2.14	0.44	0.00
	5	1	2.08				0.00	1	2.08			0.00		1	2.08		0.00
	6	2	0.23	0.05			0.00	2	0.23	0.05		0.00		2	0.23	0.05	0.00
	1	111	0.75	0.48	11	1.11	0.81	111	0.75	0.48	11	1.11	0.81	122	0.78	0.52	0.00
	2	492	0.72	0.44	172	0.71	0.39	491	0.72	0.43	173	0.72	0.40	627	0.71	0.43	37 0.79 0.34
Spain	4	508	1.48	0.65	311	1.45	0.63	500	1.48	0.66	319	1.44	0.62	738	1.47	0.65	81 1.44 0.59
	5	1,144	1.29	0.57	308	1.28	0.49	1,141	1.29	0.57	311	1.28	0.49	1,349	1.29	0.56	103 1.25 0.47
	6	91	0.42	0.25	39	0.43	0.27	91	0.42	0.25	39	0.43	0.27	127	0.42	0.26	3 0.45 0.12
	1	7	1.57	0.74	20	1.40	0.74	7	1.57	0.74	20	1.40	0.74	27	1.45	0.73	0.00
	2	26	0.42	0.25	294	0.50	0.28	10	0.62	0.27	310	0.49	0.28	311	0.50	0.28	9 0.45 0.24
	3	2	1.05	0.49			0.00			0.00	2	1.05	0.49	2	1.05	0.49	0.00
Sweden	4	58	1.03	0.43	908	0.93	0.55	32	0.94	0.44	934	0.94	0.54	966	0.94	0.54	0.00
	5	24	1.11	0.40	237	0.99	0.50	17	1.22	0.30	244	0.99	0.50	261	1.00	0.49	0.00
	6	4	0.22	0.14	35	0.15	0.08			0.00	39	0.16	0.09	39	0.16	0.09	0.00

(Continued)

Table 3.2 (Continued)

Country	No ESG			ESG			No Responsible Investment			Responsible Investment			No SRI			SRI		
	Obs	Mean	Std	Obs	Mean	Std	Obs	Mean	Std	Obs	Mean	Std	Obs	Mean	Std	Obs	Mean	Std
Switzerland	1	60	1.81	1.49	2	0.46	0.16	60	1.81	1.49	2	0.46	0.16	62	1.76	1.49		0.00
	2	559	0.33	0.37	291	0.33	0.28	527	0.34	0.38	323	0.32	0.27	849	0.33	0.34	1	0.89
	3	123	0.71	0.59	10	0.41	0.09	116	0.71	0.60	17	0.49	0.18	133	0.69	0.57		0.00
	4	1,000	0.57	0.59	630	0.72	0.53	954	0.57	0.59	676	0.71	0.53	1,595	0.63	0.57	35	0.72
	5	373	1.01	0.46	405	1.04	0.39	360	1.00	0.46	418	1.05	0.39	758	1.02	0.43	20	1.20
	6	74	0.21	0.14	62	0.18	0.11	74	0.21	0.14	62	0.18	0.11	136	0.19	0.13		0.00
	8	38	0.75	0.14	26	0.85	0.28	37	0.75	0.15	27	0.84	0.28	64	0.79	0.22		0.00
	1	124	0.92	0.50	19	1.40	0.75	124	0.92	0.50	19	1.40	0.75	143	0.98	0.56		0.00
UK	2	1,440	0.52	0.38	262	0.41	0.29	1,343	0.53	0.38	359	0.42	0.30	1,681	0.50	0.37	21	0.49
	4	4,405	0.79	0.50	1,122	0.68	0.49	4,226	0.79	0.50	1,301	0.70	0.50	5,493	0.77	0.50	34	0.56
	5	3,249	0.87	0.47	499	0.68	0.38	3,191	0.87	0.47	557	0.68	0.39	3,714	0.84	0.46	34	0.99
	6	88	0.20	0.23	1	0.11		63	0.24	0.26	26	0.11	0.07	89	0.20	0.23		0.00
	7	2	1.40	0.64			0.00	2	1.40	0.64			0.00	2	1.40	0.64		0.00
	8	179	0.93	0.45	19	0.94	0.21	176	0.92	0.45	22	0.98	0.26	198	0.93	0.43		0.00
	1	967	1.46	0.64	6	0.84	0.56	955	1.46	0.64	18	1.13	0.51	966	1.45	0.64	7	1.18
	2	5,260	0.80	0.46	114	0.75	0.38	5,144	0.80	0.47	230	0.73	0.38	5,256	0.80	0.46	118	0.69
USA	3	79	1.14	0.50			0.00	79	1.14	0.50			0.00	79	1.14	0.50		0.00
	4	9,244	1.05	0.50	372	1.02	0.44	8,998	1.06	0.50	618	1.00	0.47	9,339	1.05	0.50	277	0.95
	5	3,537	0.64	0.51	237	0.50	0.41	3,479	0.64	0.50	295	0.52	0.44	3,697	0.63	0.50	77	0.54
	6	847	0.40	0.29	5	0.53	0.45	845	0.40	0.29	7	0.46	0.40	852	0.40	0.29		0.00

Source: Author's own elaboration based on the LSEG Workspace.

Notes: 1 means alternatives investment funds; 2 means bond investment funds; 3 means commodity investment funds; 4 means equity investment funds; 5 means mixed assets investment funds; 6 means money market investment funds; 7 means other investment funds; 8 means real estate investment funds.

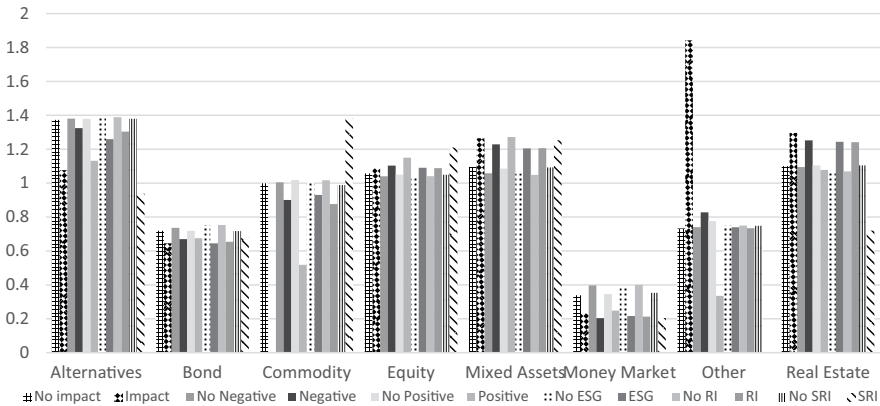


Figure 3.1 Value of total expense ratio of investment funds according to the investment strategy and the type of assets.

Source: Author's own elaboration based on the LSEG Workspace.

- **Negative and positive screening strategies:** Lower expense ratios than those of conventional funds are observed for alternative, bond, commodity, and money market asset classes. In contrast, higher expense ratios are found for equity, mixed asset, real estate, and other asset classes.
- **ESG and responsible investment funds:** Lower expense ratios than those of conventional funds are observed for alternative, bond, commodity, and money market asset classes, while higher expense ratios are noted for equity, mixed asset, real estate, and other asset classes. The pattern is reversed for SRI funds.

These results indicate that the total expense ratio varies by asset class. For green funds, expense ratios are lower for alternative, bond, commodity, and money market asset classes. However, for funds investing in mixed assets, real estate, and other asset classes, expense ratios are higher than those of conventional funds. These differences are generally modest, with the largest disparities observed for the impact strategy, followed by positive and negative screening strategies.

The analysis also reveals that total expense ratios are generally lower in the United States than in Europe (1.01 vs. 0.90). In both regions, expense ratios are lower for ESG funds than for conventional funds. This pattern is consistent with the results observed across asset classes. The highest expense ratios are found in Poland, Bulgaria, Hungary, Greece, Estonia, Portugal, Italy, Iceland, and Czechia, while the lowest ratios are observed in Norway, the Netherlands, the United Kingdom, Switzerland, Sweden, and the United States. These findings suggest a strong geographic bias. This relationship is also related to the structure of the funds' investments.

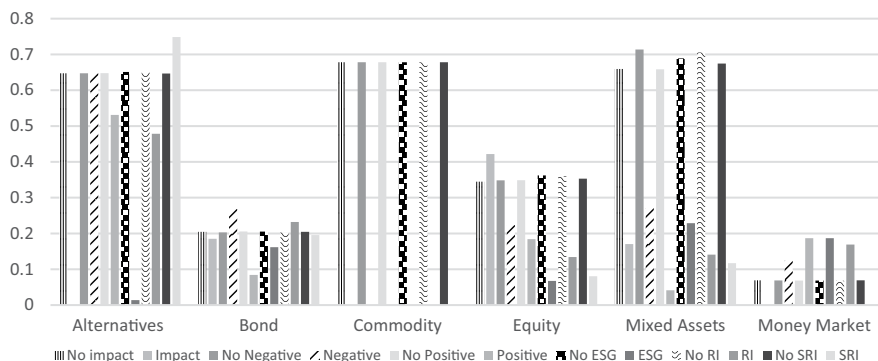


Figure 3.2 Value of the management fee of investment funds according to the investment strategy and the type of assets.

Source: Author's own elaboration based on the LSEG Workspace.

The analysis of management fees for investment funds, based on investment strategy and asset type, is presented in Figure 3.2. The lowest management fees are observed for bond and money market asset classes. Investment strategy appears to have a strong influence on management fee levels.

- **Impact strategy:** Lower management fees than those of conventional funds are observed for bond and mixed-asset classes. Conversely, higher management fees are found for equity asset classes.
- **Negative screening strategy:** Lower management fees than those of conventional funds are observed for equity and mixed-asset classes. In contrast, higher management fees are found for bond and money market asset classes. Funds investing in alternative assets incur management fees similar to those of conventional funds.
- **Positive screening strategy:** Lower management fees than those of conventional funds are observed for alternative, bond, equity, and mixed-asset classes. In contrast, higher management fees are found for money market asset classes.
- **ESG funds:** Lower management fees than those of conventional funds are observed for all asset classes except money market funds.
- **Responsible investment funds:** Lower management fees than those of conventional funds are observed for all asset classes except bond funds. For SRI funds, lower management fees are observed for all asset classes except alternatives.

The significant part of the analysis is testing the impact of changes in the United States regulatory policy under the administration of President Donald Trump and the United States' withdrawal from the Paris Agreement in January 2025, on the activity of investment funds. The hypothesis is as follows: Changes

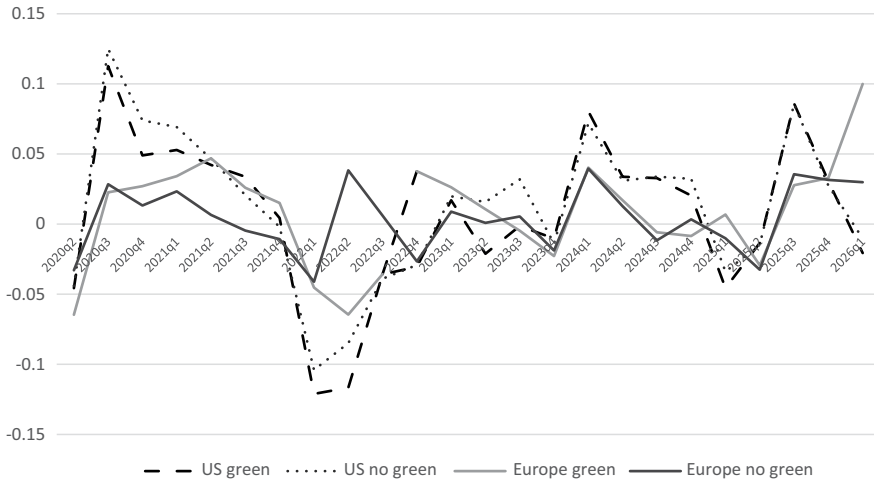


Figure 3.3 Changes in the net asset value of the investment funds by the type of funds and geographical location.

Source: Author's own elaboration based on the LSEG Workspace.

in US regulatory policy under the Trump administration affected the activity of investment funds (H5). The analysis is based on changes in net asset values (NAV) and changes in the investment portfolio. Figures 3.3 and 3.4 present changes in the quarterly mean NAV for European and US funds by considering the type of funds (green and brown funds) and the type of strategy management (active and passive managed funds). The results indicate several significant findings:

- From 2025, a strong outflow of financial sources from US investment funds and an inflow in Europe is observed. It is observed for both green and brown funds. In the case of Europe, the stronger inflow is noticed for the green than the brown funds.
- The impact of the political decisions has also been noticed in the case of the other periods. In the United States and Europe, a strong inflow to the investment funds was observed during the COVID-19 period, and an outflow after this period. In the case of Europe, the stronger inflow to the green investment funds was noticed for 2022–2023. For the US funds, the reaction was similar, but lower. It is an effect of the introduction of new regulations described before. In 2024, a strong inflow to the US funds was observed for both groups.
- The analysis of the investment funds inflows and outflows by considering the type of strategy management shows varied results. In Europe, the strong inflow for the passive managed investment funds was noticed in the 2022/2023 period; at the moment, they are not observed as strongly significant changes in the NAV for this group. In 2025, the NAV inflows for the

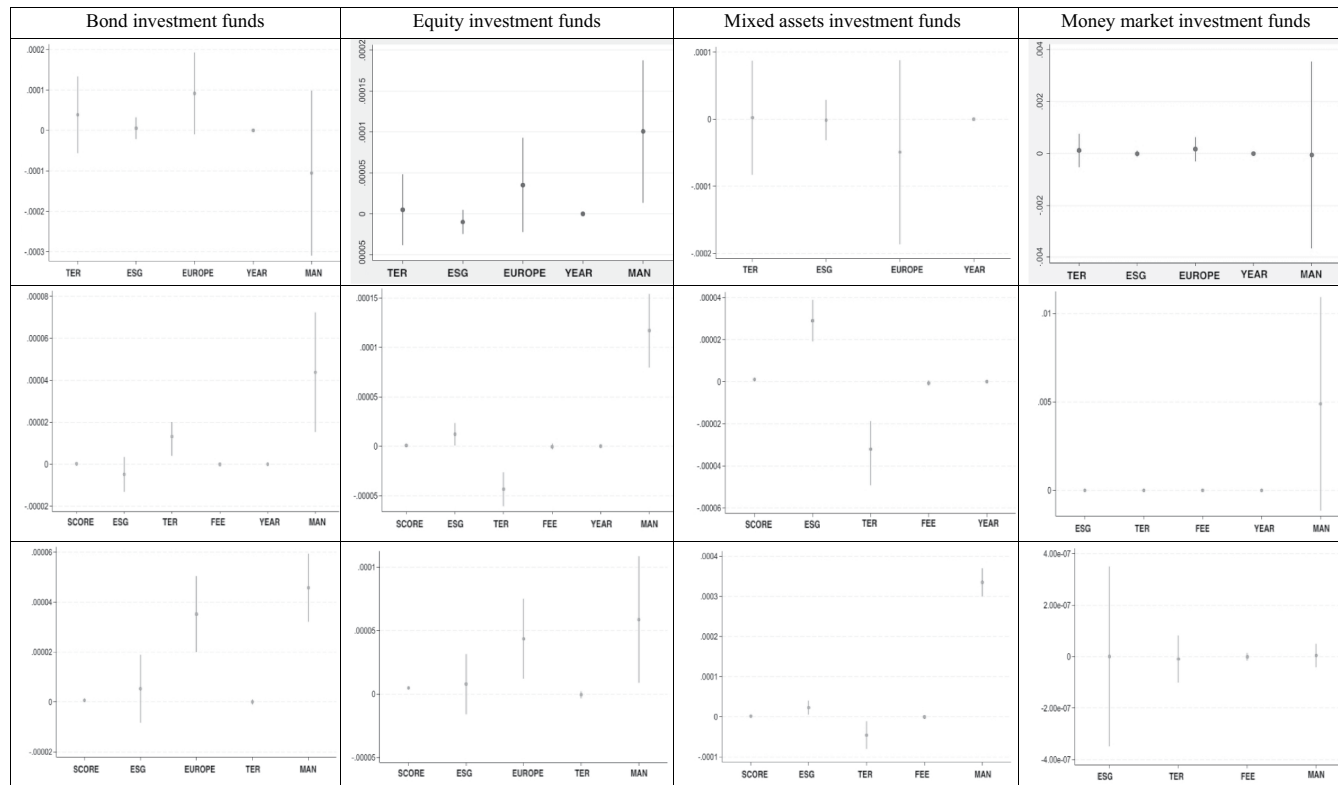


Figure 3.4 Factors determine changes in the net asset value estimated by using LASSO methods.

Source: Author's own elaboration based on the LSEG Workspace.

European active managed funds, which is stronger than for the brown funds. In the case of the United States, a weaker trend of the interest of investors for all types of funds is observed, but this trend is weaker for the passively managed brown funds.

The presented situation confirms the impact of the changes of the regulations related to non-financial reporting, green investments, and others that are similar. It also shows the impact of the decisions taken by the United States' administration not only on the United States market but also on the European one. In the case of the US funds, a strong uncertainty is also noticed. In Europe, a strong interest in investing in green funds is observed, and positive sentiment can be observed for investors. The rising trend in inflows for green funds confirms this. The received results also confirm that the strong impact of the strategy investment has been noticed. In the case of the passive managed funds, the impact of the changes in regulations is weaker.

As a result of the described phenomenon, the next point of the analysis was related to testing factors that influence the changes of NAV by using linear LASSO for each type of assets. As a result, variables described in Table 3.3 were used for the estimation.

Results of the analysis using linear LASSO¹ have been presented on Figure 3.4. They show the varied reaction of the market for a particular type of asset. The first line presents effects for the period 2022–2025, the second shows the

Table 3.3 List of variables used for the linear LASSO method

<i>Name of variable</i>	<i>Description</i>	<i>Abbreviation</i>
ESG score	Value of the ESG score. The minimum value is 0, and the maximum value is 100.	SCORE
Management strategy	Active strategy is 1, passive strategy is 2	MAN
Total expense ratio	It is an annual percentage fee measuring the total costs of managing and operating an investment fund, including management fees, administrative overhead, and marketing expenses. It is calculated by dividing total fund expenses by average net assets, with higher ratios reducing net returns, presented as a percent.	TER
Management fee	It is a periodic payment made by an investment fund to its investment adviser for investment and portfolio management services, expressed as a percentage.	FEE
ESG fund	Dummy variable, where 1 means that it is an ESG fund, 0 otherwise	ESG

Source: Author's own elaboration based on the LSEG Workspace.

effect of the ESG score impact and ESG type of funds, and the last one presents the effect of the mentioned relationship for 2025.

Challenges in ESG Risk Management for Investment Funds

The current situation in the investment fund market poses several challenges. Initially, regulations or guidelines to help manage these funds are necessary. As mentioned in the previous subchapter, a few guidelines or initiatives do exist in this area; however, they do not address all problems. To start with, many differences exist between measures related to ESG risks. The ESG Rating Directive has been introduced in Europe; however, it does not cover all issues. It is less restrictive than the Credit Rating Directive. The methodology used by ESG data providers is not verified, as in the case of credit ratings. It is also not very different across agencies, which creates problems when building portfolios based on ESG ratings assessment. In fact, investors often disregard the extent of ESG disclosure when making investment decisions, despite the availability of this information (Chodnicka-Jaworska, 2025). Consequently, the obligation to assess the ESG risk independently when building the investment portfolio should be available. This situation also presents issues with the quality of data associated with non-financial reporting and is related to regulatory changes. The instability of green policy and non-financial reporting in the United States directly affects the volume of non-financial data published by companies. Consequently, investment funds face challenges in creating the correct portfolio. In practice, the following issues can be identified:

- Building an investment portfolio based on ESG ratings and scores;
- Building an investment portfolio based on the ESG ratings and scores presented as a sector-wide average rather than for the particular company;
- Issues related to the lack of non-financial data;
- Greenwashing in fund nomenclature; and
- Window-dressing issues and changes to the construction of the investment portfolio.

To increase reliability and effectiveness, methods must meet stringent impact measurement requirements (Chatterji & Levine, 2006; Chodnicka-Jaworska, 2025). Lack of trust in ESG data is the biggest problem associated with accessing more robust and comparable measurement tools (Busch et al., 2015). Investment funds must rely on self-assessment data and on checking the methods used by other institutions. Data presented by ESG data providers is not always reliable and verifiable. The independent data, typically available only in an aggregated form at the industry level, also presents a challenge. They do not include company-specific information. Datasets are often very expensive and typically require many databases from different data providers, which contributes to the high costs and a lack of transparency in the methodology. The high quality and transparency of datasets are essential for accurate quantification of the ESG risk (Olsthoorn et al., 2001; TCFD, 2017).

Another challenge is the assessment tool's ability to quantify impact in terms of an investment's contribution to defining SDGs. Absolute values or comparisons with conventional benchmarks cannot reveal the contribution of investment portfolios to achieve global SDGs (Rekker et al., 2019). The most popular goals are related to the Paris Agreement (Battiston et al., 2017) and the United Nations SDGs (UNCTAD, 2014). If investment funds accurately prepare specific goals and take decisions according to their strategies, they can prompt companies to change their business activity according to the "green" economy rules (IPCC, 2018; Schoenmaker & Schramade, 2019). The concept of net-zero investment portfolios is gaining popularity as investor initiatives require a robust framework that aligns portfolios with the goal of net-zero emissions by 2050 (Net-Zero Alliance, 2020). IOSCO (2021) focused on the need to make investment decisions based on the scientific framework, which not only increases the credibility of investments but also helps identify companies and activities that can deliver the most significant impact.

The next significant aspect is the restrictiveness of regulations and their impact on the green window-dressing problems. In the United States, funds are legally required to disclose their portfolios four times a year (at the end of each fiscal quarter), with some voluntarily disclosing more frequently, up to 12 times a year. In most European countries, disclosure is obligatory at least twice a year. Although this provides some transparency, it still means that investors only know with certainty the assets held by their funds on four days per year in the United States and two days per year in Europe. It also brings problems with the quality of the investment portfolio and greenwashing of the financial products problems.

The next aspect that needs analysis is the impact of the risk-return-environment criteria (Capelle-Blancard & Monjon, 2012; Talan & Sharma, 2019). There is a lack of analysis regarding the impact of the decisions taken by investment funds on the economy, taking SDGs into consideration. A forward-looking approach to impact offers a more effective method to plan changes in the context of sustainability solutions and helps better identify risks and opportunities by investors than the retrospective approach (Angelakoglou & Gaidajis, 2015). One of the TCFD recommendations suggests reporting emissions over a wider range of time periods to enable trend analysis (TCFD, 2017).

The next section addresses the direct investor impact, defined as the investor's contribution that would not have been achieved without their involvement, as outlined by Brest and Born (2013), which plays a significant role in the case of the investment funds, because it can influence corporations' behavior and their cost of capital (Kölbel et al., 2020). The more concentrated, actively managed portfolios and support for sustainability-related shareholder resolutions, the larger the change in companies (Boermans & Galema, 2019; Dimson et al., 2015; Dyck et al., 2019; Schoenmaker & Schramade, 2019). An actively managed investment fund should be rewarded in comparison to a passive investment fund (Popescu et al., 2021).

Some of the studies presented have been reviewed by regulators, resulting in the implementation of national-level programs aimed at improving the management of investment funds and offering better products. Below are the most significant initiatives for the administration of products and asset management (Table 3.4).

Table 3.4 Description of supervisors’ initiatives related to ESG financial products and asset management

Area	Description
<i>Measures at the product level</i>	
Areas Details Reviews (thematic or targeted) of product-level disclosure materials and marketing materials	In Canada, the OSC Ontario and AMF Québec review prospectuses before a receipt is issued for the prospectus that would permit securities offered under the prospectus to be offered to the public. The OSC Ontario has conducted thematic reviews focused on ESG-related investment funds as part of its continuous disclosure review program. If greenwashing is identified in these reviews, staff of the OSC Ontario and AMF Québec work with the investment fund manager to correct the disclosure in question. Depending on the severity of the greenwashing, the investment fund manager and its funds may be referred for enforcement action. In addition, depending on the severity of the issue, the OSC Ontario and AMF Québec may take enforcement action against the investment fund manager and its funds. The FCA UK plans to conduct reviews of the characteristics of labeled products once its new labeling rules are in force. The proposed criteria for labeling require firms to carry out due diligence on any research and analytical resources they rely upon, including third-party ESG ratings and data providers. This is consistent with the expectations in our Guiding Principles on the design, delivery, and disclosure of ESG/sustainability funds published in July 2021. MAS Singapore collects information from asset managers and uses data from Morningstar to monitor asset managers’ sustainability products and practices.

(Continued)

Table 3.4 (Continued)

Area	Description
Market-wide studies into sustainability-related disclosures	AFM Netherlands has also conducted market-wide studies into sustainability-related disclosures at the product level, which have led to actions such as letters to individual asset managers informing them about applicable standards. It has also recently closed its public consultation on the guidelines on sustainability claims. In these guidelines, financial institutions and pension providers will find tools to help them comply with the existing information requirements. In addition, the AFM Netherlands has published an exploratory study into the sustainability risk management of management companies of Dutch collective investment companies.
<i>Measures at the asset-manager level</i>	
Assessments or review of the asset manager's entity-level policies, procedures, practices, and disclosure. This is conducted as part of the licensing or registration process or as part of the ongoing compliance review process for registered entities. Such assessments or reviews may include a focus on sustainability-related issues depending on whether the asset manager offers any sustainability-related products.	At CONSOB Italy, the analysis is conducted in the context of the licensing procedure of Management Companies. The analysis is focused, inter alia, on the decision-making process, taking also into account the funds categories under the SFDR's classification that the manager intends to manage. In this context, parameters such as allocation of roles and responsibilities, resources and tools, and potential investment strategies are deeply scrutinized to assess the manager's preparedness and to detect potential weaknesses. The AMF France conducted in 2022 a study and a SPOT inspection campaign (Supervision des Pratiques Opérationnelle et Thématique – operational and thematic supervision of practices) on compliance with non-financial contractual commitments by funds (UCITS and AIFs) managed by portfolio asset management companies (AMCs). In practice, the AMF reviewed the systems for defining, managing, and controlling these commitments in a representative sample of AMCs. The AMF also assessed the level of compliance of these practices with the AMCs' regulatory obligations, identified good and poor practices in this field, and published a summary of the results of those inspections in July 2023. The SFC Hong Kong has been conducting reviews on fund managers' compliance with its climate risk management requirements and their sustainability-related disclosures as part of the supervision of licensed corporations since the FMCC requirements came into effect in 2022. The OSC Canada conducts regular compliance reviews of asset managers.

(Continued)

Table 3.4 (Continued)

Area	Description
Inspections	In addition to conducting desk reviews/fund analyses with regard to possible cases of sustainability issues, FINMA Switzerland uses onsite reviews and supervisory dialogue to monitor and assess whether asset managers and sustainability-related products comply with regulatory requirements. MAS Singapore conducted a review of the environmental risk management practices of thirty asset managers in 2021 and published an information paper highlighting the good practices observed and the recommendations for improvements. The US SEC's Division of Examinations (EXAMS) carries out examinations and inspections of securities firms under its purview. EXAMS publishes its priorities each fiscal year. For the fiscal years 2021, 2022, and 2023, the consideration of certain ESG and climate-related risks was included. It has also issued a Risk Alert to highlight observations from recent exams of investment advisers, registered investment companies, and private funds offering ESG products and services. While not specifically referenced in its 2024 priorities, EXAMS will continue to examine firms to evaluate whether they are accurately disclosing their ESG investing approaches and have adopted and implemented policies, procedures, and practices that accord with their ESG-related disclosures.
	In addition to monitoring disclosure requirements of asset managers and the product by the FSA Japan, the Securities and Exchange Surveillance Commission also conducts onsite monitoring of asset management companies and cooperates with the FSA's supervisory departments on the results of such monitoring.
Risk-based approach	Risk assessments are conducted by SC Malaysia. ESG risks/concerns, if any, would be considered, subject to SC Malaysia's risk assessment and prioritization. Generally, the asset managers themselves are expected to undertake a compliance approach, that is, internally have policies and processes to ensure they are in compliance with their "mandate" and to have the necessary governance, risk management, and controls to achieve their objectives/mandate.

(Continued)

Table 3.4 (Continued)

Area	Description
Reviews (thematic or targeted)	The risk based on CONSOB Italy covers a sample of Management Companies representative of domestic asset management sector and classified as riskier in terms of compliance for the sample. A deep scrutiny of ESG policies published by these sampled companies on their website is carried out together with the analysis of their official documents. Strategies, parameters, and informational data sources adopted by the companies to assess potential ESG/sustainable investments represent the focus of the analysis, with the objective to identify potential weaknesses in terms of ESG risk and portfolio management.
	In the EU, ESG disclosures are included in the new Union Strategic Supervisory Priorities (USSPs): As noted in the ESMA Progress Report, the USSP will also foster an integrated approach to supervision across the sustainable investment value chain (SIVC) by considering the most relevant sectors (issuers, investment managers, and investment service providers) and the interlinkages among them. In that context, ESMA and the EU's financial markets regulators and supervisors have launched a Common Supervisory Action (CSA) with National Competent Authorities (NCAs) on sustainability-related disclosures and the integration of sustainability risks. The goal is to assess the compliance of supervised asset managers with the relevant provisions in the SFDR, the Taxonomy Regulation, and relevant implementing measures, including the relevant provisions in the UCITS and AIFMD implementing acts on the integration of sustainability risks, using a common methodology developed by ESMA. At the domestic level, some EU NCAs (such as FSMA Belgium, AFM Netherlands, CNMV Spain, and CONSOB Italy) perform disclosure supervision. The disclosure supervision is focused on the ex-ante templates envisaged by the SFDR for art. 8 and art. 9 products. The regulators review regulatory documents (for example, prospectus, offering document, and Key Information Document) together with overseeing marketing communication, such as verifying the content of the websites of all fund managers managing funds with ESG characteristics and marketing materials of funds, with a specific attention to any ESG-related claims.

(Continued)

Table 3.4 (Continued)

<i>Area</i>	<i>Description</i>
Information/Intelligence Gathering: Some jurisdictions rely on the collection of data and information as a supervisory tool.	The OSC Ontario conducted a marketing desk review with the objective of ensuring that registrants have an adequate compliance system in place to support claims relating to ESG products and services. This involved reviewing the asset manager's policies and procedures relating to its investment framework, and its internal oversight regime, including oversight of the investment process and the use of external service providers providing ESG analysis.
	MAS Singapore plans to conduct thematic inspections, which will include reviewing the sustainability frameworks and practices of asset managers against their public claims.
	The FSA Japan uses the information it collects to issue orders to asset management companies requiring certain reports.
	MAS Singapore also collects information from asset managers and uses data from Morningstar to monitor asset managers' sustainability products and practices.
	The FCA UK utilizes intelligence gathered on the quality of fund authorization applications as part of its supervisory approach to greenwashing.
Complaints monitoring	FINMA Switzerland also conducts surveys of asset managers to assess greenwashing.
	The SFC Hong Kong uses intelligence from different sources, including self-reported breaches.
	The CMVM Portugal conducts its supervision in the ESG area primarily by using the regular information provided on a periodic basis to the CMVM by asset managers, which is then subject to a comprehensive analysis
Interactions with industry	The FCA UK and the SFC Hong Kong adopt such an approach.
	The CNMV Spain monitors and dialogues with the industry regarding disclosure relating to taxonomy information of listed entities, which started in 2023. These disclosures are specifically monitored for both eligible and aligned activities. Since it is the first year of applications, a continuous dialogue is being maintained with issuers in order to address any doubts that may arise, facilitating consistent criteria for the Spanish market.
	In addition to conducting deep dives into sustainability issues, FINMA Switzerland also conducts desk reviews/fund analyses regarding possible cases of deception and conducts supervisory dialogue to monitor and assess whether asset managers and sustainability-related products comply with regulatory requirements.
	The SFC Hong Kong maintains regular interactions with the asset managers that it regulates with a view to identifying and assessing the risks arising from their business activities.

(Continued)

Table 3.4 (Continued)

Area	Description
Others	Finansinspektionen (FI), Sweden, has a number of tools at its disposal as a supervisory authority, namely granting authorizations, conducting supervision, issuing rules, and intervening to address this phenomenon. It also uses more informal or indirect tools, such as preparing guidelines for the industry, offering financial education, communicating about sustainability, and cooperating internationally on sustainability. AMMC Morocco, FRA Egypt, and CNBV Mexico are in the process of developing/implementing guidelines or requirements/supervisory tools in the area of sustainability-related practices and disclosure for asset managers and their products.

Source: IOSCO (2023).

Conclusions

The ESG risk has a direct impact on the activities of the investment funds. Not without significance are current changes in regulations. Changes in US regulatory policy under the Trump administration affected the activity of investment funds (H5). These findings highlight a substantial presence of responsible investment funds in Europe and the United States, yet reveal significant regional disparities in market adoption and strategy preferences. The dominance of negative screening suggests that exclusion-based approaches remain the most accessible and widely adopted method for responsible investing. However, the growing presence of positive screening and impact investing indicates a shift toward more proactive sustainability approaches. The results also suggest that regulatory stability and alignment with international frameworks (e.g., the Paris Agreement) may play a crucial role in driving investor engagement in sustainable finance. Future research should investigate the effectiveness of these strategies in achieving measurable ESG outcomes and examine the impact of regulatory harmonization on market growth and investment performance.

The analysis indicates that the total expense ratio and management fees of investment funds differ notably across asset classes, investment strategies, and geographic regions. Money market funds exhibit the lowest total expense ratio, while alternative funds display the highest. Across green investment strategies, total expense ratios tend to be lower than those of conventional funds for alternative, bond, commodity, and money market asset classes, but higher for mixed asset, real estate, and other asset classes. The largest differences are associated with the impact strategy, followed by positive and negative screening strategies. Management fees are lowest for bond and money market funds, and strategy choice significantly affects fee levels. ESG and responsible investment funds generally charge lower management fees than conventional funds across most asset classes, although exceptions exist for certain asset categories such as money market and bond funds.

The findings also reveal a strong geographic bias in fund costs, with total expense ratios generally lower in the United States than in Europe. The highest total expense ratios are observed in several Eastern and Southern European countries, while the lowest ratios are found in Northern Europe and the United States. These differences appear to be related to market structure, regulatory frameworks, and the composition of fund portfolios.

In addition, the study highlights major challenges in ESG risk management, including inconsistent ESG ratings, insufficient non-financial data quality, and the prevalence of greenwashing and portfolio green window dressing. These issues underscore the need for more rigorous and transparent ESG methodologies, improved data availability, and forward-looking impact measurement frameworks aligned with global sustainability goals. Future research should investigate the effectiveness of regulatory interventions and standardized ESG metrics in reducing cost disparities and improving the reliability of sustainable investment products.

Note

- 1 Linear lasso: (1) no of observations: 10,955,736; exogenous: TER; selected controls: ESG, EUROPE, YEAR, MAN; (2) no of observations: 20,111,993; exogenous: TER; selected controls: ESG, EUROPE, YEAR, MAN; (3) no of observations: 12,145,460; exogenous: TER; selected controls: ESG, EUROPE, YEAR; (4) no of observations: 1,344,443; exogenous: TER; selected controls: ESG, EUROPE, YEAR, MAN. (5) no of observations: 8,271,629; exogenous: SCORE ESG; selected controls: TER, FEE, YEAR, MAN; (6) no of observations: 14,580,228; exogenous: SCORE ESG; selected controls: TER, FEE, YEAR, MAN; (7) no of observations: 5,007,793; exogenous: SCORE ESG; selected controls: TER, FEE, EUROPE, YEAR, MAN; (8) no of observations: 834,472; exogenous: SCORE ESG; selected controls: TER, FEE, EUROPE, YEAR, MAN; (9) no of observations: 1,520,009; exogenous: SCORE ESG; selected controls: TER, FEE, EUROPE, MAN; (10) no of observations: 2,677,724; exogenous: SCORE ESG; selected controls: TER, FEE, EUROPE, MAN; (11) no of observations: 940,795; exogenous: SCORE ESG; selected controls: TER, FEE, EUROPE, MAN; (12) no of observations: 244,032; exogenous: SCORE ESG; selected controls: TER, FEE, EUROPE, MAN.

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4 ESG Risk Management in Insurance Sector

ESG Risk and Capital Adequacy in Insurance

ESG risk in the insurance sector can be assessed from a few aspects. The first is regulation and analysis of physical and transitional risks and their influence on the portfolios of insurance companies. The second is ESG ratings and scores and their impact on the insurance sector. Both mentioned aspects have a direct or indirect impact on the capital adequacy in the insurance sector. The first point of the analysis will focus on assessing the physical risk. Globally, exposure to climate-relevant assets is approximately 33%–40% of global insurers' general accounts. The stress test revealed a drop in the asset evaluation of around 12%, although this should be considered in the long term.

According to the Solvency II regulation, the most significant measure is Pillar 1 of the SCR. The capital level is sufficient to cover losses that could occur on average once every 200 years (99.5% VaR). A level of 100% represents the safe zone. The specific SCR level depends on the risk taken, risk appetite, and risk management techniques and instruments. A level above 200% should be considered very good. The SCR without transitional measures (SCR w/o Trans) is a measure that considers the mitigation resulting from specific mechanisms (such as transitional interest rate measures, volatility adjustment, and matching adjustment) implemented by Omnibus II (Van Hulle, 2019, p. 102), primarily after the financial crisis of 2007–2008. It allows for the use of advanced algorithms in SCR calculations. Capital requirements are just one of the numerous safety measures, such as technical reserves and reinsurance (Van Hulle, 2019, p. 5). The division of own funds reflects the characteristics of the capital employed. Tier 1 capital comprises excess assets over liabilities and subordinated liabilities. Paid-in share capital is classified as Tier 1. Tier 1-unrestricted is immediately available to absorb losses. Additional own funds are represented in Tiers 2 and 3 and require prior supervisory approval to be recognized as own funds. There are legal maximum thresholds for levels other than Tier 1-unrestricted. The Solvency II Directive divides capital requirements into different risk types, indicating different types of activity. The level of risk depends on the volume of risk. This can be reduced through preventive measures. The overall impact can be reduced through diversification. A higher

share of capital employed simply indicates a greater risk or a lower ability to cope with it. From the perspective of the European single market, the supply of ESG products is particularly linked to the solvency framework due to the potentially catastrophic consequences (Summerville & Leblanc, 2022). Properly incorporating this risk into the forecasts used within the ORSA framework is crucial. Another crucial area is prevention and adaptation mechanisms aimed at mitigating the impact of environmental threats. The above issues can be summarized as ESG risk management, which leads us to three important aspects. First, the availability and quality of data and models. Second, the availability of reinsurance coverage, and finally, state involvement and partnerships. Capital requirements are a key element of the solvency framework. The way ESG risks are incorporated into the standard formula is crucial. Finally, any offer to entities that do not comply with ESG principles may entail reputational risk (Karwowski & Raulinajtys-Grzybek, 2021).

As a component of ESG risk, climate risk receives the most emphasis in Solvency II and other regulations. Data on catastrophe risk is provided in current reports, which is crucial for non-life insurance companies. Figure 4.1 presents the value of insured and uninsured losses from natural disasters worldwide and the share of insured losses in 2024, expressed in bn USD. It displays the expected increasing trend in reducing the protection gap. All types of risk are expected to become more significant, especially drought, precipitation, and water stress, underscoring the need for insurance companies to include risk in their estimation.

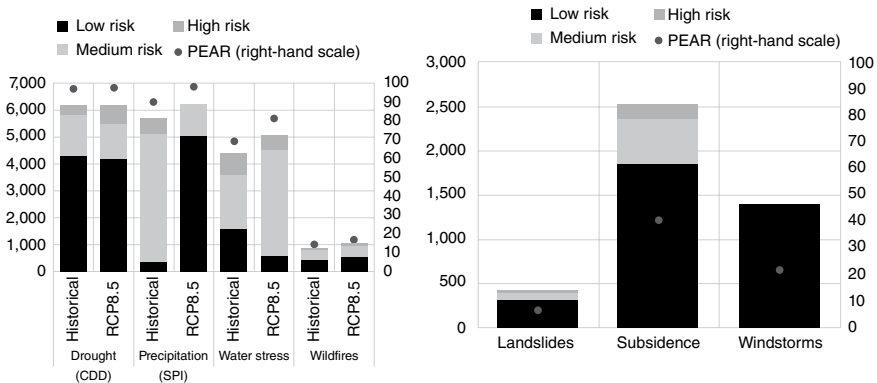


Figure 4.1 Global natural disasters insured and uninsured losses, share of insured losses (USD bn, 2024 prices).

Sources: European System of Central Banks (ESCB) calculations based on data from AnaCredit, Register of Institutions and Affiliates Database (RIAD), Securities Holding Statistics (SHSS), Intergovernmental Panel on Climate Change Interactive Atlas, World Resource Institute, Joint Research Centre (JRC), and Copernicus.

Notes: RCP8.5 projections are for 2050. Historical and projection estimates are based on varying reference periods depending on the hazard considered.

The potential exposure at risk (PEAR) indicator provides an insight into the prevalence of a natural phenomenon and is compiled as a sum of risk scores (from 1: low risk, to 3: high risk). The PEAR indicator can serve as a summary measure, enabling comparison across various dimensions of the indicators. Figure 4.2 presents the PEAR for flood protection for specific countries in Europe.

The exposure to risk of flood during the last five years increased significantly (Figure 4.3). The presented risk illustrates the large interval between the 25th and 75th percentiles, which highlights the character of the catastrophe. In the case of exposure at risk to windstorms, the trend is quite stable, but the interval is even higher.

Appendix 1 presents the heat maps for the insurance sector according to the type of sector and the type of the insurers' activity, which have been presented by PSI.

The next part of the analysis tests the **impact of ESG scores on solvency capital requirements, the structure of own funds** of insurance companies, and their impact on their profits. The analysis of the ESG scores for the insurance sector by LSEG reveals a significant variation in ESG scores across countries, even within Europe. It not only presents the impact of the geographical location, which is associated with regulations related to non-financial reporting, the connection between countries, the restrictiveness of national supervisors (Chodnicka-Jaworska, 2025), and also the culture of being “green”. The highest measures are noticed for European countries and Australia (Figure 4.4). A stable situation is observed for Africa. In the other regions, an increase in ESG

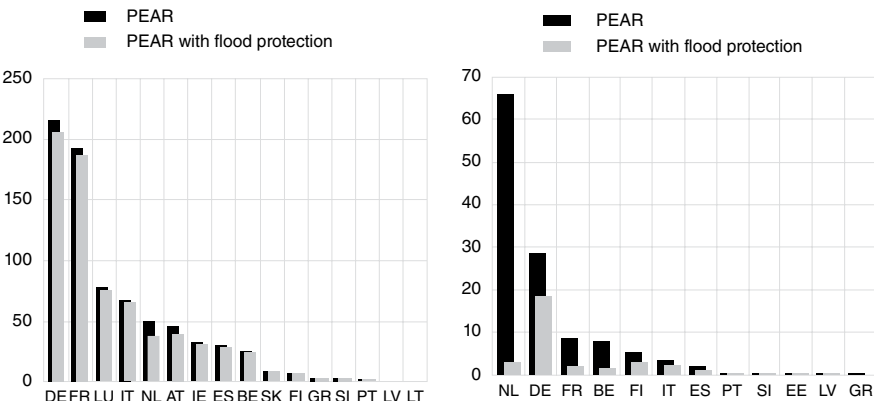


Figure 4.2 PEAR and PEAR with flood protection.

Sources: European System of Central Banks (ESCB) calculations based on data from AnaCredit, Register of Institutions and Affiliates Database (RIAD), Securities Holding Statistics (SHSS), Intergovernmental Panel on Climate Change Interactive Atlas, World Resource Institute, Joint Research Centre (JRC), and Copernicus.

Notes: RCP8.5 projections are for 2050. Historical and projection estimates are based on varying reference periods depending on the hazard considered.

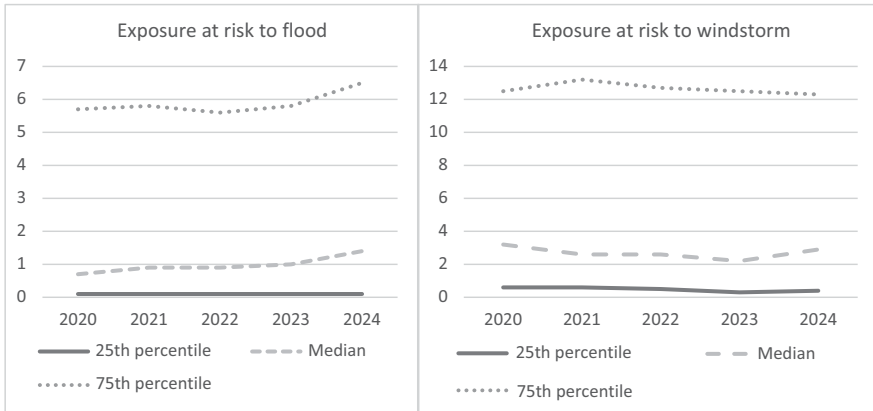


Figure 4.3 Exposure to the risk of flood and windstorm.

Source: EIOPA new dashboard on insurance protection gap for natural catastrophes, Eurostat, Litpop, ARG.



Figure 4.4 ESG scores for the insurance sector by continent.

Source: Author's own elaboration based on the LSEG Workspace.

scores is observed. It shows the increasing trend in the ESG score. The strongest effects are observed in Australia, South America, and Oceania. For Europe and North America, this effect presents a predominantly stable long-term increase.

The data reveals, in most cases, an upward trend in the ESG scores; however, occasionally, this relationship can be the opposite. The analysis presented

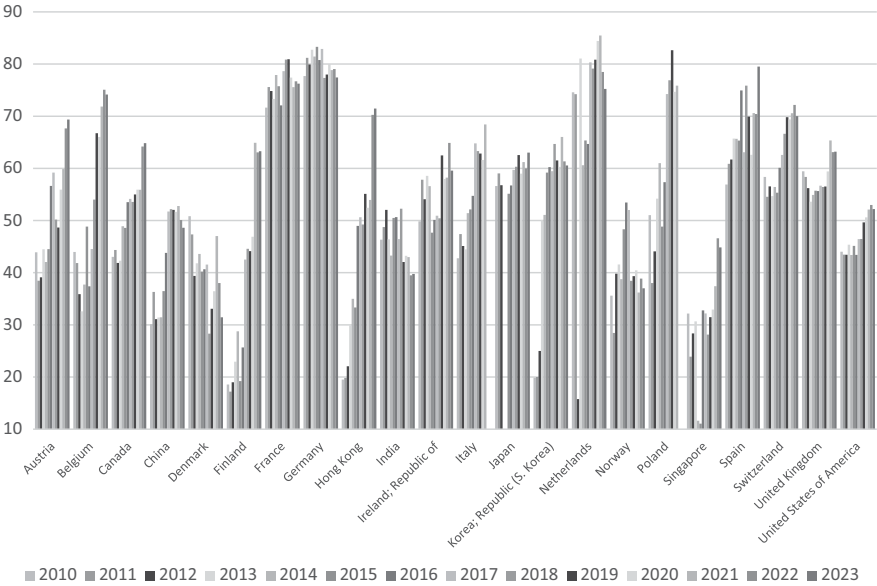


Figure 4.5 ESG scores for the insurance sector for selected countries.

Source: Author's own elaboration based on the LSEG Workspace.

for some selected countries shows a large variance even in Europe (Figure 4.5). The largest increases over the last few years have been observed in Finland, Hong Kong, Italy, South Korea, and Poland. Denmark, the Netherlands (which still has the highest measure), and Singapore exhibit instability in their ESG scores. A stable score is observed for France, Germany, Japan, the United Kingdom, and the United States. It reveals that most developing countries, Western European countries, and Asian countries experienced a greater increase in ESG scores. This is a result of the previously described regulations and a higher level of non-financial reporting.

The ESG risk can impact the insurer's insolvency risk. Caporale et al. (2017) define this risk as risk related to loss, that is, an effect of the changes in the credit standing of the securities' issuers, counterparties, and debtors of companies that are subject to the Solvency II Directive. The increasing ESG risk can impact the long-term sustainability of insurers' operations and investments (Fitch, 2023), irresponsible investments, and unfulfilling the long-term commitments related to paying future claims (Moalla & Dammak, 2023). Consequently, the analysis of ESG score trends can have a statistically significant impact on the financial condition of insurance companies. Carannante et al. (2024) prepared a model suggesting that increased interest in ESG activities improves the insurance company's reputation. Therefore, the policyholder should pay a higher premium for the insurer's commitment to ESG.

The risk associated with climate changes and disasters has a very significant impact on the insurance sector (Gupta & Venkataraman, 2024). Environmental risk should be included in the strategic development of the insurance companies. If not correctly considered and measured, insurers cannot develop correct insurance products and estimate premiums to reduce their risk (Di Tommaso & Mazzuca, 2023). Climate change also affects life assurance owing to heat waves. Finally, increasing ESG consciousness could lead consumers to favor insurance entities with green risk portfolios (Bethlendi et al. 2022).

The analysis of the Environmental Pillar Score, as presented by LSEG Workspace in Figure 4.6, indicates that Europe exhibits the highest value among the factors discussed. It is an effect of the described regulations of insurance companies focusing on environmental and climate risks. The European regulations are the most restrictive and, as was described previously, focused on the impact of climate risk in estimating the solvency capital. In each case during 2021/2022, the moment when the mentioned factor rose was observed. This is a consequence of the non-financial reporting regulations. The lowest value of the factor was observed for Oceania.

For a long time, social issues have not been overlooked. Most of the attention has been on environmental aspects. The social aspects are related to the 3SDG – “Good Health and Wellbeing”. UNEP (2012) presented the United Nations Environment Program (UNEP) Finance Initiative (FI) Principles for

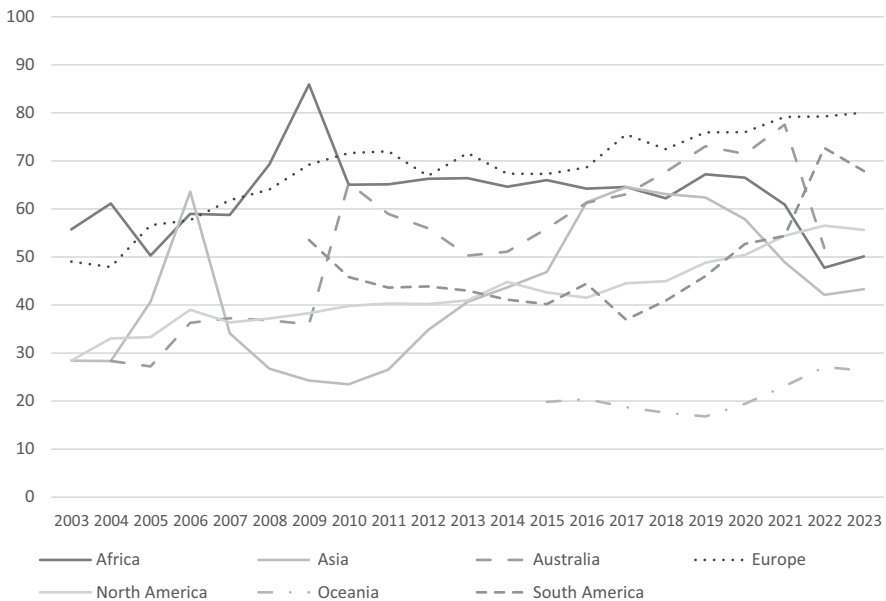
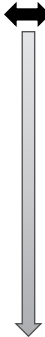


Figure 4.6 Environmental Pillar Score for the insurance sector by continents.

Source: Author's own elaboration based on the LSEG Workspace.

Table 4.1 AIA contributed to the inaugural United Nations Environment Programme (UNEP) Finance Initiative (FI) Principles for Sustainable Insurance (PSI) ESG Underwriting Guide for Life and Health Insurance

Mortality – the risk of the insured dying prematurely. Longevity – the risk of the insured living longer than expected and running out of money before dying. Morbidity – the risk of the insured developing a condition or contracting a disease. Hospitalization – the risk of the insured requiring private medical treatment.	Life and health underwriting risks: • Mortality • Longevity • Morbidity • Hospitalization	 ESG factors • Antimicrobial and antibiotic resistance • Climate change • Ecosystem imbalance • Environmental degradation • Infectious diseases • Unsustainable practices • Algorithmic underwriting • Customer characteristics • Financial capability • Health capability/awareness • Human rights • Lifestyle behavior
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Source: UNEP (2012).

Sustainable Insurance (PSI) ESG Underwriting Guide for Life and Health Insurance. ESG factors and their impact on life and health underwriting risk, including mortality, longevity, morbidity, and hospitalization, were presented (Table 4.1). In 2022, an ESG guide for the global life and health insurance industry was introduced by the UN Environment Program’s Principles for Sustainable Insurance Initiative, which primarily focused on the same set of factors. The potential impact of each ESG risk is presented by using the following scale:

- High positive “H+” - increases the underwriting risk to a great extent;
- Low positive “L+” - increases the underwriting risk to a low extent;
- High negative “H–” - decreases the underwriting risk to a great extent;
- Low negative “L–” - decreases the underwriting risk to a low extent;
- Neutral “N” - neither increases nor decreases the underwriting risk;
- Not applicable “N/A” - the ESG risk is not applicable in life and health underwriting.

Scores are assigned for each of the four groups: mortality, longevity, morbidity, and hospitalization.

The impact of climate change on human health is an increasingly prominent area of study. Figure 4.7 provides an overview of climate-sensitive health risks, their exposure pathways, and vulnerability factors. Climate change impacts health both directly and indirectly and is strongly mediated by environmental, social, and public health determinants. The relationship outlined highlights the

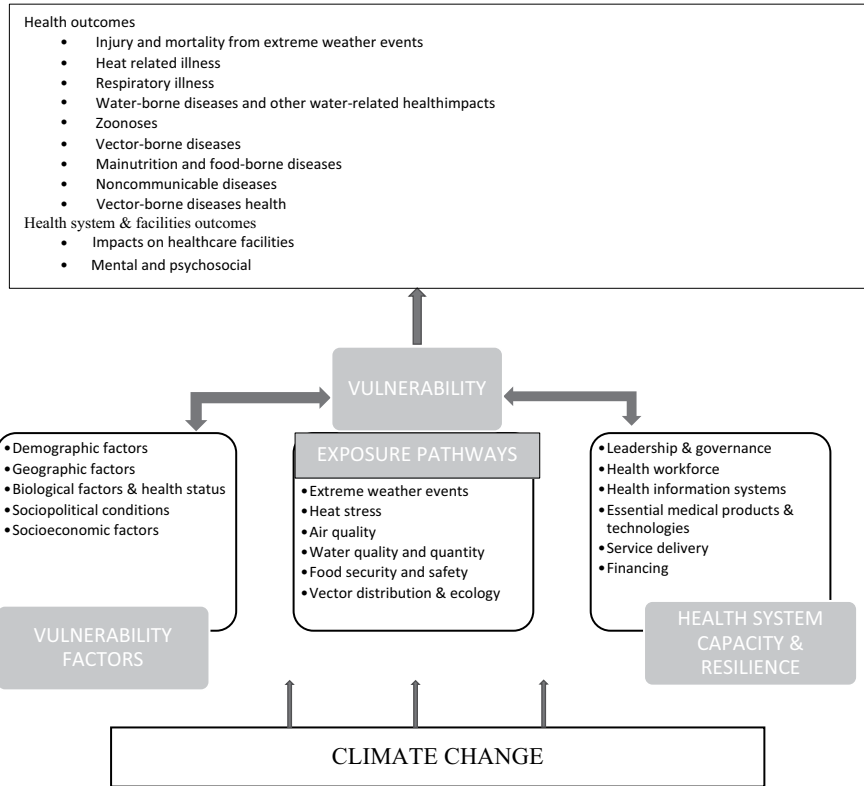


Figure 4.7 Overview of climate-sensitive health risks, their exposure pathways, and vulnerability factors.

Source: WHO (2023).

significance of assessing climate change in relation to the risks and issues affecting the insurance sector's activities. Table 4.2 presents the life and health ESG risk heat map that breaks down ESG risk into specific themes relevant to the life and health insurance business.

The measures presented are strictly related to the insurance products rather than to their operational activities. The analysis of their non-financial statements and the impact on their activity is described by the Social Pillar Score. The value of the mentioned score, prepared by LSEG and its changes, is presented in Figure 4.8. The highest value is for companies from Australia; the lowest, albeit emerging, is for companies from Oceania. In South America, Oceania, and Australia, a decrease in the analyzed value was observed over the previous year. This score increases for Africa; however, it remains stable for Europe, Asia, and North America. The reduced variance of this measure indicates that the social measures are significant for the insurance sector, but they exhibit greater stability compared to environmental measures.

Table 4.2 Life and health ESG risk heat map

<i>A heat map of the potential risk</i>	<i>Agribusiness</i>	<i>Property</i>	<i>Liability</i>	<i>Product liability</i>	<i>Workers' compensation</i>	<i>Construction and engineering</i>	<i>Credit and surety</i>	<i>Cyber</i>	<i>Directors' and officers' liability</i>	<i>Financial lines</i>	<i>Marine hull</i>	<i>Protection and indemnity</i>	<i>Aviation</i>	<i>Cargo</i>
Child labor														
Human trafficking														
Forced labor														
Forced resettlement (including land/water rights for native people, land grabbing)														
Poor worker safety record (e.g., worse than sector average record on accidents)														
Violation of workers' rights (e.g., discrimination, collective bargaining)														
Misconduct of security personnel (e.g., physical harm to people, human rights abuses)														
Controversial weapons exposures (e.g., UN conventions)														

Source: UNEP (2012).

Note: From white color, this means that the risk does not exist, up to black color, which means that risk is extremely high.

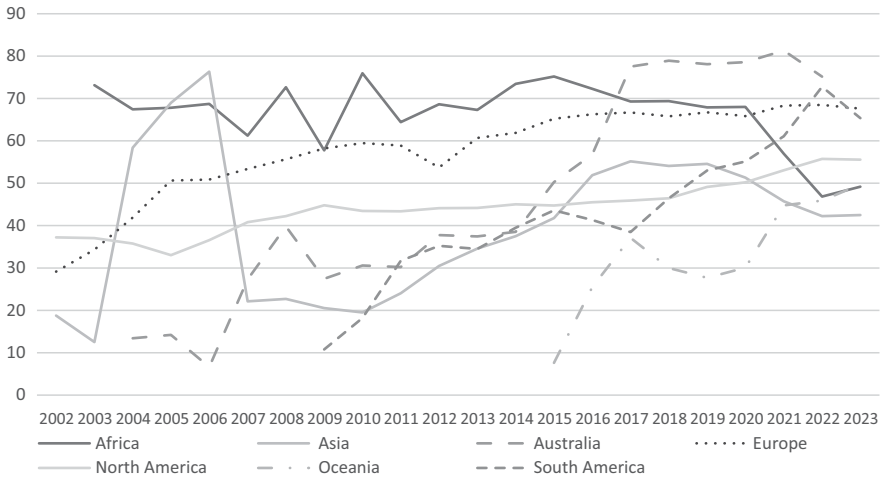


Figure 4.8 Social Pillar Score for the insurance sector by continents.

Source: Author's own elaboration based on the LSEG Workspace.

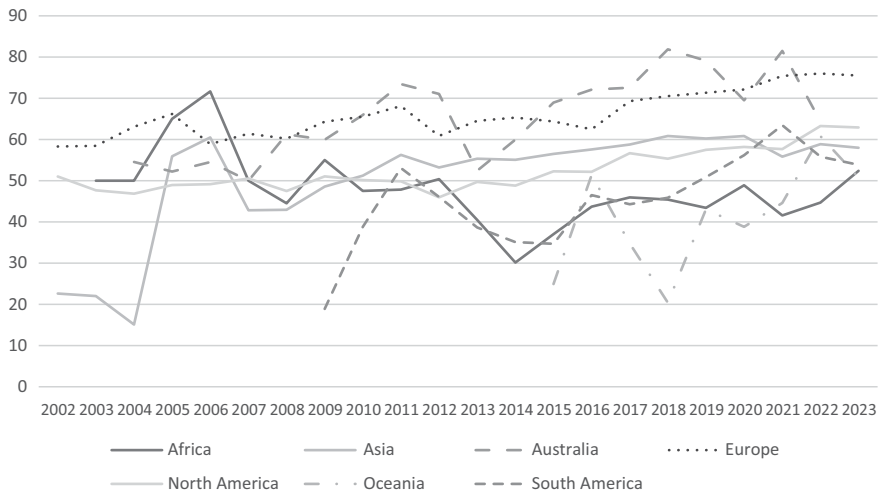


Figure 4.9 Governance Pillar Score for the insurance sector by continents.

Source: Author's own elaboration based on the LSEG Workspace.

The analysis of the Governance Pillar Score reveals significant changes over recent years (Figure 4.9). No trend is observed in this case. We observed the largest value for European and Australian companies. In Africa and Oceania, this measure is the lowest. This analysis presents similar results to those received for previous indicators.

Risk related to ESG can also be observed in the history of scandals and their impact on the reputation and insolvency of insurance companies (Tica & Weißenberger, 2022), and consequently, the negative impact on the stakeholders' perception, decisions (Will et al., 2017), and companies' financial stability. The Controversies Pillar Score is one of the measures that presents controversies related to ESG, as reported in the press (Aouadi & Marsat, 2018; Shakil, 2021). These controversies have a negative impact on their reputation (Bauer & Hann, 2010; Galletta & Mazzù, 2023; Wong, 2014), stakeholders' perspective (Shakil, 2021), and insolvency risk. The insurance sector, in contrast to other sectors' findings (Lee & Isa, 2024), demonstrates a greater impact of ESG controversies on company reputation (Ruiz et al., 2014; Wang et al., 2003) similar to the banking sector (Aevoae et al., 2023; Agnese et al., 2023; Chiaramonte et al., 2022). Giráldez-Puig et al. (2025) identified a limited influence on the insurance companies' ESG practices in counteracting the increasing insolvency risk resulting from ESG controversies (Nirino et al., 2021).

Stakeholder theory highlighted the availability of information on investor behavior. Thus, presenting information on non-financial data is a part of the risk reduction between companies and stakeholders (Adams & Larrinaga-González, 2007; Adams & McNicholas, 2007). The legitimacy theory posits that reputation is built over time because it involves a combination of reliability, trustworthiness, accountability, and credibility (Wong, 2014), which is especially significant for insurance companies (Cummins & Doherty, 2006). An insurer's reputation for fulfilling its obligations is crucial in establishing good-faith agreements between both parties. The ESG controversies highlight the companies' risk exposure, as reported in global news (Agnese et al., 2023), which can destroy insurers' reputations (Riera & Iborra, 2017; Shakil, 2021). Information presented to the public creates public pressure (Brammer & Pavelin, 2004; Cormier & Magnan, 2003) as well as sanctions and fines from stakeholders to reduce negative behaviors and the need to stop them (Shakil, 2021). They can also create skeptical behaviors and perceptions regarding corporate hypocrisy (Du et al., 2010; Maignan & Ralston, 2002), which diminishes the company's credibility (Godfrey et al., 2009; Yoon et al., 2006), adversely affecting the company's value and financial performance (Passas et al., 2022), thereby increasing the insolvency risk. The controversies related to ESG can also influence stock prices (Klassen & McLaughlin, 1996; Krüger, 2015), the volatility of the rates of returns on the stock prices (Krüger, 2015), and reduces the company's ability to raise capital from investors (Barkemeyer et al., 2023), especially within a group of sustainable investors. Studies have demonstrated a significant inverse relationship between sustainable practices and firm risk (Chollet & Sandwidi, 2018; Oikonomou et al., 2012; Sassen et al., 2016). Companies with more solid reputations seem more resilient to market volatility than those with weaker reputations (Hristov et al., 2022).

The Controversies Pillar Score, presented by LSEG, indicates that the highest number of controversies has been observed in Europe, Australia, and North America in recent years (Figure 4.10). The mentioned area primarily concerns

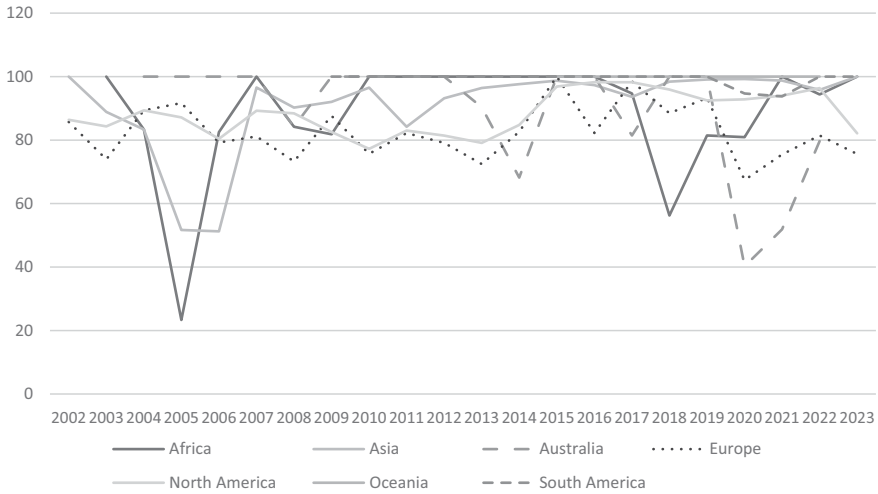


Figure 4.10 Controversies Pillar Score for the insurance sector by continents.

Source: Author's own elaboration based on the LSEG Workspace.

new ESG-related regulations. The situation presented indicates that controversies are evident even in the insurance sector, and most of them are associated with highly developed countries.

Figure 4.11 presents the standard deviation of the ESG measures for the insurance sector. The largest variance in ESG scores is observed in Asia, South America, and Europe. Currently, the situation is comparable across all regions. The variance observed in the results, when compared to other sectors, is low (results compared with Chodnicka-Jaworska, 2025). It is related to several points. The insurance sector initially exhibits stable ESG risk. Next, the insurance sector is among the most highly regulated sectors, with its stability influenced by ESG risk analysis. As mentioned earlier, the largest standard deviation was noticed for the G-factor. Now, it is quite similar for each region, but it is still the highest among other measures. In the case of the E factor, the lowest variance is noticed for European companies, the highest for North American institutions. The analysis of the S-factor indicates that the lowest standard deviation was observed for Africa, and the highest for Asia, Europe, and North America. The standard deviation is higher, mostly in regions with higher ESG scores, and is not always lowest in regions with lower values of the mentioned factors.

The analysis of the standard deviation of the Controversies Pillar Score (Figure 4.12) reveals that this indicator exhibits the greatest variance. The highest standard deviation was observed in Europe and North America, and the lowest in Asia and Africa.

The analysis of insurance companies' business activities can directly affect ESG risk exposure. Figure 4.13 presents the mean value of the ESG scores for

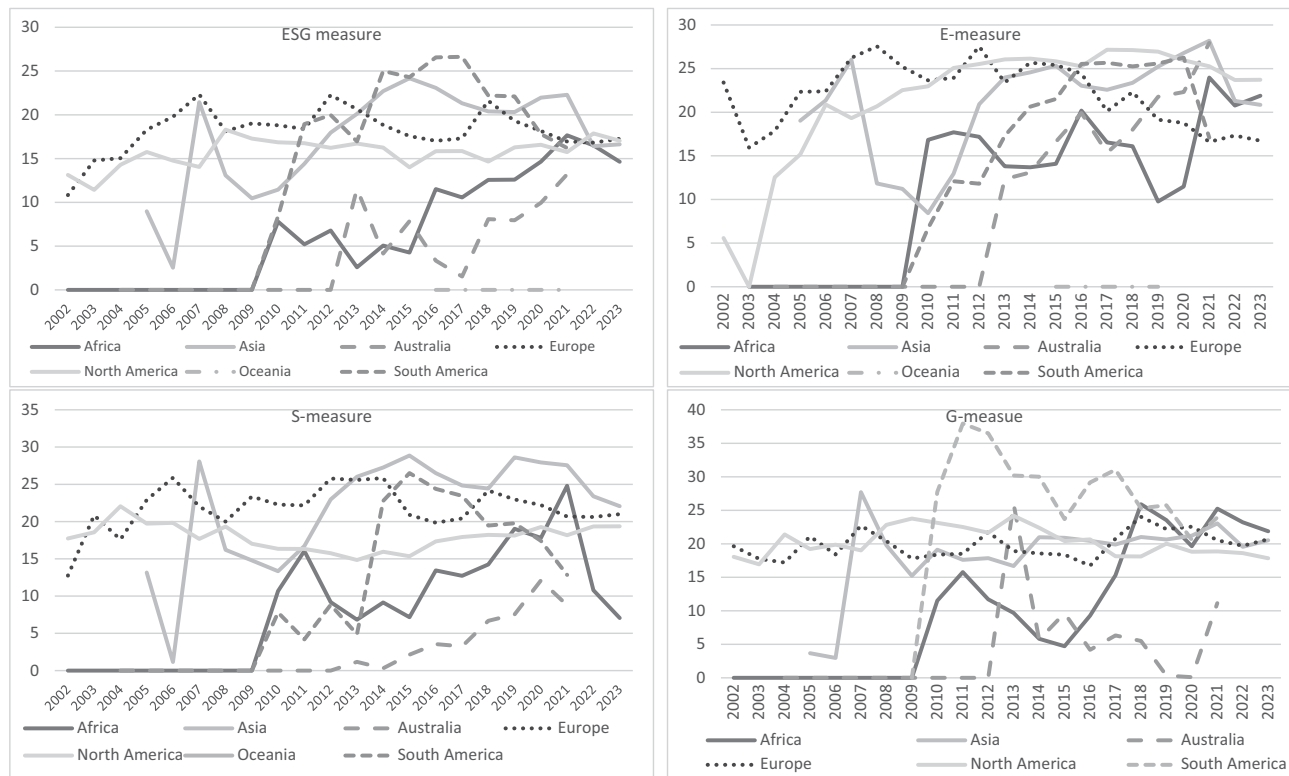


Figure 4.11 Standard deviation of the ESG measures for the insurance sector by continents.

Source: Author's own elaboration based on the LSEG Workspace.

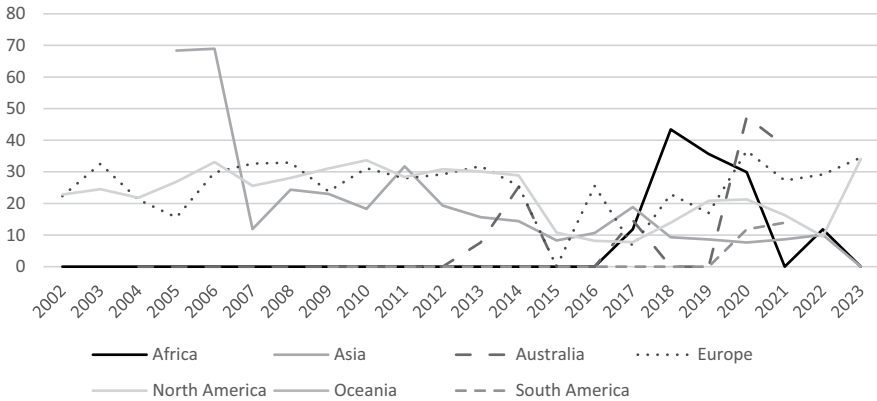


Figure 4.12 Standard deviation of the Controversies Pillar Score for the insurance sector by continents.

Source: Author's own elaboration based on the LSEG Workspace.

four business lines: life and health insurance, property and casualty insurance, multi-line insurance and brokers, as well as reinsurance. Figure 4.14 presents the standard deviation for the business lines. A few notable observations are as follows:

- The ESG score and sub-scores increase for all types of business.
- The ESG score is similar for life and health insurance, as well as multi-line insurance and brokers.
- The lowest ESG score is noticed for property and casualty insurance.
- The highest values are observed for G, followed by E factors, and the lowest values are observed for S factors.
- The biggest difference in the sub-score was noticed for E factors between types of business. For property and casualty insurance, the difference is around 40, but for life and health insurance, as well as multi-line insurance and brokers, it is around 70. For the S-measure, this difference is around 20 points, and for the G-factor, it is around 25.
- The highest difference is noticed for G, followed by E, and the lowest was observed for the S factors.
- The variance for the previous year between particular lines is smaller than earlier.

The presented measure confirms that specific lines exhibit varying risk exposures and necessitates estimating results separately by business type. This situation confirms the significance of the varied guidelines for a specific type of product and lines of business activity. Therefore, in subsequent studies, the type of business will be distinguished.



Figure 4.13 ESG measures for the insurance sector business lines.

Source: Author's own elaboration based on the LSEG Workspace.

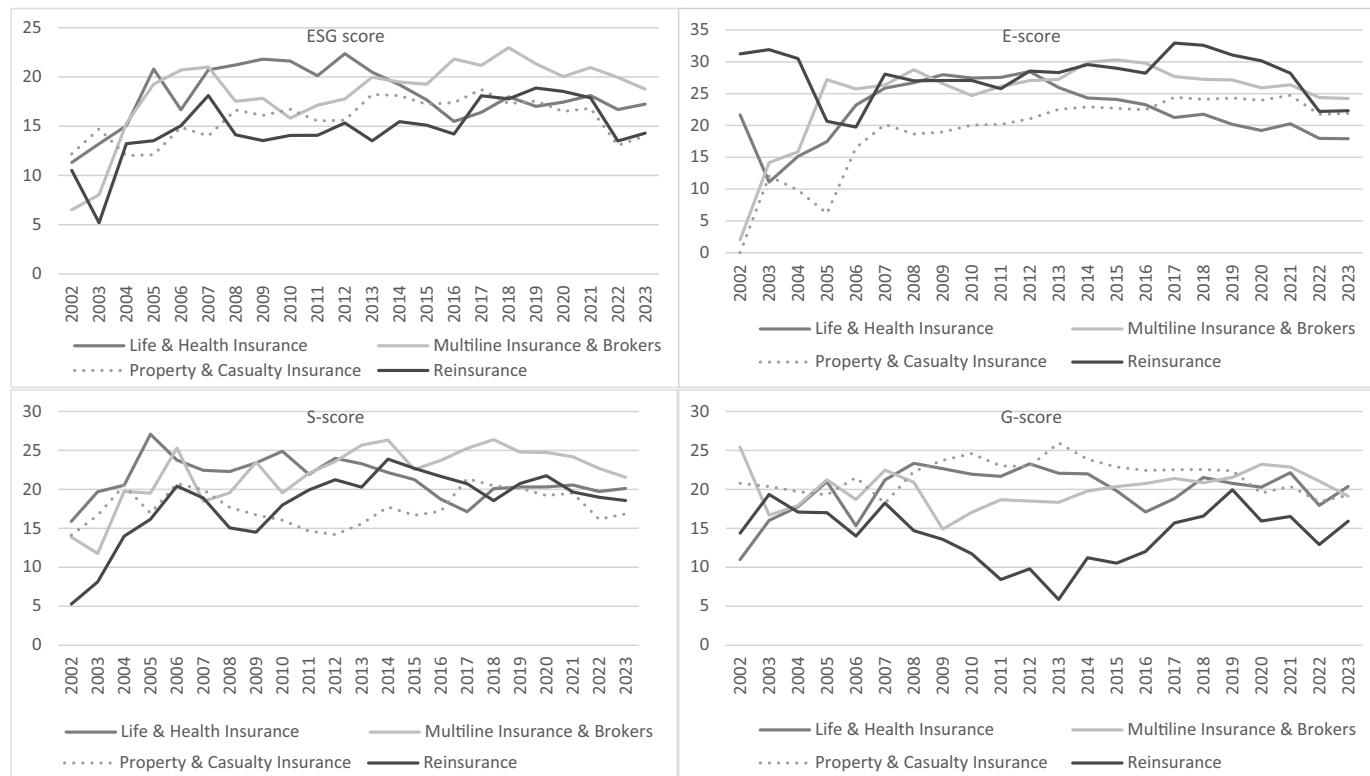


Figure 4.14 Standard deviation of the ESG measures for the insurance sector business lines.

Source: Author's own elaboration based on the LSEG Workspace.

The analysis of the mean value of the Controversies Pillar Score reveals that the largest number of controversies is presented for the multi-line insurance and brokers' activity (Figures 4.15 and 4.16). This type of business activity also presents the highest standard deviation. The lowest number of controversies is presented for the reinsurance activity. In this case, the standard deviation is also the lowest.

Previous literature suggests systemic ESG risk in the insurance sector. Sonnenberger and Weiss (2021) developed the CSR index, which accounts for both internal and external CSR activities and captures not only the classical

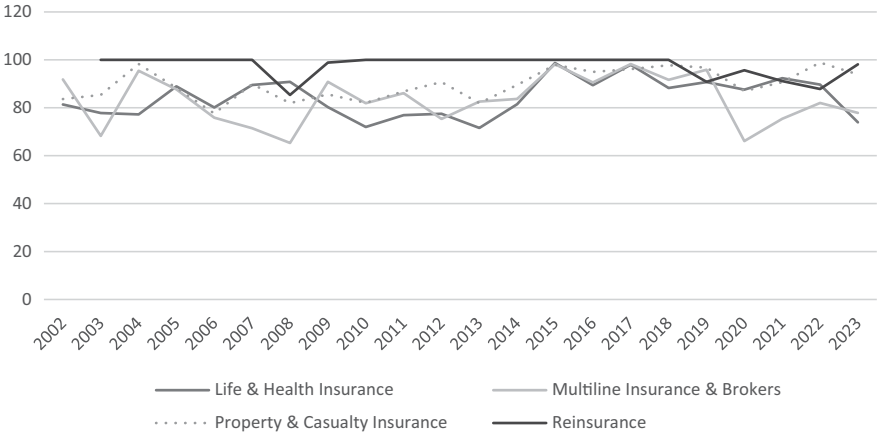


Figure 4.15 Controversies Pillar Score for the insurance sector business lines.

Source: Author's own elaboration based on the LSEG Workspace.

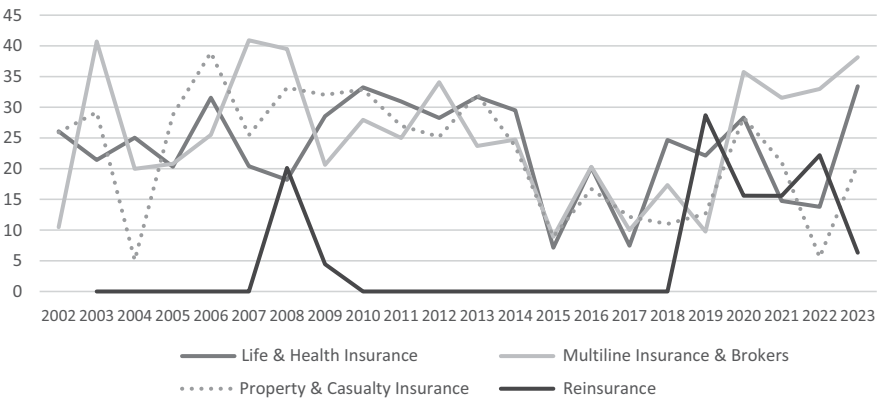


Figure 4.16 Standard deviation of the Controversies Pillar Score for the insurance sector business lines.

Source: Author's own elaboration based on the LSEG Workspace.

three E, S, and G dimensions but also adds tailor-made components, allowing for a more comprehensive view of insurers' CSR characteristics. They found that insurance companies' tail risk (measured by ES and short- and medium-term exposure to systemic risk, as proxied by the MES) significantly decreases with their involvement in CSR activities. Lupu et al. (2022) document that the influence of ESG scores on financial stability is nonlinear and that the impact of each of the three pillars differs. Curcio et al. (2024) found that banks appear to be systemically more vulnerable to green companies' risk exposure. Insurers seem to be more exposed to the risks of firms active in the oil and gas industry. The breakdown of the overall ESG scores into E, S, and G shows that the channels through which the sustainability performance of non-financial firms affects banks' and insurers' systemic risk differ.

Insurers with high ESG ratings are financially more stable (Bressan, 2023a; Chiaramonte et al., 2020) and have a higher market valuation (Bressan, 2023a; Di Tommaso & Mazzuca, 2023). Nevertheless, the literature remains unexplored on whether insurers' ESG characteristics influence profits. The positive effect of ESG on insurance profits does exist (Bressan, 2023b; Brogi et al., 2022), which is related to different sources of profitability. Brogi et al. (2022) prepared a scoring model for the ESG awareness of the insurance company. They demonstrated that companies with the highest level of ESG awareness are larger, more profitable, and solvent. Brogi and Lagasio (2019) found a positive relationship between the ESG index and the profitability of insurance companies. The purchase of reinsurance diminishes the ESG score, thereby making the firm more profitable (Bressan, 2023b).

As a result, the following hypotheses have been put forward: Geographical bias influences ESG risk measurement and the capital levels of insurance companies (H2); Size bias affects ESG risk measurement and capital adequacy of insurance companies (H3); Sectoral bias impacts ESG risk measurement and capital adequacy of insurance companies (H4).

This section examines the impact of ESG scores on capital adequacy measures. Micro-level data were obtained from the LSEG and quarterly financial and non-financial reports of insurance companies, complemented by sectoral datasets. All insurance companies listed on stock exchanges from 2010 to 2024 were analyzed. The data were systematically classified by geographical location, ESG policy decisions, time period, and sectoral characteristics (Life & Health Insurance, Multi-line Insurance & Brokers, Property & Casualty Insurance, Reinsurance). Owing to the small sample size, dynamic panel data models with the required tests were used rather than machine-learning models. Linear dynamic panel data models include p lags of the dependent variable as covariates and contain unobserved panel-level effects, fixed or random. By construction, the unobserved panel-level effects are correlated with the lagged dependent variables, rendering standard estimators inconsistent. Arellano and Bond (1991) derive a consistent generalized method of moments (GMM) estimator for the parameters of this model. Anderson and Hsiao (1981, 1982) propose using lags of the level or first differences of the dependent variable to

instrument lagged dependent variables in a dynamic panel data model, after first-differencing to exclude panel-level effects. Building on Holtz-Eakin, Newey, and Rosen (1988) and using the GMM framework developed by Hansen (1982), they identify how many lags of the dependent variable, predetermined variables, and endogenous variables are valid instruments and how to combine these lagged levels with first differences of the strictly exogenous variables into a potentially large instrument matrix. Using this instrument matrix, Arellano and Bond (1991) derive the corresponding one-step and two-step GMM estimators, as well as the robust estimator for the one-step model. Furthermore, they find that the two-step robust estimator is seriously biased. Windmeijer (2005) provides a bias-corrected (WC) robust estimator for two-step GMM: the test of autocorrelation of order m and the Sargan test of overidentifying restrictions, derived by Arellano and Bond (1991). The dataset is as follows:

y_{it} is an unobservable latent variable that measures the solvency margin of company i in period t ;

F_{it} is a vector of explanatory variables related to the insurance company's financial condition; that is,

$$F_{it} = [WLR_{it}, WER_{it}, WCR_{it}, WOM_{it}, WITM_{it}, WITR_{it}, WNM_{it}, WROE_{it}, WROA_{it}, WROEA_{it}, WCCR_{it}, WOR_{it}, WIR_{it}, WCGPR_{it}, WOINPW_{it}, WOIPW_{it}, WDA_{it}, WDC_{it}, WDE_{it}, WDSTP_{it}, WICR_{it}, WERR_{it}, WDPR_{it}, WDDC_{it}].$$

Table 4.3 presents the dataset and construction of the aforementioned variables.

Table 4.3 List of variables used for estimation

Type of measure	Code	Description
<i>Profitability/return</i>		
Loss Ratio - Insurance - %	WLR	Implied Losses/Net Premium Earned
Expense Ratio - %	WER	Implied Expenses/Net Premium Earned
Combined Ratio - Insurance - %	WCR	Loss Ratio – Expense Ratio
Operating Margin - %	WOM	Operating Profit before Non-Recurring Income or Expense/Revenue from Business Activity
Income before Tax Margin - %	WITM	Income before Taxes/Revenue from Business Activities
Income Tax Rate - %	WITR	Income Taxes/Income before Taxes
Net Margin - %	WNM	Income before Discontinued Operations and Extraordinary Items/Revenue from Business Activities
Return on Average Common Equity - %	WROE	Income available to Common excluding Extraordinary Items/Shareholders Equity

(Continued)

Table 4.3 (Continued)

<i>Type of measure</i>	<i>Code</i>	<i>Description</i>
Return on Earning Assets - %	WROEA	Net Income after Minority Interest/ Earning Assets
Return on Average Total Assets - %	WROA	Income before Discontinued Operations and Extraordinary Items/Total Assets
<i>Insurance - other metrics</i>		
Solvency Margin - Insurance - %	WSM	Shareholders Equity-Common/Premium Written -Gross
Claims Ratio - Insurance - %	WCCR	Losses, Benefits & Adjustments/Premium Earned - Total
Operating Ratio - Insurance - %	WOR	Underwriting Expenses/Net Premium Earned
Investment Ratio - %	WIR	Investment Income/Net Premium Earned
Claims & Loss Expense Percentage of Gross Premiums Written	WCGPW	Total Claim and Loss Expense/Gross Premium Written
Operating Income Percentage of Net Premiums Earned	WOINPW	Operating Profit before Non-Recurring Income or Expenses/Net Premium Earned
Operating Income Percentage of Gross Premiums Written	WOIPW	Operating Profit before Non-Recurring Income or Expenses/Premium Written - Gross
<i>Financial strength/leverage</i>		
Total Debt Percentage of Total Assets	WDA	Total Debt/Total Assets
Total Debt Percentage of Total Capital	WDC	Total Debt/Total Capital
Total Debt Percentage of Total Equity	WDE	Total Debt/Total Equity
Debt Service Percentage of Normalized after Tax Profit	WDSTP	Debt Service/Normalized after Tax Profit
Interest Coverage Ratio	WICR	Earnings before Interest & Taxes/Interest Expense
Earnings Retention Rate	WERR	Retained Earnings/Income available to Common, excluding Extraordinary Items
Dividend Payout Ratio - %	WDPR	Dividends – Common Stock/Income available to Common, excluding Extraordinary Items
Dividend Coverage - %	WDDC	Income available to Common excluding Extraordinary Items/Dividends – Common Stock
<i>Size of company</i>		
Size of company	WASS	Logarithmic assets of company
<i>ESG measures</i>		
ESG Score	ESG	A company's overall score based on self-reported information across the environmental, social and governance pillars.

(Continued)

Table 4.3 (Continued)

<i>Type of measure</i>	<i>Code</i>	<i>Description</i>
ESG Combined Score	ESGC	Overall company score based on reported information in the Environmental, Social and Governance Pillars (ESG Score) with an ESG Controversy overlay.
Environmental Pillar Score	ENV	It measures a company's impact on living and non-living natural systems, including air, land, and water, as well as entire ecosystems. It reflects how well a company uses best management practices to avoid environmental risks and exploit environmental opportunities to generate long-term shareholder value.
Social Pillar Score	SOC	It measures a company's ability to generate trust and loyalty among employees, customers, and the public using best management practices. It reflects a company's reputation and the health of its operating licenses, which are key factors in determining its ability to generate long-term shareholder value.
Governance Pillar Score	GOV	It measures how well a company's systems and processes ensure that board members and executives are acting in the best interests of its shareholders. It reflects the ability of a company, through the application of best management practices, to direct and control its rights and responsibilities by creating incentives, as well as checks and balances, to generate long-term shareholder value.
ESG Controversies Score	CONT	It measures a company's exposure to environmental, social, and governance controversies and negative events reflected in global media.

X_{it} is a vector of explanatory variables related to the insurance company's ESG risk; that is,

$$X_{it} = [ESG_{it}, ENV_{it}, SOC_{it}, GOV_{it}].$$

Owing to the characteristics of the dataset, differences and lagged explanatory variables are first used. The final model is as follows:

$$\Delta y_{it} = \lambda_i \Delta y_{it-m} + \beta_i \Delta X_{it-n} + \beta_i \Delta F_{it-1} + \delta \Delta (F * Z)_{it} + \Delta \varepsilon_{it};$$

where $\varepsilon_{it} \sim N(0,1)$, $m \in [1,2]$, $n \in [1,2,3,4,5,6,7,8]$.

The decision regarding the estimation of lagged variables depends on the characteristics of the phenomenon. The LSEG Workspace publishes ESG scores with a maximum of 2 years' delay. As quarterly data are considered, the maximum lag is 8.

Owing to collinearity, some data are removed. Table 4.4 shows the mean values in the groups and standard deviations for the value of the solvency margin. The analysis of the descriptive statistics shows a lower solvency margin for companies that received an ESG score. This value varies according to the type of business activity. The lowest value is presented for multi-line insurance, broker activity, and reinsurance activity, and the highest for life and health and property and casualty insurance. The solvency margin and the mentioned

Table 4.4 Descriptive statistics of the solvency margin by groups

Continent	Period	Sector	ESG	Green	Obs	Mean	Std. Dev.	Min	Max
Europe	>2019	L	YES		21.507	130.399	546.262	-3340.789	24897.510
			LACK		15.875	132.531	620.977	-3340.789	24897.510
		M	YES		4.181	134.637	244.564	-67.003	2778.716
			LACK		6.712	124.615	540.839	-166.343	20917.200
		P	YES		9.181	132.963	670.707	-3340.789	24897.510
			LACK		1.309	124.401	186.593	11.422	2452.713
		R	YES		2.836	147.315	282.489	-67.003	2778.716
			LACK		5.691	125.826	581.819	-166.343	20917.200
		L	YES		6.465	129.155	776.390	-3340.789	24897.510
			LACK		772	150.707	234.851	11.422	2452.713
		M	YES		1.742	140.593	245.109	-67.003	2453.594
			LACK		2.49	137.287	755.860	-166.343	20917.200
		P	YES		3.625	146.936	942.018	-3340.789	24897.510
			LACK		492	135.686	266.769	12.757	2452.713
		R	YES		1.076	147.269	280.092	-67.003	2453.594
			LACK		1.963	140.713	842.638	-166.343	20917.200
		L	YES		2.276	147.859	1159.456	-3340.789	24897.510
			LACK		227	204.978	377.593	28.152	2452.713
		M	YES		224	98.758	96.417	10.180	530.055
			LACK		380	71.235	37.892	-2.748	238.716
		P	YES		238	76.091	42.579	15.657	182.383
			LACK		105	52.663	15.278	34.477	98.337
		R	YES		124	103.806	123.151	10.180	530.055
			LACK		155	72.885	42.907	-2.748	238.716
		L	YES		114	62.462	23.377	20.957	140.201
			LACK		37	63.360	14.807	36.403	84.948
		M	YES		446	197.000	346.701	-67.003	2453.594
			LACK		121	567.902	764.657	52.672	2286.994
		P	YES		1.154	161.315	406.212	-3340.789	2018.419
			LACK		141	289.931	461.014	51.282	2452.713
		R	YES		187	285.797	504.099	-67.003	2453.594
			LACK		23	1546.764	961.995	56.922	2286.994
		L	YES		247	195.656	449.093	-3340.789	1432.258
			LACK		46	658.939	668.415	53.799	2452.713

Source: Author's own elaboration based on the LSEG Workspace.

Note: L, Life & Health Insurance; M, Multi-line Insurance & Brokers; P, Property & Casualty Insurance; R, Reinsurance.

difference increased after 2019; therefore, the project's introduction was related to the expanded form (SFDR) and CSRD. A comparison of this value between the United States and Europe shows that the highest value is observed in the United States and Europe. These results show that insurance companies have lower solvency margins when they focus on ESG risks. In this case, the significant impact is the geographical location that relates to the varied regulation of ESG risk and its significance in the insurance sector. The significant impact is on the moment of analysis, which is also related to the period of introducing new proposals, initiatives, and regulations.

Table 4.5 provides the analysis of the impact of changes in ESG scores on changes in the solvency margin. For the entire sample, a significant impact is observed on the environmental pillar score, especially for the life and health insurance sub-sectors. An increase in E-score decreases the solvency margin. A similar but weak reaction is also observed in property and casualty insurance. Changes in other factors do not significantly influence changes in the solvency margin. This relationship confirms the results presented in Table 4.4. From 2020, the mentioned relationship was stronger, especially in the property and casualty insurance; however, it was also observed for multi-line insurance, brokers, and reinsurance companies. The significant impact of the changes in the E-score is an effect of the character of the property insurance activity. Additionally, a strong significant impact from 2020 was also observed for the S-score in the property, and casualty insurance and reinsurance activity. An increase in the S-score causes an increase in the solvency margin, which is related to a non-homogenous sample. A rising G-score reduces the solvency margin presented by life and health insurance. This factor has the strongest impact in 2020.

The next part of the analysis compared the European and US markets after 2020 and reaction of the solvency margin to the changes in the ESG scores. The results show a stronger reaction of the solvency margin on the E-score than in the case of European companies, especially in the life and health insurance, multi-line insurance, and brokers. A similar relationship is observed for S and G sub-factors. It means that US insurance companies are more interested in analyzing the ESG risk, especially in the case of environmental risk, than European companies. This is related to the increased climatic risk in this area.

ESG Risk and Insurance Portfolios

The main source of profit for insurance companies is the sale of insurance products; however, they also generate revenue by investing the premium income that is not being paid out to customers to cover losses. Higher ESG measures also open the capital market and bring sustainable funds as investors. The analysis and market observations suggest that the demand for investment products related to ESG risk rises. Both retail and institutional investors are more interested in these types of investments (Matos, 2020; Petelczyc, 2022). Access to ESG investments is varied (Adamska et al., 2016), and it is mostly

Table 4.5 Impact of changes in the ESG scores on the changes in the solvency margin according to the type of the sub-sector, period of introducing regulations, region, and the type of the sub-score.

<i>Variable</i>	<i>L</i>	<i>M</i>	<i>P</i>	<i>R</i>	<i>L</i>	<i>M</i>	<i>P</i>	<i>R</i>	<i>L</i>	<i>M</i>	<i>P</i>	<i>R</i>	<i>L</i>	<i>M</i>	<i>P</i>	<i>R</i>
Total																
WSM																
LD.	−0.046***	−0.085***	−0.023	−0.087***	−0.050***	−0.085***	−0.025	−0.087***	−0.051	−0.087***	−0.024	−0.077***	−0.047	−0.084***	−0.023	−0.086***
L2D.	−0.026**	−0.035	−0.034*	−0.085***	−0.032**	−0.035	−0.034*	−0.089***	−0.026	−0.036	−0.033	−0.075***	−0.026	−0.035	−0.034*	−0.086***
	ESG				ENV				SOC				GOV			
D1.	0.336	−0.104	0.019	−0.183	0.082	−0.04	−0.139	0.195	0.087	0.022	−0.154	−0.022	0.221	−0.088	0.026	−0.252
LD.	−0.009	0.02	0.015	−0.097	−0.093***	0.003	−0.025	0.028	−0.007	0.031	0.038	0.048	0.01	0.004	−0.004	−0.082
L2D.	0.001	0.015	0.035	−0.1	−0.061*	−0.002	−0.036	−0.047	0.004	0.027	0.049	−0.04	0.008	−0.003	0	−0.075
L3D.	0.041	0.015	0.017	−0.091	−0.058**	0.002	−0.039	−0.069	0.017	0.024	0.056*	−0.034	0.03	0.001	−0.017	−0.073
L4D.	0.034	0.078	−0.028	0.24	−0.187	−0.01	−0.026	−0.098	0.103	0.091	0.256	0.286	0.052	0	−0.099	0.137
L5D.	−0.016	0.023	0.042	−0.065	−0.081**	0.004	−0.026	−0.082	−0.016	0.031	0.064	0.023	0.011	0.005	0.003	−0.056
L6D.	−0.006	0.015	0.023	−0.073	−0.076*	0.011	−0.058*	−0.088	−0.006	0.025	0.065	−0.002	0.01	−0.004	−0.014	−0.059
L7D.	−0.029	−0.001	0.005	−0.094	−0.086***	0.004	−0.061**	−0.086	−0.02	0.006	0.057	−0.029	0.004	−0.005	−0.024	−0.063
L8D.	−0.056	0.064	−0.115	−0.036	−0.116	0.062	−0.092	−0.756	−0.109	0.005	−0.079	0.33	0.004	0.042	−0.041	−0.102
LD.SIZE	−16.331**	0.503	−0.37	−3.268	−15.03	0.557	−0.245	−0.245	−13.107	0.655	−0.157	−3.499	−16.054	0.44	−0.54	−2.288
LD.WLR	0.113	−0.036	0.02	0.073	0.12	−0.051	0.021	0.091	0.129	−0.042	0.017	0.055	0.107	−0.01	0.02	0.126
LD.WER	0.023	−0.043	−0.165	0.017	0.026	−0.062	−0.196	−0.056	0.009	−0.048	−0.176	−0.049	0.009	−0.021	−0.169	0.015
LD.WOM	−0.02	0.002	−0.011	−0.037*	0.042	0.01	−0.017	−0.034	−0.032	0.005	−0.014	−0.035	−0.025	0.006	−0.007	−0.031
LD.WITR	−0.028	0.005	0.011	−0.019	−0.019	0.006	0.011	−0.023*	−0.009	0.003	0.011	−0.031	−0.025	0.008	0.011	−0.036
LD.WROEA	0.643	0.108	0.069	−0.154	0.341	0.11	0.068	−0.128	0.781	0.115	0.066	−0.119	0.677	0.119	0.068	−0.119*
LD.WCCR	−0.047	0.035	−0.035	−0.098	−0.042***	0.045	−0.042	−0.098	−0.05	0.04	−0.038	−0.067	−0.052	0.014	−0.034	−0.14
LD.WOR	0.071	−0.025	−0.005	0.044	0.114	−0.022	−0.004	0.25	0.072	−0.03	−0.005	0.206	0.069	−0.017	−0.004	0.051
LD.WIR	0.01	−0.012	0.036	−0.148	0.002	−0.013	0.044	−0.269	0.009	−0.011	0.039	−0.191	0.007	−0.013	0.03	−0.234
LD.WDC	0.029	0.008	0.234	−0.028	0.032	0	0.231	−0.054	0.019	0.009	0.231	−0.066	0.035	0.005	0.233	−0.032
LD.WDSTP	0	−0.001	−0.001	−0.003	0.000*	−0.001	−0.001	−0.03	0	0	−0.001	−0.03	0	0	−0.001	−0.007
LD.WICR	0.001	0.001	0	0	0	0.001	0	0	0.001	0.001	0	0	0.001	0.001	0	0
LD.WDPR	0.002	0	0.001	−0.008	0.001	0	0.001	−0.003**	0.001	0	0	−0.003	0.001	0	0.001	−0.01
LD.WDDC	−0.001	−0.001	0	0.001**	−0.001*	−0.002	0	0.001	−0.001	−0.001	0	0.001**	−0.001	−0.002	0	0.001*
N	221	422	1190	153	221	422	1190	153	221	422	1190	153	221	422	1190	153

(Continued)

Table 4.5 (Continued)

Variable	L	M	P	R	L	M	P	R	L	M	P	R	L	M	P	R
From 2020																
WSM																
LD.	0.111	-0.103***	-0.04	-0.171***	0.179***	-0.092***	-0.038	-0.245***	0.105*	-0.105***	-0.04	-0.198***	0.114	-0.105***	-0.034	-0.187***
L2D.	-0.025	-0.034	-0.037	-0.197***	-0.046*	-0.036	-0.036	-0.200***	-0.039**	-0.031	-0.037	-0.200***	-0.02	-0.032	-0.034	-0.208***
	ESG				ENV				SOC				GOV			
D1.	0.921	-0.186	-0.137	-0.05	1.284	-0.079	-0.274	0.246	0.258	0.191	-0.324	0.488*	0.696	-0.263	-0.046	-0.262
LD.	-0.083	-0.057	0.027	-0.333	0.01	-0.118**	-0.132	0.166	-0.069	-0.022	0.113	-0.383	-0.039	0.023	-0.046	-0.191
L2D.	-0.085	-0.086	0.046	-0.091	-0.223	-0.077	-0.120*	0.032	-0.055	0	0.098	0.035	-0.039	-0.022	-0.029	-0.107
L3D.	-0.04	-0.064	0.021	-0.121	-0.053	-0.078	-0.110*	-0.023***	-0.109	0.008	0.093	-0.065	0.018	-0.014	-0.043	-0.102
L4D.	0.684	0.171	0.365	0.508	-0.833	0.039	-0.128	-0.007	0.392	0.094	0.650*	0.037	0.454	0.063	-0.073	0.334
L5D.	-0.109	-0.043	0.084	-0.212	-0.16	-0.045*	-0.1	-0.038	-0.065	0.013	0.154*	-0.076	-0.049	0.008	-0.043	-0.203
L6D.	-0.116	-0.07	0.087	-0.075	-0.192	-0.079	-0.108*	-0.042	-0.064	-0.01	0.140*	-0.032	-0.042	-0.008	-0.031	-0.031
L7D.	-0.158	-0.122	0.047	-0.124	-0.095	-0.089	-0.105*	-0.039	-0.052	-0.02	0.110*	-0.051	-0.103	-0.048	-0.045	-0.1
L8D.	0.393	-0.051	-0.179	-0.573	-0.191	-0.099	-0.125	-0.537	0.141	-0.16	-0.093	0.042	-0.386***	0.061	-0.102	-0.317
LD.SIZE	-27.685*	15.416	0.741	-2.317	-36.877	15.293	0.408	1.638	-31.727	12.129	0.312	1.47	-29.524*	14.051	0.557	-0.196
LD.WLR	0.439***	-0.073	-0.005	0.452***	0.3	-0.224	-0.001	0.399**	0.517***	0.022	0.001	0.650*	0.411**	0.071	-0.031	0.438***
LD.WER	0.144	-0.038	-0.238	-0.046	-0.141	-0.227	-0.264	-0.049	0.104	0.063	-0.217	0.061	0.162	0.12	-0.237	-0.032
LD.WOM	0.888*	-0.095	0.008	-0.018	1.369***	-0.124**	0.014	-0.008	0.916***	-0.064	0.011	0.011	0.788**	-0.104*	0.019	-0.005
LD.WITR	-0.192*	-0.034	0.011	-0.084	-0.118	0.013	0.011	-0.118*	-0.117	-0.019	0.011	-0.181*	-0.172*	-0.016	0.011	-0.081
LD.WROEA	-4.998	0.579	0.049	-0.116**	-7.216***	0.621	0.049	-0.037	-4.671***	0.554	0.044	-0.03	-4.274	0.65	0.042	-0.038
LD.WCCR	0.282	0.166*	-0.02	-0.577***	0.461***	0.176**	-0.019	-0.296***	0.299*	0.086	-0.023	-0.657*	0.293*	0.059	0.006	-0.507***
LD.WOR	0.820**	-0.002	-0.025	-0.812*	1.016***	0.028	-0.019	0.299	0.874***	0	-0.015	-0.926	0.679	-0.024	-0.022	-0.784
LD.WIR	-0.073	-0.069	0.068	0.133	-0.139***	-0.062*	0.079	-0.168	-0.088**	-0.067	0.065	-0.026	-0.072	-0.063	0.033	-0.044
LD.WDC	0.709**	0.03	0.225	0.097*	0.824***	0.059	0.222	-0.01	0.747***	-0.028	0.223	0.099	0.566	-0.033	0.231	0.108*
LD.WDSTP	0.002*	-0.038***	0	-0.017	0.003***	-0.044***	-0.001	0	0.003**	-0.032***	-0.001	0.016	0.002**	-0.035***	-0.001	-0.011
LD.WICR	-0.008	0	0	0.001**	-0.013***	0.004	0	0.000*	-0.008***	0.001	0	0.001*	-0.007*	0.001	0	0.001*
LD.WDPR	0.47	0	0	-0.027***	0.701**	0	0	-0.017	0.54	0	0	-0.046***	0.506**	0	0	-0.023***
LD.WDDC	0.034	-0.005	0	-0.001***	0.052***	-0.005	-0.001	0	0.038*	-0.005	0	-0.002	0.035**	-0.005	0	0
N	100	149	677	81	100	149	677	81	100	149	677	81	100	149	677	81

Europe from 2020

WSM													
L2D.	0	-0.03	-0.016	0.034	0	-0.022	-0.071	0	-0.023	-0.021	0	-0.029	-0.054
LD.		-0.128***	-1.788***			-0.122***			-0.141***			-0.106***	
	ESG				ENV			SOC			GOV		
D1.	41.707***	-0.348	-0.302	0.511	9.764***	0.009	-0.215	27.559***	-0.215	0.108	11.838***	-0.164	0.373
L2D.	0	-0.231	0.184	0.037	0	-0.181*	-0.011	0	-0.165	-0.018	0	-0.062	-0.028
L3D.	0	-0.154	0.189	-0.002	0	-0.182*	-0.016	0	-0.106	-0.009	0	-0.019	0.027
L4D.	30.307***	0.477	0.56	0.438	-2.001***	0.239	0.026	-14.160***	0.817	0.279	9.001***	0.139	0.22
L5D.	0	-0.079	2.572***	-1.164	0	-0.043		0	-0.07		0	-0.019	0.171
L6D.	0	-0.148	0.435	-0.009	0	-0.133	0.016	0	-0.085	0.001	0	-0.037	0.016
L7D.	0	-0.221*	0.422	-0.079	0	-0.153*	0.011	0	-0.125	-0.015	0	-0.065	0.057
L8D.	7.447***	0.246	-0.874	0.2	-0.171***	-0.187	-0.395	2.321***	0.549	-0.191	2.327***	0.137	0.118
LD.		-0.264	-3.676**			-0.176	-0.24		-0.311***	-0.098		0.003	-0.332
LD.SIZE	0	17.941	-2.293	10	0	21.425	-7.019	0	16.311	0.966	0	13.719	-8.816
LD.WLR	0	0.283*	0.649***		0	0.124		0	0.104		0	0.045	
LD.WER	0	-0.05	0.552***		0	-0.02		0	-0.02		0	0.057	
LD.WOM	0	-0.016	-0.065	0.038	0	-0.016	0.005	0	-0.008	-0.001	0	-0.003	0
LD.WITR		0.074	-3.212**			0.166			0.079			0.085	
LD.WROEA		0.08	-11.363**			0.17			0.062			0.16	
LD.WCCR		0.032	0.218			-0.04			0.063			-0.144	
LD.WOR		-0.019	-3.116*	0.177		-0.032	-0.002		0.043	-0.025		-0.167	
LD.WIR		1.814	15.079***			1.721			1.047			0.195	
LD.WDC		0.078	-0.004			0.085			0.077			-0.041	
LD.WDSTP		-0.11	9.776***			-0.104			-0.065			-0.021	
LD.WICR		0.407***	-6.056***			0.493**			0.139			0.317***	
LD.WDPR		-0.032***	-0.278***	0.073		-0.056***	-0.019		-0.018	-0.007		-0.040***	-0.009
LD.WDDC		-0.003	0.113***	0.069		0.019	0.008		0	0.005		0.038	0.024
N	14	98	61	18	14	98	18	14	98	18	14	98	18

USA from 2020

WSM													
LD.	-0.127***	-0.172	-0.035	-0.137	-0.218***	-0.138*	-0.259	-0.205***	0.117***	-1.778	-0.112***	-0.014	0.590***
L2D.	-0.007	-0.039***	-0.068***	-0.211	-0.033	-0.086***	-0.165	-0.019	-0.036*	-0.212	-0.004	0.089*	-0.215***

(Continued)

Table 4.5 (Continued)

Variable	L	M	P	R	L	M	P	R	L	M	P	R	L	M	P	R
ESG				ENV				SOC				GOV				
D1.	1.49	0.076	0.04	-1.196	-0.538	-0.158***		-1.541	0.665	0.317		-0.2	1.219	-2.319***		-0.954
LD.	0.292	1.442	0.07	-5.44	-0.234*	-0.474***		1.308	-0.208	0.077		-3.246	0.182	-0.607*		-4.141***
L2D.	0.153	-0.03	0.108	-0.279	-0.444***	-0.043**		-0.215	-0.135	0.004		0.003	0.059	0.588***		-0.196
L3D.	0.122	-0.017	0.084	-0.078	-0.2	-0.022***		-0.145	-0.152	0.005		-0.008	0.059***	-0.07		-0.065
L4D.	1.801	-0.477***	0.512	0.075	-0.162	-0.184***		-2.227	0.492*	-0.312***		-0.412	1.216	-2.315***		-0.841
L5D.	-0.018	-0.086	0.109	1.222	-0.333***	0.019		-0.54	-0.042	0.060***		0.017	0.017	-1.059*		-0.242
L6D.	0.065	-0.073***	0.1	0.01	-0.448	-0.052*		-0.489	-0.063	-0.021		0.168	0.019	0.187*		-0.065***
L7D.	0.068	-0.031	0.056	0.018	-0.357***	-0.033		-0.22	-0.116	0.005		0.115	0.013	-0.187***		0.006
L8D.	0.673	-0.662	0.007	-1.373	-0.129	-0.064**		-1.831	0.685	-0.665***		0.212	0.571**	-0.936**		-1.216**
LD.SIZE	3.128	18.145	0.3	34.226	-17.393	17.689		44.072	-6.386	13.863		40.377	-0.804	115.454***		58.168
LD.WLR	0.532***		-0.038		1.027***	-1.944*		0.033	1.049***			5.464	0.426			-1.841***
LD.WER	0.311	-0.071	0.044	0.107	0.376***	0.818		-0.669	0.317***			3.243	0.316*	1		0.806***
LD.WOM	0.291		-0.008		0.887***				0.796***				0.133			
LD.WITR	0.085		0.053	-1.493	0.019				0.045***	-1.082**		-5.301	0.088	0.124		
LD.WROEA	0.001***	0.345	-0.001		0.001***	-0.197***			0.001***	0.014		0		-0.132***		
LD.WCCR	-0.005	0.03	-0.001	-0.015	-0.015*	-0.044*		0.001	-0.014**	-0.031***		-0.016	-0.004	-0.058*		-0.011***
LD.WOR		1.439***	0.01	-0.623				0.117				-1.184				0.335
LD.WIR		0.610**	0.069			1.017				-0.007				-0.561**		
LD.WDC		-0.319	0.131	0.955		-0.272		-0.297		0.784**		-1.833		0.157		1.329***
LD.WDSTP		0.010***	0	0.077		0.000***		0.134		0.000**		-0.389		0		0.122***
LD.WICR			-0.559*													
LD.WDPR			0.012													
LD.WDDC			0	1.902				0.525		1.678***		-0.194				0.881***
N	48	38	570	38	48	38		38	48	38		38	48	38		38

Source: Author's own elaboration based on the LSEG Workspace.

Note: L, Life & Health Insurance; M, Multi-line Insurance & Brokers; P, Property & Casualty Insurance; R, Reinsurance; N - number of companies; t-test - student test results; *p<0.05; **p<0.01; ***p<0.001.

related to the market and construction of the types of investments. The profitability from this kind of investment is also not the same (Giese et al., 2019). It is different for green bonds, green stocks, green funds, and real estate. Insurance companies, because of their unique activities, are mostly interested in investing in green bonds, especially life insurance companies. Next, when building their investment portfolio, they should pay attention to green real estate. If regulations continue as they have for banks, they will need to assess their portfolio against the capital requirements, as a component of investment risk. Therefore, the understanding of the profitability of these types of investments significantly influences the construction of the investment portfolio. The previous analysis indicates that green bonds are greeniums and lack stable characteristics; they vary by bond type, certification type, currency, security form, sector, and the period when they were estimated (Chodnicka-Jaworska, 2025). Asset and liability management, along with appropriate risk mitigation, require a balanced investment portfolio. As ESG issues grow in importance, the availability of ESG investments becomes increasingly critical. ESG also influences macroeconomic factors, and consequently, parameters such as the ultimate forward rate (UFR), capital adequacy ratio, and capital requirements.

Previous studies reveal that companies with higher ESG scores are considered more stable and generate lower ESG risks. Therefore, their stocks exhibit lower volatility. In the case of the insurance companies, it means that the insurers with higher ESG scores would be less likely to invest in securities with high volatility (and high yield). By contrast, insurance firms with low ESG measures would be more likely to choose securities with a risk-reward profile that tracks more uncertain future cash flows. Thus, the earnings of companies with low ESG scores are more closely tied to investment returns than those of companies with high ESG scores. Bressan and Du (2025) suggest that high ESG measures enhance the dependence of profits on premiums. Profits are less related to investments when ESG ratings are high. Robust ESG criteria improve insurers' claim management, leading to more stable and predictable liabilities in the future, which they match with less aggressive (though less rewarding) investments. ESG influences the composition of the investment portfolio, prompting insurers to allocate larger shares of assets to debt securities than to equity-type securities.

Figure 4.17 presents an analysis of the type of investments made by insurance companies in green bonds, and exhibits a few trends. The figure illustrates that the number of insurance companies investing in green bonds has remained stable over the last five years. The increase was noticed in the second quarter of 2024. It was an effect of the reduced issuance of green bonds during this period. The median of the value of these investments increases, and the distance between the 25th and 75th percentiles increases. This results from diverse regulations and as a result of the varying demand across regions and types of institutions.

The analysis of insurance companies' investments in green bonds (Figure 4.18) indicates a year-on-year decline in the value of new investments in

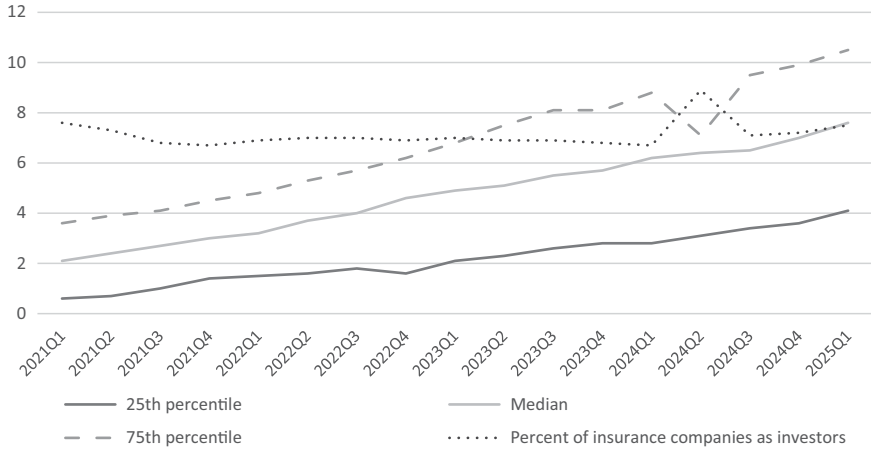


Figure 4.17 Insurance companies' investments in green bonds.

Source: Author's own elaboration based on the LSEG Workspace.

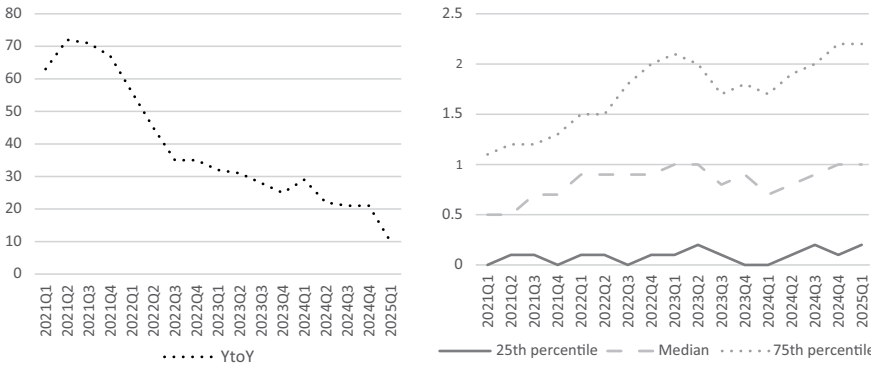


Figure 4.18 Changes in insurance companies' investments in green bonds.

Source: Author's own elaboration based on the LSEG Workspace.

green bonds. This may result from a long-term investment period. Next, this form of investments is still quite new, and some investors are waiting for their final assessment of the profitability. A significant impact can also result from the greenium's high volatility and the challenges in estimating it. The investment structure indicates an increasing median when accounting for the investment value.

The analysis of the climate-relevant assets based on their greenhouse gas emissions is presented in Figure 4.19. It reveals that the highest median in Europe was presented in 2024, with a peak in the first quarter. The current situation involves waiting for the final regulations on the Omnibus package.

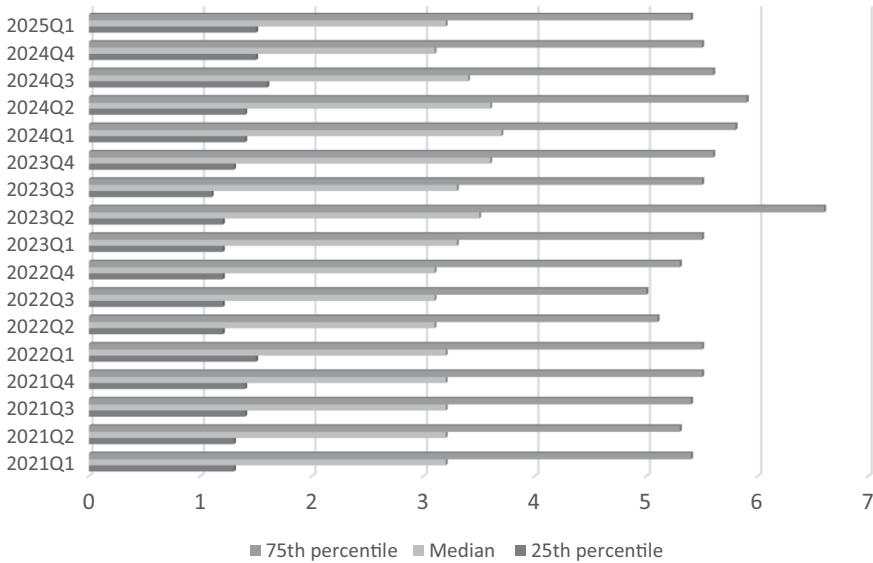


Figure 4.19 Climate-relevant assets based on their greenhouse gas emissions.

Source: EIOPA new dashboard on insurance protection gap for natural catastrophes, Eurostat, Litpop, ARG.

The SFDR report requires data related to green investments. For insurance companies, green investments are observed in green properties and securities. The analysis of the dataset and files in the LSEG does not provide this information because these fields are empty. Therefore, the only way to estimate this relationship is to verify how changes in the ESG score influence changes in the investment structure ratios, that is, the value of the property to the total value of assets; total value of investments, including loans as a percentage of total assets; and investment securities available to sell as a percentage of total assets. These measures are not directly related to green investments but are helpful in assessing investment policies.

The analysis on the impact of changes in ESG scores on the changes in property investments shows a low level of the coefficient value, both in the case of the whole sample and after 2020 (Table 4.6). Consequently, the focus is on the relationship between Europe and the United States after 2020. For European companies, an increase in the ESG score has a positive influence on changes in the property investment index. Life and property insurance companies react especially to changes in ESG scores. The same impact is observed for changes in the sub-factors. The strongest positive reaction is observed for changes in the E-score, which are smaller but still positive on the G-measure, whereas the S-factor is negative. In US companies, a statistically significant reaction is observed only for property insurance, and it is negative.

Table 4.6 Impact of changes in the ESG scores on the changes in the property investments according to the type of the sub-sector, period of introducing regulations, region, and the type of the sub-score.

<i>Variable</i>	<i>L</i>	<i>M</i>	<i>P</i>	<i>R</i>	<i>L</i>	<i>M</i>	<i>P</i>	<i>R</i>	<i>L</i>	<i>M</i>	<i>P</i>	<i>R</i>	<i>L</i>	<i>M</i>	<i>P</i>	<i>R</i>
Total																
WPROP																
LD.	0.038	-0.664***	-0.02	-0.253	0.017	-0.663***	-0.014	-0.660***	0.028	-0.663***	-0.023	-0.495	0.018	-0.665***	-0.022	-0.25
L2D.	-0.011	-0.322***	0.042	-0.018	0.018	-0.322***	0.03	-0.005	-0.016	-0.321***	0.047	0.014	0.005	-0.331***	0.039	0.029
	ESG				ENV				SOC				GOV			
D1.	0	-0.001	0	0	0	0	-0.000*	0	0	0.001	0	0	0	-0.001	0	0.001***
LD.	0	0	0	0.001	-0.000**	0	0	0.001***	0	0.002	-0.000*	-0.001	0	-0.001	0	0
L2D.	0	0	0	0.000***	0	0	0	0.000***	0	0	0	0.000*	0	0	0	0.000***
L3D.	0	0	0	0.000***	0	0	0	0.000**	0	0.002	0	0.000*	0	-0.001	0	0.000***
L4D.	0	0	0	0	0	0	0	0	0	-0.001	0	0	0	0	0	-0.000***
L5D.	-0.000*	-0.002	0	0	0	0	0	0.000*	0	-0.002	-0.000*	-0.001***	0	-0.001	0	-0.000***
L6D.	0	0	0	0	0	0	0	0.000*	0	-0.001	0	0	0	0	0	0
L7D.	0	0	0	0	0	0	0	0	0	0.001	0	0	0	0	0	0
L8D.	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.000*	0	0.000***
LD.WSM	0	-0.001	0	-0.001	0	-0.001	0	-0.001**	0	-0.001	0	0.002**	0	-0.001	0	0
LD.SIZE	-0.001	-0.042	0.001	0.002	-0.002	-0.039	0.001	-0.001	-0.001	-0.037	0.001	-0.001	-0.001	-0.051	0.001	0
LD.WLR	0	0.007	0	-0.003	0	0.01	0	-0.000***	0	0.004	0	0.001*	0	0.009	0	-0.002
LD.WER	-0.000*	0.02	0	0.004	0	0.021	0	0.001*	0	0.023	0	-0.002**	-0.000*	0.018	0	0.002
LD.WOM	0	0.01	0	0	0	0.009	0	0	0	0.01	0	-0.000*	0	0.009	0	0
LD.WITR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000*
LD.WROEA	0	-0.023	0	0	0	-0.017	0	0	0	-0.024	0	-0.000***	0	-0.019	0	0
LD.WCCR	0	0.002	0	-0.002	0	0.001	0	-0.001***	0	0.003*	0	0.001	0	0.001	0	0
LD.WOR	0	0.003	0	0	0	0.003	0	0	0	0.003	0	0	0	0.003	0	0
LD.WIR	0	-0.002	0		-0.000*	-0.002	0		-0.000*	-0.002	0		-0.000*	-0.002	0	
LD.WDC	0	-0.001	0	0.005	0	-0.001	0.000*	0	0	-0.001	0.000*	-0.002*	0	-0.001	0.000*	0.003
LD.WDSTP	-0.000*	0	0	0.002	-0.000*	0	0	0.001**	-0.000*	0	0	-0.001**	0	0	0	0.001
LD.WICR	0	0	0	0	0	0	0	0.000*	0	0	0	0	0	0	0	0
LD.WDPR	0	0	0	-0.002	0	0	0	-0.000**	0	0	0.000*	0.001*	0	0	0	-0.001
LD.WDDC	-0.000***	0	0.000*	0	0	0	0	-0.000***	-0.000***	0	0.000*	0	-0.000***	0	0.000*	0
N	187	263	368	52	187	263	368	52	187	263	368	52	187	263	368	52

From 2020

WPROP																
LD.	0.007	-0.279***	-0.115	0.133	-0.121	-0.335**	-0.109	-0.632**	0.186***	-0.313***	-0.127	-0.072	-0.105	-0.274***	-0.112	0.127
L2D.	0.006	-0.044*	-0.11	-0.079***	0.028	-0.067	-0.12	0.005	-0.021	-0.037***	-0.11	-0.065***	0.039	-0.039**	-0.117	-0.014
	ESG				ENV				SOC				GOV			
D1.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.001***
LD.	0	0	0	0	0.000*	0	0	0.001***	0	0	0	0	0	0	0	0
L2D.	0	0	-0.000*	0.000***	0	0	0	0.000***	0	0	0	0	0.000*	0	0	0.000*
L3D.	0	0	0	0.000***	0	0	0	0.000***	-0.000***	0	0	0	0	0	0	0.000***
L4D.	0	0	0	0	0.000***	0	0	0	0	0	0	0	0	0	0	-0.000***
L5D.	0	0	0	0	0	0	0	0.000***	0	0	0	0	0	0	-0.000*	0
L6D.	0	0	0	0	-0.000***	0	0	0.000***	0	0	0	0	0.000*	0	0	0
L7D.	0	0	0	-0.000**	-0.000*	0	0	0	0	0	0	-0.000**	0	0	0	0
L8D.	-0.000***	0	0	0	-0.000***	0	0	0	-0.000***	0	0	0	0.000***	0	0	0.000***
LD.WSM	0	0	0	0	-0.001*	0	0	-0.001***	0	0	0	0	0	0	0	0
LD.SIZE	-0.003	0.026	-0.001	0.003	-0.005	0.026	-0.001	0.001	-0.004	0.028	-0.001	-0.001	-0.003	0.028	0	0.002***
LD.WLR	0.000***	0	0	0.000*	-0.000*	-0.001	0	0.000***	0	0	0	0	0.000*	0	0	0.000***
LD.WER	0	0	0	-0.000***	-0.001**	0	0	-0.000***	0	0	0	-0.000***	0	0	0	0
LD.WOM	0	0	0		-0.000***	0	0		0	0	0		0	0	0	
LD.WITR	0	0	0		-0.001*	0	0		0	0	0	-0.000**	0	0	0	
LD.WROEA	0	0	0		0.000**	0	0.001		0	0	0.001		0	0	0.001	
LD.WCCR	-0.000**	0.001	0		0	0.001	0		0	0.002	0		0	0.001	0	
LD.WOR	0	0	0	0	0	0	0	0.000***	0	0	0	0	0.000**	0	0	0
LD.WIR	-0.000*	0	0	0	0.000*	0	0	0.000***	-0.000*	0	0	0	0	0	0	0
LD.WDC	0.000*	0	0	0	0	0	0	-0.000***	0	0	0	0	0	0	0	0
LD.WDSTP		0	0			0.002	0	-0.001***		0.001	0			0	0	
LD.WICR		0.001	0	0		0.001	0			0.001	0			0.001	0	0
LD.WDPR		0.002	0	0		0.006	0	0		0.004	0	-0.000*		0.002	0	-0.000***
LD.WDDC		0	0.000*	0		0	0	-0.000***		0	0.000**	0		0	0.000**	0
N	71	92	204	42	71	92	204	42	71	92	204	42	71	92	204	42

(Continued)

Table 4.6 (Continued)

Variable	L	M	P	R	Variable	L	M	P	R	Variable	L	M	P	R	Variable	L	M	P	R
Europe																			
WPROP																			
LD.	0.863***	−0.702**	−0.457***	1.779	0.877***	−1.358	−0.429	−0.068	2.078***	−0.501**	−0.453**	−1.727	−0.072***	−1.563	−0.439***	1.017			
L2D.	0.453***	−0.04	−0.297***	−0.113	−19.970***	−0.049	−0.225***	0.074	0.093***	−0.036***	−0.279***	0.334	0.480***	−0.028***	−0.258***	−0.593			
ESG					ENV					SOC					GOV				
D1.	0.011***	0	0	0	0.006***	0	0.000**	0	−0.000***	0	0	0	0.003***	0	0	0.001			
L2D.	0.000***	0	0.000***	0	0.044***	0	0.000***	0	−0.001***	0	0	0	0.000***	0	0	0			
L3D.	0.000***	0	0.000***	0	0.003***	0	0	0	−0.001***	0	0	0	0.000***	0	0	0			
L4D.	0.008***	0	0	−0.001	0.002***	0	0.000**	0	−0.004***	0	0	0	0.002***	0	0	0			
L5D.	0.000***	−0.001	0	−0.001	0.000***	0.002	0.000**		−0.000***	0	−0.000***		0.000***	−0.002	0.000***	0			
L6D.	0.000***	0	0.000**	0	0.002***	0	0	0	0.000***	0	0	0	0.000***	0	0.000***	0			
L7D.	0.000***	0	0	0	0.000***	0	0.000***	0	−0.000***	−0.000**	0	0	0.000***	0	0	0			
L8D.	0.002***	0	0	−0.001	0.000***	0	0.000*	−0.001	−0.000***	0	0.000*	−0.001	0.001***	0	0	0			
LD.		−0.001	0.001***			−0.002	0.004***	0.001		0	0.003***	−0.007		−0.001	0.000***	0			
LD.WSM	−0.019***	0.026	−0.002	0.053	−0.112***	0.03	−0.003	0.008	0.046***	0.029	−0.002	0.035	−0.030***	0.012	−0.002	0.027			
LD.SIZE	0.000***	0.004	0.000**		0.001***	0.001	−0.002***		−0.001***	0.001	0.001***		0.000***	0.01	0				
LD.WLR	−0.000***	0.001	0.000***		−0.000***	0.002	−0.000***		−0.000***	0.001	0		0.000***	0.004	0.000***				
LD.WER	0.000***	0	−0.000***	0	−0.000***	0	−0.000***	0	0.000***	−0.000*	0.000***	0	−0.000***	−0.001	−0.000***	0			
LD.WOM		0	−0.001***			0.002	−0.001***			0	0.001***			−0.001	−0.000***				
LD.WITR		−0.006	−0.001***			0.002	−0.005***			−0.001	0.002***			−0.02	−0.001***				
LD.WROEA		0.002	−0.005***			−0.004	−0.018***			0.003	0.013***			0.003	−0.003***				
LD.WCCR		0	0.001***			−0.005	0			−0.001	−0.002***			−0.001*	0.000***				
LD.WOR		0	0	0		0.001	−0.007***	0		0	0.005***	−0.002		−0.007	0.001***				
LD.WIR		−0.017	0.009***			−0.012	−0.007**			−0.009	−0.002			−0.091	0.005***				
LD.WDC		0	0			0	−0.001***			0	0.000***			−0.001	0				
LD.WDSTP		0	0.007***			0.001	−0.008***			0	0.013***			0.002	0.005***				
LD.WICR		0.006	−0.003***			0.013	−0.007***			0.004	0.002***			0.017	−0.002***				
LD.WDPR		0	−0.000***	0		0	0.000***	0		0	−0.000***	−0.001		0	−0.000***	0			
LD.WDDC		0	0.000*	0		0	0.000***	0		−0.000*	−0.000***	0		0	0	0			
N	14	79	61	18	14	79	61	18	14	79	61	18	14	79	61	18			

USA

WPROP								
LD.	-0.261	-0.024	-0.261	-0.024	-0.261	-0.024	-0.261	-0.024
L2D.	-0.161	-0.03	-0.161	-0.03	-0.161	-0.03	-0.161	-0.03
	ESG		ENV		SOC		GOV	
D1.	0	0	0	0	0	0	0	0
LD.	0	0	0	0	0	0	0	0
L2D.	0	-0.000**	0	-0.000**	0	-0.000**	0	-0.000**
L3D.	0	0	0	0	0	0	0	0
L4D.	0	0	0	0	0	0	0	0
L5D.	0	0	0	0	0	0	0	0
L6D.	0	0	0	0	0	0	0	0
L7D.	0	0	0	0	0	0	0	0
L8D.	0	0	0	0	0	0	0	0
LD.WSM	-0.005	-0.001	-0.005	-0.001	-0.005	-0.001	-0.005	-0.001
LD.SIZE	0	0	0	0	0	0	0	0
LD.WLR		0		0		0		0
LD.WER		0.001***		0.001***		0.001***		0.001***
LD.WOM		0.001***		0.001***		0.001***		0.001***
LD.WITR		-0.001*		-0.001*		-0.001*		-0.001*
LD.WROEA		0.000*		0.000*		0.000*		0.000*
LD.WCCR		0		0		0		0
LD.WOR		-0.001***		-0.001***		-0.001***		-0.001***
LD.WIR		-0.003***		-0.003***		-0.003***		-0.003***
LD.WDC		0.001		0.001		0.001		0.001
LD.WDSTP		-0.001		-0.001		-0.001		-0.001
LD.WICR		0		0		0		0
LD.WDPR		0		0		0		0
LD.WDDC		0		0		0		0
N	19	95	19	95	19	95	19	95

Source: Author's own elaboration based on the LSEG Workspace.

Note: L, Life & Health Insurance; M, Multi-line Insurance & Brokers; P, Property & Casualty Insurance; R, Reinsurance. Notes: N - number of companies; t-test - student test results; *p<0.05, **p<0.01, ***p<0.001.

The aforementioned relationship indicates the following: First, the European market reacts in the opposite way to the US market regarding ESG risk in property investments. The US market is nearly insensitive to changes in ESG scores and has a negative relationship. In the European market, this relationship has a positive character, which means that insurance companies with higher ESG scores are interested in investments in green assets, in this case, green and sustainable property.

The next part of the analysis tests the impact of changes in ESG scores on changes in the available-for-sale investment index (Table 4.7). An analysis of the impact of changes in ESG indicators on the available-for-sale investment index shows that the European market reacts more strongly to these changes than the US market. In most cases, an increase in ESG measures results in a decrease in the aforementioned indicators. A statistically significant impact is observed for companies in the life sector, followed by multiple companies. However, no reaction is observed regarding the ESG measures in the remaining sub-sectors. The sub-sectors react most strongly to changes in the E-indicator. The second most significant measure is the S-measure. This measure also affects the changes in this index in the property insurance market. The results show that with a decrease in ESG risks and, therefore, an increase in ESG measures, the market reacts more strongly.

Table 4.8 shows the analysis of the impact of changes in the investment indicator, measured as a percentage of total investments, including loans, relative to total assets. The results indicate the significant impact of changes in the ESG score on changes in the investment index but the results are varied. This means that, in particular regions, this relationship differs across sub-sectors and time periods. An increasing impact of ESG score changes is observed after 2020. Moreover, it is stronger in Europe than in the United States.

The results show that an increase in ESG score has a positive impact on the investment index, especially for life and health insurance, multi-line insurance, brokers, and property and casualty insurance. The strongest relationship is observed for the first group of companies. In the United States, this relationship is observed for life property and insurance, but is negative. This situation is closely related to the regulations and policies responsible for green investments. In Europe, a positive relationship is also observed for the E- and G-measures and a negative relationship for the S-measure.

The focus should be on environmental risks. This finding is significant for all sub-samples except for reinsurance activity. The focus is on the life and property insurance. A similar reaction is observed for G- and S- measures.

These results confirm the influence of changes in ESG scores on investment portfolios. In the near future, more data on this activity will be available as a result of presenting SFDR reports and presenting these data by ESG data providers.

The significant impact of changes in ESG scores on investment structure is directly related to rising environmental risks, especially climate risks. This shows that companies with lower ESG risk invest more in securities and real estate, especially in Europe.

Table 4.7 Impact of changes in the ESG scores on the changes in the available-for-sale investments index according to the type of the sub-sector, period of introducing regulations, region, and the type of the sub-score.

<i>Variable</i>	<i>L</i>	<i>M</i>	<i>P</i>	<i>R</i>	<i>L</i>	<i>M</i>	<i>P</i>	<i>R</i>	<i>L</i>	<i>M</i>	<i>P</i>	<i>R</i>	<i>L</i>	<i>M</i>	<i>P</i>	<i>R</i>
Total																
WAVAIL																
LD.	-0.006	-0.561***	-0.085	-0.654***	0.004	-0.542***	-0.107*	-0.666***	-0.011	-0.544***	-0.102*	-0.683***	-0.01	-0.557***	-0.092*	-0.643***
L2D.	0.011	0.096	0.01	0.153	0.008	0.109	-0.009	0.141	0.011	0.126	-0.015	0.144	0.013*	0.109	0.013	0.151
	ESG				ENV				SOC				GOV			
D1.	0	0	0.001	0	0	0	-0.002	0.002*	0	-0.001	0	-0.001	0	0	0.001	0.002
LD.	0.001	-0.001	-0.002	-0.008***	0	0	-0.001*	0.002	0	0	-0.001	-0.01	0.001	0	-0.001	-0.004***
L2D.	0	0.002	0	-0.004***	0	0.001	0	0	0	0.002	0	-0.003	0	0	0	-0.003**
L3D.	0	0.001***	0.001	-0.001	0	0	0	0.001**	0	0	0	0	0	0.001***	0.000**	0
L4D.	0.001	0	0.002	-0.002	0.000***	0	-0.001	0.003	0	-0.001	0.001	0.001	0.001	0	0.001	-0.001
L5D.	-0.001*	0.001*	-0.002	-0.003	-0.001	0	0	0.004**	-0.000*	0	-0.001	-0.001	0	0.001**	-0.001	-0.003
L6D.	0	0	0	-0.002	0.000*	-0.001*	0	0.001	0	-0.001	0	-0.002	0	0.001	0	-0.001
L7D.	0	0	0	-0.001	0	0	0	0.001	0	0	0	0	0	0	0	-0.001
L8D.	0	-0.001*	0.003	0	0	-0.000*	0	-0.009	0	-0.001	0.002	-0.002	0	-0.001	0.002	0.001
LD.WSM	0	0	0.001**	0	0	0	0.001*	0	0	0	0.001*	0.000*	0	0	0.001**	0
LD.SIZE	0.013	-0.096	-0.019	-0.132	0.019	-0.091	-0.014	-0.079	0.009	-0.093	-0.021	-0.095	0.01	-0.097	-0.02	-0.12
LD.WLR	0.001	0	0.001	-0.004	0.001	-0.001	0.001	0.001	0.002	-0.001	0.002	0	0	0	0	-0.003
LD.WER	0.004	0	-0.002***	0.002	0.003	-0.001	-0.001*	0.009*	0.004	-0.001	-0.001	0.006	0.004	0	-0.002***	0.001
LD.WOM	-0.003	0	0	0.004***	-0.002	0	0	0.003***	-0.003	0	0	0.004***	-0.003*	0	0	0.004***
LD.WITR	-0.007***	0	0.000*	-0.004	-0.006***	-0.000*	0.000**	0.004	-0.01***	-0.000*	0	-0.005	-0.007***	-0.000*	0.000***	-0.003
LD.WROEA	-0.057	0	0.001**	-0.005***	-0.067	0.001	0.002**	-0.006***	-0.058	0	0.002*	-0.005**	-0.052	0.002*	0.001***	-0.005***
LD.WCCR	-0.003**	-0.001	0	0.005	-0.003*	0	0	0.002***	-0.003*	0	-0.001	0.001	-0.003*	0	0	0.004
LD.WOR	0.008**	0	0	-0.010***	0.008**	0	0	0.008	0.008**	0	0	-0.014	0.008**	0	0	-0.008
LD.WIR	-0.002	0	-0.001	-0.001	-0.001	0	-0.001	0.001	-0.001	0	-0.001	-0.003	-0.002	0	-0.001	-0.004
LD.WDC	0	-0.001	0	0.003	0	0	-0.001	-0.01	0	-0.001	-0.001	0.004	-0.001	0	0	0.003
LD.WDSTP	0	-0.000*	0	0	0	0	0	0.004**	0	0	0	0.002	0	0	0	0
LD.WICR	0.000*	0	0	0.000***	0.000*	0	0	-0.000**	0.000*	0	0	0	0.000**	0	0	0.000**
LD.WDPR	0.000***	-0.000*	0	0.001	0.000***	0	-0.000**	-0.002*	0.000***	0	-0.000*	0	0.000***	-0.000*	-0.000**	0.001
LD.WDDC	0	-0.000*	0	0	0	-0.000**	0	0	0	-0.000*	0	-0.000***	0	-0.000***	-0.000*	0
N	154	300	284	89	154	300	284	89	154	300	284	89	154	300	284	89

(Continued)

Table 4.7 (Continued)

Variable	L	M	P	R	L	M	P	R	L	M	P	R	L	M	P	R
From 2020																
WAVAIL																
LD.	0.015	−0.046	−0.108	0.360*	0.023	−0.077	−0.137	0.724	0.015	−0.091	−0.138	0.39	0.018	−0.063	−0.114	0.489
L2D.	0.019***	−0.098	0.006	−0.015	0.007	−0.065	−0.03	−0.032	0.015**	−0.073	−0.031	−0.049	0.016***	−0.047	0.003	−0.016
ESG				ENV				SOC				GOV				
D1.	0	0.003	0.002	0.002	0.001	0	−0.001	0.001	0	0	0.001	−0.001	0	0.002***	0.001	0.003
LD.	0	−0.001	−0.001	0.012	0.003***	0.001*	0	−0.01	0	−0.003***	0	0.009	0	0.001	−0.001	0.013
L2D.	0	0.002*	0	−0.001	0.001	0.001*	0.001	0	0	0.001	0.001	−0.001	0	0.001*	0	0
L3D.	0	0	0.001*	−0.001	−0.001	0.001*	0.001	−0.002	0	0	0	−0.002*	0	0	0	0
L4D.	0	0.003	0.002	−0.002	0.003*	0.001	−0.002	0.001	0	−0.001	0.001	0.001	0	0.002***	0.001	−0.001
L5D.	0.001	0.003**	−0.001	0.015	0.005***	0	0	−0.002	0.001	0.001*	0	0.007*	0	0.001**	−0.001	0.028
L6D.	0	0	0	−0.002	0.000***	0	0	−0.001	0	−0.001	0	−0.002*	0	0	0	0
L7D.	0	0.001	0	−0.002	0	0.001***	0	−0.002	0	−0.001	0	−0.002*	0	0.001***	0	−0.001
L8D.	0	−0.003	0.003	0	0.000*	−0.000*	0	−0.011*	0	−0.001	0.002	−0.004**	0	−0.002**	0.001	0.001
LD.WSM	−0.015***	−0.000*	0.001*	0.024	−0.022***	0	0.001*	0.015***	−0.02***	0	0.001	0.019**	−0.013***	0	0.001*	0.036
LD.SIZE	−0.035	−0.171**	−0.013	0.048	0.013	−0.190*	−0.005	0.025	−0.004	−0.172*	−0.007	−0.041	−0.013	−0.103*	−0.013	0.01
LD.WLR	−0.004**	0.003*	0	−0.002**	−0.007***	0.002	0	−0.005*	−0.003*	0.002	0	−0.003	−0.006***	0.001	0	−0.005
LD.WER	−0.023***	0.004*	0	0.026	−0.021***	0	0	−0.005	−0.02***	0.001	0	0.018	−0.022***	0.002	0	0.019
LD.WOM	−0.003*	0	−0.001	−0.077	−0.007***	0	−0.001	−0.040***	−0.003*	0.001	−0.001	−0.059**	−0.005***	−0.002	−0.001	−0.098
LD.WITR	0	−0.002*	0	−0.075	0.026***	−0.001	0	−0.027***	0	−0.001	0	−0.058**	−0.003*	−0.001	0	−0.076
LD.WROEA	0.015***	−0.009*	−0.001	0.008	0.008***	−0.007*	−0.001	0.006	0.016***	−0.008***	−0.001	0.001	0.014***	−0.007*	−0.001*	−0.011
LD.WCCR	0.000***	0	0	0.036	0.000***	0.000*	0	0.003	0.000***	0.000***	0	0.018**	0.000***	0	0	0.048
LD.WOR	0.000***	−0.004***	0	0	0.000***	−0.002	0	−0.000***	0.000***	−0.002	0	−0.000*	0.000***	−0.002	0	0
LD.WIR	−0.001***	−0.000**	0	0	−0.001***	0	0	−0.000**	−0.00***	0	0	−0.000***	−0.001***	−0.000***	0	0
LD.WDC		−0.001	0.003	0.036		−0.004	0.003	0.009***		−0.006	0.003	0.027***		−0.002	0.002	0.035
LD.WDSTP		−0.002	−0.001	0.092		−0.005	0	0.012		−0.006	0	0.047**		−0.003	−0.001*	0.123
LD.WICR		0.021**	0.001**	−0.003		0.009	0.001**	−0.005***		0.019	0.001**	−0.006***		0.018*	0.001***	−0.005*
LD.WDPR		0.002**	0	0.121		0	0	0.01		0.001	0	0.075*		0.001	0	0.217
LD.WDDC		−0.001***	0	−0.032		0	0	−0.007***		−0.001*	0	−0.019**		0	0	−0.043
N	52	107	209	62	52	107	209	62	52	107	209	62	52	107	209	62

Europe																
WAVAIL																
LD.	-0.000***	-0.129***	0.127	0.478	0.932***	-0.096	0.264	-0.273	-0.82***	-0.127	0.277*	-3.267	0.962***	-0.141	0.049***	1.9
L2D.	2.010***	-0.127	0.069	0.414	-0.562***	-0.094	0.133	-0.003	-0.11***	-0.077	0.145*	0.736	-1.665***	-0.069	0.057	0.307
ESG				ENV				SOC				GOV				
D1.	-0.081***	0.003*	0.004	0.013	-0.007***	0	-0.036	0.004	-0.04***	0.001	0.009***	-0.025	0.022***	0.001***	0	0.014
L2D.	0.014***	0.002***	0.001	0.001	-0.001***	0.001*	0.009	0.004	0.018***	0.002	0.001***	-0.02	0.003***	0.001**	0	0.001
L3D.	0.003***	0.001	0	-0.001	-0.007***	0.001**	0.016	0.002	0.005***	0.001	-0.001	-0.017	-0.004***	0	0	-0.002
L4D.	-0.073***	0.003*	0.003	-0.015	0.006***	0.001*	-0.014	-0.006	0.006***	0	-0.001	-0.025	0.024***	0.002***	0.003***	-0.011
L5D.	0.000***	0.003***	-0.002	-0.211	-0.001***	-0.001			-0.003***	0.001	-0.012*		-0.007***	0.001***	-0.002	-0.029
L6D.	-0.005***	0	0	0.004	0.000***	0	0.003	0	0.002***	0	-0.001	-0.024	0.007***	0	0	0.006
L7D.	0.003***	0.002*	0	-0.013	-0.001***	0.001***	0	-0.002	-0.000***	0	-0.001***	-0.037	-0.002***	0.001***	0.001	-0.006
L8D.	-0.015***	-0.003*	0.009	-0.009	-0.000***	0	-0.014	-0.022	-0.005***	0	0.009***	-0.01	-0.001***	-0.002**	0.008**	0
LD.		0.003				0.003***		0.025		-0.003		-0.336		0.002*		0.03
LD.SIZE	-0.757***	-0.217***	-0.008	1.926	0.073***	-0.252*	-0.023	0.421	0.222***	-0.214*	-0.205	1.805	0.528***	-0.150**	0.06	1.822
LD.WCCR	0.003***	-0.002			-0.004***	0			-0.006***	0.002	-0.034		-0.004***	-0.003		
LD.WICR	0.000***	-0.003***	0.002		0.000***	-0.001	0.004		-0.000***	-0.002	0.001***		-0.000***	-0.002***	0.001	
LD.WDDC	-0.000***	0	0.004	0.007	0.000***	0	0.005	-0.001	0.000***	0	-0.001	-0.006	0.000***	0	0.004***	0.001
LD.WSM		0	0.005			0.001**	0.007			0	0.005***			0.000*	0.005***	
LD.WLR		-0.003	0.009			-0.009*	0.01			-0.008	0.022**			-0.004	0.006	
LD.WER		-0.003				-0.008				-0.009				-0.004		
LD.WOM		0				-0.001	-0.007			0.002				0		
LD.WITR		0.001	-0.008	0.029		-0.002**	-0.022	0.005		0.002		-0.087		0.001	-0.001	
LD.WROEA		-0.003				0.011				-0.001				-0.004		
LD.WOR		0	-0.001			-0.002	-0.001			0.001	-0.001			0	-0.001***	
LD.WIR		0				0				0				0		
LD.WDC		-0.012**				-0.012***				-0.009***				-0.012***		
LD.WDSTP		0	-0.006	0.013		0.000***	-0.003	0.002		0.000*	0.019	-0.025		0	-0.008	0.001
LD.WDPR		0	0	0.013		0	0.001	-0.001		-0.001	0	0.017		0	0	-0.001
N	14	88	33	18	14	88	33	18	14	88	33	18	14	88	33	18
USA																
WAVAIL																
LD.			-0.042				-0.037				-0.058				-0.054	
L2D.			0.019				-0.005				-0.015				0.024	

(Continued)

Table 4.7 (Continued)

Variable	L	M	P	R	L	M	P	R	L	M	P	R	L	M	P	R
	ESG				ENV				SOC				GOV			
D1.			0.001				0.001*				0				0	
LD.			-0.001				-0.001**				-0.001***				0	
L2D.			0				0.001***				0				0	
L3D.			0.001				0				0				0	
L4D.			0.001				0				0				0	
L5D.			0				0.001**				0				0	
L6D.			0				-0.000*				0				0	
L7D.			-0.001				0				-0.001				0	
L8D.			0.001				0				0				0	
LD.WSM			0				0				-0.001*				0	
LD.SIZE			0.01				0.016				0.018				0.007	
LD.WLR			0.001				0.002				0.002*				0.002	
LD.WER			0.001				0.001				0.002*				0.001	
LD.WOM			0.001				0.001				0.001*				0.001	
LD.WITR			0				0				0				0	
LD.WROEA			0				0.001				0.001				0	
LD.WCCR			-0.001				-0.001				-0.001				-0.002	
LD.WOR			-0.002				-0.002				-0.002				-0.003	
LD.WIR			0				0.001				0				0	
LD.WDC			0.001				0				0				0	
LD.WDSTP			0				0				0				0	
LD.WICR			0				0				-0.000**				0	
LD.WDPR			0				0				0				0	
LD.WDDC			-0.000**				0				0				-0.000*	
N			128				128				128				128	

Source: Author's own elaboration based on the LSEG Workspace.

Note: L, Life & Health Insurance; M, Multi-line Insurance & Brokers; P, Property & Casualty Insurance; R, Reinsurance. Notes: N - number of companies; t-test - student test results; *p<0.05; **p<0.01; ***p<0.001.

Table 4.8 Impact of changes in the ESG scores on the changes of the investments index according to the type of the sub-sector, period of introducing regulations, region, and the type of the sub-score

<i>Variable</i>	<i>L</i>	<i>M</i>	<i>P</i>	<i>R</i>	<i>L</i>	<i>M</i>	<i>P</i>	<i>R</i>	<i>L</i>	<i>M</i>	<i>P</i>	<i>R</i>	<i>L</i>	<i>M</i>	<i>P</i>	<i>R</i>
Total																
WINVEST																
LD.	-0.494***	-0.458***	-0.140*	-0.619***	-0.478***	-0.456**	-0.142*	-0.624***	-0.484***	-0.462**	-0.140*	-0.645***	-0.495***	-0.457***	-0.141*	-0.637***
L2D.	0.307***	-0.097	-0.163**	-0.034	0.338***	-0.09	-0.167**	-0.02	0.322***	-0.086	-0.162**	-0.038	0.297**	-0.088	-0.165**	-0.046
	ESG				ENV				SOC				GOV			
D1.	0	0	0.001	0.005*	0	0	0	0.007***	0	0	0.001	0.004	0	0	0	0.003
LD.	-0.001**	0	-0.001	0	0	0	0.000*	0.006*	0	0	-0.001	0	0	0	0	0
L2D.	-0.001	0.001	0	0	0	0	0	0.001**	0	0.001	0	0	0	0	0	0
L3D.	-0.001	0.001*	0	0.001	0	0.001	0	0	0	0.001*	0	0.001	0	0.000*	0	0.001
L4D.	0	0	0.001	0.001	0.000*	0	0	0.001***	0	0	0.001	0.001	0	0	0	0.001
L5D.	-0.001*	0	-0.001	-0.001	0.000*	0	0	-0.001	0	0	-0.001	-0.001	-0.000***	0	0	-0.001
L6D.	0	-0.001	0	0.001***	0	-0.001*	0	0.001	0	0	0	0.001	0	0	0	0
L7D.	0	0.001	0	0	0.000*	0.000*	0	0.001	0	0.000**	0	0	0	0.001	0	0
L8D.	0	-0.001	0.001	-0.001	0	0	0	-0.005	0	0	0	-0.003	0	0	0	0.001
LD.WSM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LD.SIZE	-0.022	-0.087	0.017	-0.162	-0.028	-0.091	0.018	-0.087	-0.032	-0.089	0.016	-0.184	-0.021	-0.09	0.018	-0.185
LD.WLR	-0.001	-0.002*	0	-0.001	-0.001	-0.002*	0	-0.002	-0.001	-0.001*	0	-0.002	-0.001	-0.002*	0	-0.001
LD.WER	0.001	-0.002	-0.002**	-0.002**	0.001	-0.002*	-0.002*	-0.004***	0.001	-0.002*	-0.002*	-0.002**	0.001	-0.002	-0.002*	-0.002***
LD.WOM	0	0	0	0.001**	0.001	-0.001	0	0.001*	0	0	0	0.001*	0	-0.001	0	0.001*
LD.WITR	-0.001	0	0.000*	-0.001	-0.001	0	0.000*	0	-0.001	0	0.000*	0	-0.001	0	0.000*	-0.001
LD.WROEA	0.001	0.002*	0.001	-0.005**	-0.001	0.002*	0.001	-0.005***	0.002	0.002	0.001*	-0.005**	0.002	0.002**	0.001	-0.005**
LD.WCCR	0	0	-0.001	0.001	0	0	-0.001	0.002	0	0	-0.001	0.001	0.000*	0	-0.001	0.001
LD.WOR	-0.001	0	0	-0.004	-0.001	0	0	0.004	-0.001*	0	0	-0.004	-0.001	0	0	-0.005
LD.WIR	0	0.000*	0.001	0.005*	0	0.000*	0.001	0.002	0	0.000*	0.001	0.006**	0	0	0.001	0.005*
LD.WDC	-0.001	0	0	0	-0.001	0	0	-0.002	-0.001	0	0	-0.001	-0.001	0	0	0
LD.WDSTP	0	0	0	-0.001**	0	0	0	-0.002***	0	0	0	-0.001***	0	0	0	-0.001**
LD.WICR	0	0	-0.000***	-0.000***	0	0	-0.000***	-0.000***	0	0	-0.000*	-0.000***	0	0	-0.000***	-0.000***
LD.WDPR	0.000**	0	0	0	0.000*	0	0	0.000***	0.000**	0	0	0	0.000***	0	0	0
LD.WDDC	0	-0.000*	0	0	0	0	0	0	-0.000*	0	0	0	0.000*	-0.000*	0	0
N	222	428	1199	156	222	428	1199	156	222	428	1199	156	222	428	1199	156

(Continued)

Table 4.8 (Continued)

Variable	L	M	P	R	L	M	P	R	L	M	P	R	L	M	P	R
From 2020																
WINVEST																
LD.	-0.083	-0.680***	-0.213***	-0.313**	-0.084	-0.662***	-0.220***	-0.343**	-0.096	-0.660***	-0.213***	-0.387**	-0.096	-0.648***	-0.219***	-0.327**
L2D.	0.049	-0.1	-0.204***	-0.264	0.12	-0.087	-0.211***	-0.248*	0.09	-0.129*	-0.202***	-0.289*	0.068	-0.082	-0.207***	-0.257*
ESG				ENV				SOC				GOV				
D1.	0	0.002	0.001	0.007***	0	0	0	0.006***	-0.000*	0	0.001	0.006*	0	0.003*	0	0.005*
LD.	-0.001**	0	0	-0.001	0	-0.001	0.001	0.006	0	-0.001***	0	-0.008	-0.001***	0.001	0	-0.001*
L2D.	-0.001	-0.002	0	0.002	-0.001	-0.001	0	0.003**	0	-0.001	0	0.003*	-0.001	-0.001	0	0.001
L3D.	0	0.001	0	0	0.001	0.001	0	0	0	0	0	-0.001	0	0	0	0
L4D.	0	0.002	0	0.001	0	0	0	0.002***	-0.000*	0.001	0.001	0.002*	0	0.002**	0	0.002
L5D.	-0.001**	0	-0.002	-0.001	-0.000*	0	0	0.001	0	-0.001	-0.001	0	-0.001***	0.001**	-0.001*	-0.003
L6D.	0	-0.001	0	0	0	-0.000*	0	0.001*	0	-0.001	0	0	0.000*	0	0	0
L7D.	0	0.001	0	-0.001	0	0	0	0	0	0	0	0	0	0.001*	0	-0.001*
L8D.	0	-0.001	0.001	-0.002	0	0.001	0	-0.004	0	0	0	-0.004*	0	-0.001	0.001	0
LD.WSM	0	0	-0.000*	-0.001	0	0	-0.000**	-0.002	0	0	-0.000**	-0.001	0	0	-0.000**	-0.001
LD.SIZE	-0.016	-0.032	-0.016	-0.112	-0.031	-0.018	-0.018	-0.052	-0.037	-0.03	-0.017	-0.162	-0.011	-0.017	-0.017	-0.105
LD.WLR	-0.002***	-0.004**	0	-0.004	-0.002***	-0.005**	0	-0.004	-0.002**	-0.006**	0	0.001	-0.002***	-0.002	0	-0.003
LD.WER	0.001**	-0.004**	-0.003*	-0.002*	0.001	-0.006***	-0.002	-0.002	0.002*	-0.006**	-0.003*	-0.002	0.001*	-0.002	-0.003*	-0.003***
LD.WOM	0.002**	-0.002	0	0	0.003*	-0.002**	0	0	0.002	-0.002**	0	0	0.002	-0.002*	0	0
LD.WITR	-0.002***	0	0	0	-0.002***	0	0	0.001	-0.002*	0	0	0	-0.002***	0	0	0
LD.WROEA	-0.023***	0.002	0	-0.009***	-0.023***	0.002	0	-0.008***	-0.016	0.003	0	-0.010***	-0.025***	0.005	0	-0.009***
LD.WCCR	0	0.003**	0	0.007*	0	0.004*	0	0.010*	-0.001	0.004*	0	0.002	-0.001	0.002*	0	0.005
LD.WOR	0.001*	-0.001*	0	-0.008	0.001	-0.001*	0.001	0.006	0	-0.001*	0.001	-0.02	0.001	-0.001*	0	-0.017*
LD.WIR	0	0.001**	0.001	0.001	0	0.001***	0.001	-0.002	0	0.001***	0.001	0	0	0	0.001	0
LD.WDC	0.001**	0	-0.001	-0.006	0.001*	0	-0.001	-0.008	0.001	-0.001	-0.001	-0.006*	0.002**	0	-0.001	-0.004
LD.WDSTP	0	0	0	-0.002***	0	0	0	-0.002***	0	0	0	-0.002***	0	0	0	-0.002***
LD.WICR	-0.000**	0	-0.000***	0	-0.000**	0	-0.000***	0	0	0	-0.000*	0	-0.000*	0	-0.000***	0
LD.WDPR	-0.001	0	0	0	-0.001	0	0	0	-0.001	0	0	0	-0.002	0	0	0
LD.WDDC	0	0	-0.000*	0	0	0	-0.000*	0	0	0	-0.000*	0	0	0	-0.000*	0
N	100	149	680	81	100	149	680	81	100	149	680	81	100	149	680	81

Europe																
WINVEST																
LD.	-4.431***	-0.710***	-0.127*	-0.267	1.088***	-0.653***	-0.175	-0.6	1.431***	-0.716***	-0.043	-0.569	-0.888***	-0.710***	-0.128***	-0.657
L2D.	-26.811***	-0.035	-0.120**	0.068	1.927***	-0.152*	-0.115	-0.022	2.741***	-0.214***	-0.003	-0.327	-4.362***	-0.012	-0.088**	-0.701
	ESG				ENV				SOC				GOV			
D1.	2.951***	0.004*	0.001***	-0.007	0.017***	0	0	0.006	-0.063***	-0.001	0.005**	-0.007	0.106***	0.004*	-0.002	0.011
L2D.	0.094***	-0.003	0.002	0.015	0.028***	0.003**	0.004***	0.006	-0.059***	-0.003	0.002*	0	0.006***	-0.001	0	0.014
L3D.	0.063***	0.002	0	0.004	0.007***	0.003**	0.002	0.003	-0.105***	0.003***	0.002**	0	0.003***	0	-0.001	0.002
L4D.	2.632***	0.004***	0.004	-0.025	0.013***	0.001	0.001	-0.001	-0.052***	0.002	0.005**	-0.003	0.107***	0.003***	0.001	-0.002
L5D.	0.004***	0	0.056***	-0.17	0.001***	0	0.007***		-0.007***	0.001	-0.038***		0.001***	0.001***	0.058***	0
L6D.	0.058***	-0.001	-0.001**	0.013	0.000***	0	0	0.005	-0.001***	-0.001	0.001	0.003	0.015***	0	0.002***	-0.009
L7D.	0.006***	0.003***	0	-0.001	0.001***	0	0	0.006	-0.014***	0.004**	0.002	0.005	0.000***	0.001**	0.001**	-0.003
L8D.	0.531***	-0.001	0.005*	-0.033	0.001***	0.001	0	-0.028	-0.015***	0.001	0.005***	-0.013	0.010***	0	0.003	0.005
LD.		0.002	0.023**			0	0.225***	0.054		0	0.084***	-0.005		0.002**	0.026***	0.016
LD.SIZE	7.027***	-0.04	0.134	1.07	-0.679***	-0.045	0.056	0.78	2.133***	-0.062	0.148	-0.468	0.825***	-0.026	0.121	-0.253
LD.WCCR	-0.024***	0.004***	-0.022***		0.004***	0.006***	-0.118***		-0.015***	0.006***	0.014***		-0.003***	0.001	-0.035***	
LD.WICR	-0.000***	0.001	-0.002		0.000***	0	0.017***		-0.000***	0	-0.007***		-0.000***	0.001	-0.006***	
LD.WDDC	0.002***	0	-0.003***	0.005	-0.000***	0	0.000**	-0.002	0.001***	0	0.005***	-0.001	0.000***	0	-0.005***	-0.001
LD.WSM		0	0.006			0	-0.025***			0	0.041***			0	0.003	
LD.WLR		-0.008*	0			-0.010***	-0.258***			-0.010***	0.111***			-0.006*	-0.115***	
LD.WER		-0.009**	-0.007			-0.011***	-0.904***			-0.011***	0.544***			-0.006*	-0.336***	
LD.WOM		-0.004*	0.021**			-0.003***	-0.077***			-0.002	-0.097***			-0.004***	0.038***	
LD.WITR		-0.002	0.045**	0.036		-0.002*	-0.437***	0.025		-0.001	0.173***	0.006		-0.001	-0.070***	
LD.WROEA		-0.009	-0.099***			-0.004	-0.621***			-0.003	-0.166***			-0.012	-0.318***	
LD.WOR		-0.002	-0.003***			-0.001*	-0.044***			-0.001	0.011***			-0.002**	-0.015***	
LD.WIR		0.002	-0.106***			0.001	-0.844***			0.001	0.261***			0.002*	-0.443***	
LD.WDC		-0.001	0.016			0.001	-0.274***			0.001	0.112***			-0.003	0.017*	
LD.WDSTP		0	0.004***	0.009		0	0.016***	0.003		0	-0.002***	-0.002		-0.000*	0.008***	-0.001
LD.WDPR		0.001	-0.001***	0.007		0.000**	0.008***	-0.006		0.000**	-0.004***	-0.003		0.001	0.000*	-0.004
N	14	98	61	18	14	98	61	18	14	98	61	18	14	98	61	18

(Continued)

Table 4.8 (Continued)

Variable	L	M	P	R	L	M	P	R	L	M	P	R	L	M	P	R
USA																
WINVEST																
LD.	-0.11	-0.042	-0.128*	0.377	-0.053	0.051	-0.131*	0.319***	-0.092	-0.235	-0.136*	0.446	-0.157	0.073	-0.129*	0.317***
L2D.	0.102	-0.337	-0.258***	-0.415	0.175***	-0.306	-0.258**	-0.410***	0.166***	-0.403	-0.261**	-0.469	0.05	-0.195	-0.257**	-0.375***
ESG				ENV				SOC				GOV				
D1.	-0.001**	0	0.001	0	0.001	0	0	0	-0.001***	0	0.001	0	0	0.001	0	0
LD.	-0.001*	-0.008	0.001**	-0.002	0	0.001	0	0	-0.001***	-0.001	0.001	-0.002	-0.001***	0	0	0
L2D.	-0.003*	0	-0.001	0.001	-0.002	0	-0.001	0	-0.001	-0.001	0	0.001	-0.002***	0	0	0
L3D.	-0.001	-0.001	0	0	0.001	0	0	0	-0.001	-0.001	0	-0.002	-0.001	-0.001	0	0.000*
L4D.	0	0	0	-0.001	0	0	0	0.001***	0	0	0	0.001	-0.000***	0.002	0	0.000*
L5D.	0.000***	-0.002	-0.001	-0.003	0	-0.001	0	-0.003***	-0.000*	-0.001	0	0	-0.000***	0.001	0	-0.001***
L6D.	0.001***	-0.001	0	0	-0.000*	0	0	0	0.002	-0.001	0	0.001	0	0.001	0	0
L7D.	0	-0.001	0	-0.001	0	0	0	-0.001***	0	-0.001	0	0	-0.000***	-0.001	0	-0.001***
L8D.	0	0	0	0.002	-0.001***	0	-0.001	0.001***	0	0	-0.001	-0.001	0	0.001	0	0.002*
LD.WSM	0.000*	0.001	-0.000*	0.001	0	0.001	-0.000**	0.001***	0	0	-0.000**	0.002	0.000***	0.001	-0.000*	0.001***
LD.SIZE	-0.025	0.128	-0.006	0.17	-0.049	0.138	-0.006	0.173***	-0.049	0.109	-0.008	0.199	-0.016	0.051	-0.006	0.099**
LD.WLR	-0.002***		0		-0.002*	0.015	0	-0.002***	-0.002**		0	-0.005	-0.002***		0	-0.001
LD.WOM	0	-0.005	0	0	0.001*	-0.012	0	-0.002**	0.001**		0	-0.005	-0.001**	0.006	0	-0.001***
LD.WOR	0.002***		0		0.002***		0		0.002***		0		0.002***		0	
LD.WIR	-0.000*		0.001	0	0		0.001		0	-0.008	0.001	0.004	-0.000***	-0.015	0.001	
LD.WDSTP	0.000***	-0.001	0		0.000***	0.001	0		0.000***	0	0		0.000***	0.001	0	
LD.WDDC	0.000***	0	-0.000*	0	0.000***	0	-0.000*	-0.000***	0.000***	0	-0.000*	0	0.000***	0	0	0.000***
LD.WITR		0	0	0.001			0	0.000***			0	0.001			0	0.001***
LD.WCCR		-0.002	0			-0.011	0			0.002	0			0.002	0	
LD.WDC		0.002	-0.001	-0.001		0.002	-0.001	0.001***		0.002	-0.001*	0.002		0.005	-0.001	0
LD.WDPR		0	0	0		0	0	0.000***		0		0.001		0	0	0.000***
LD.WER			-0.001				-0.001				-0.001				-0.002	
LD.WROEA			0				0				0				0	
LD.WICR			-0.000***	0			-0.000***	0.002***		-0.001	-0.000***	0.003			-0.000***	0
N	48	38	571	38	48	38	571	38	48	38	571	38	48	38	571	38

Source: Author's own elaboration based on the LSEG Workspace.

Note: L, Life & Health Insurance; M, Multi-line Insurance & Brokers; P, Property & Casualty Insurance; R, Reinsurance. Notes: N - number of companies; t-test - student test results; *p<0.05; **p<0.01; ***p<0.001.

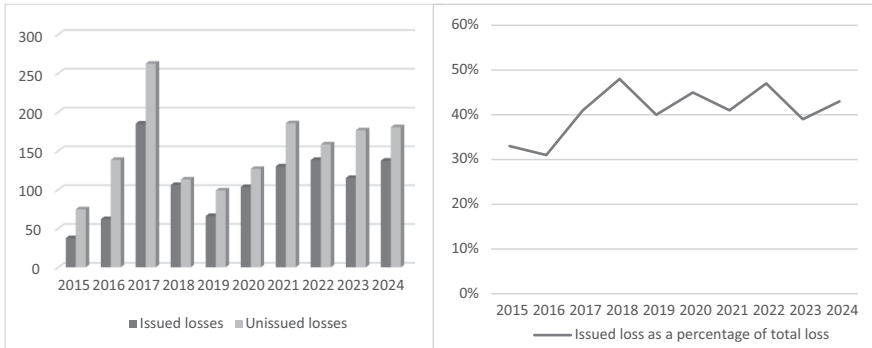


Figure 4.20 Global natural catastrophe insured and uninsured losses, share of insured losses (USD bn, 2024 prices).

Source: <https://www.swissre.com/institute/research/sigma-research/sigma-2025-01-natural-catastrophes-trend.html>

Another point pertains to the development of insurance products. A growing awareness of greenwashing has been observed (De Silva Lokuwaduge & De Silva, 2022). The aforementioned issues pose a challenge for providers of investment-based insurance products. Insurance companies can be assessed based on their own investment portfolio (liability matching) as well as by customers and shareholders. The analysis of the data presented by EIOPA illustrates natural catastrophes worldwide, highlighting the value of both insured and uninsured losses (Figure 4.20). In recent years, the value of catastrophes has remained consistent; however, a significant disparity in uninsured losses persists. This gap remains approximately 40–45%. It confirms the challenges concerning the impact of climate risk on the portfolio.

The examination of the increase in worldwide insured losses from natural catastrophes (Figure 4.21) reveals an increasing trend in this area. Most of the catastrophes are weather-related. Fewer of them are attributable to earthquakes. The current situation directly impacts the development of insurance products and trends in assessing climate risk associated with the policies offered. The analysis of their value trends indicates that the mentioned catastrophe losses are more often insured. The direct impact on the presented situation also corresponds to the amount of loss from each policy. The frequency of natural catastrophes has increased over the last 30 years (Figure 4.22).

The instrument to reduce or manage the catastrophe risk is **catastrophe bonds (CAT bonds)**. They are used by insurance companies to reduce the aforementioned risk and transfer part of it to investors, who seek potential gains if such events do not occur. They are classified as high-yield debt instruments and are designed to raise money for insurers, helping them pay claims in the event of a natural disaster or catastrophe. Their function was related to the rising catastrophic risk and ensuring the stability of insurance markets. The rise in both the number and severity of these catastrophes increases the risk for

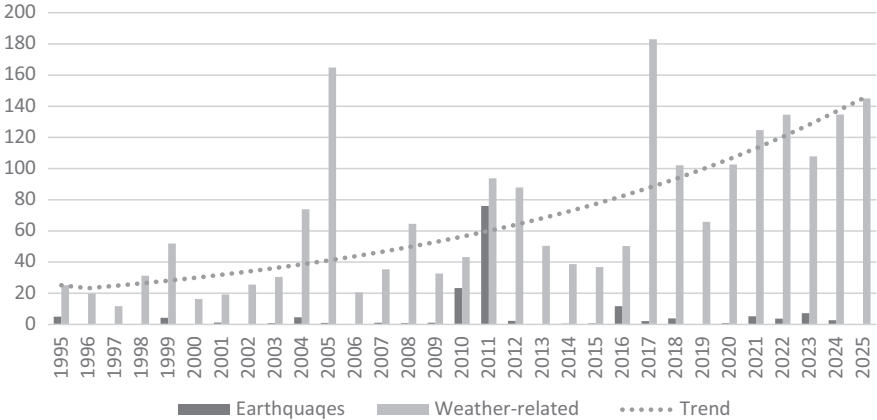


Figure 4.21 Growth in global insured losses from natural catastrophes (USD bn, 2024 prices).

Source: <https://www.swissre.com/institute/research/sigma-research/sigma-2025-01-natural-catastrophes-trend.html>.

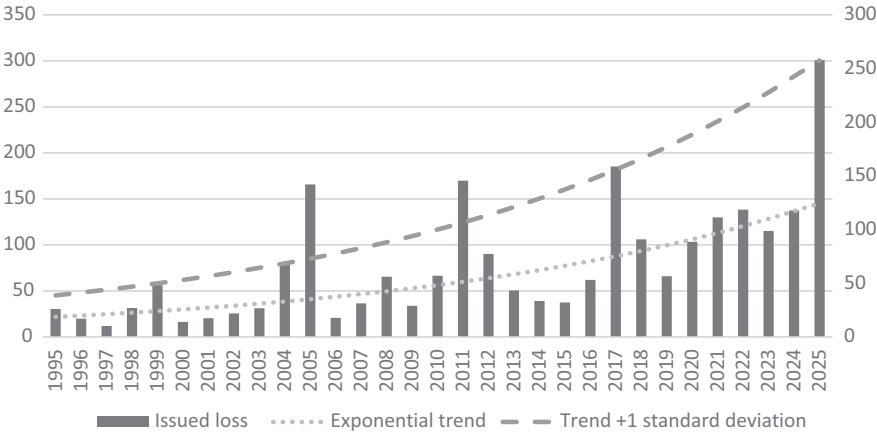


Figure 4.22 Trend in global natural catastrophes insured losses (USD bn, 2024 prices).

Source: <https://www.swissre.com/institute/research/sigma-research/sigma-2025-01-natural-catastrophes-trend.html>.

investors. They help the insurance companies to spread the risk beyond traditional players. Considering it as a sort of “reverse insurance”—instead of paying premiums to receive protection, investors receive premiums for providing protection. The risk for investors is the potential loss of their investment if a specified catastrophic event occurs before the bond matures. CAT bonds work through a special purpose vehicle (SPV) that acts as an intermediary between the sponsor (usually an insurance or reinsurance company) and investors. The

sponsor pays premiums to the SPV, while investors contribute their principal to the SPV, which typically invests in safe, short-term securities (like the US Treasury). If a triggering catastrophe does not occur during the bond's term (most bonds have a three-year maturity period), investors receive their principal back plus interest payments that are higher than traditional bonds. However, if the catastrophe happens, the sponsor can withdraw funds from the SPV to pay insurance claims, and investors may lose some or all of their principal. The following are a few forms of CAT bonds:

- Indemnity triggers: Based on the sponsor's actual losses (e.g., if an issuing insurer's claims exceed 1 USD bn).
- Industry loss triggers: Based on industry-wide losses from an event (e.g., if total insurance industry losses exceed 10 USD bn).
- Parametric triggers: Based on a single, objective measurement, like earthquake magnitude or hurricane wind speed.
- Modeled loss triggers: Based on computer-modeled loss projections from multiple parameters from the actual event.

CAT bonds are a great tool for reinsurance and help to transfer specific risks. They do not correlate with the business cycle and can react in the opposite direction during a financial crisis. They pose some categories of risks. The initial concern is related to the potential loss if the event occurs. The other risks are related to:

- Climate change risk related to the increase in the value and number of catastrophes;
- Model risk, which means that models do not estimate the probability and size of the catastrophes;
- Complexity risk related to problems with the valuation of these instruments;
- Liquidity risk and problems with the illiquidity of the secondary market;
- Basic risk for insurance companies that use non-indemnity triggers (like wind speed during hurricanes), where the payout might not match actual losses.

The first CAT Bond exchange-traded fund (ETF) was announced in the first quarter of 2025 by Brookmont Capital Management LLC, managed by King Ridge Capital Advisors Inc. It includes a portfolio of up to 75 catastrophe bonds from the estimated 250 in circulation.

The analysis of the catastrophe bonds and their rates of return in comparison to the other bonds is presented in Figure 4.23, which indicates that the Swiss Re Global Cat Bond Total Return index in 2024 generated a 17.3% return. The elevated investor demand ahead of the maturity of 3 bn USD bonds and coupon payments led to a tightening of secondary risk interest spreads, contributing to a strong start of the year for the performance of the index. In the second year, the lower-than-expected impact of Hurricanes

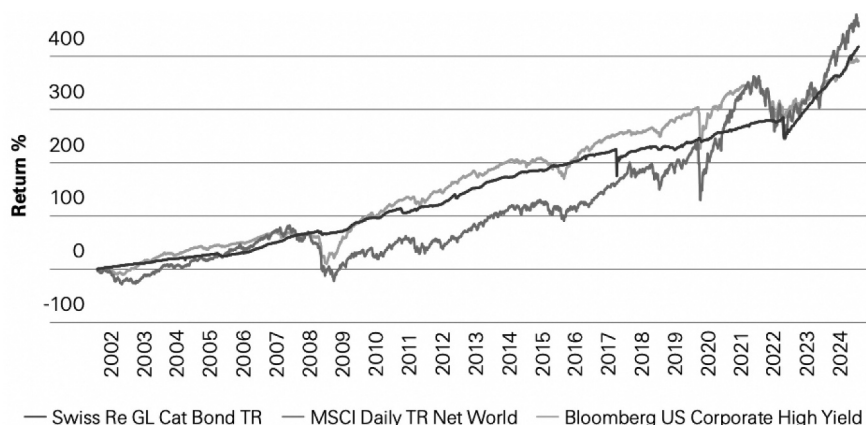


Figure 4.23 Swiss Re Index Comparison.

Source: Swiss Re Capital Markets and Bloomberg LP as of December 31, 2024.

Note: Swiss Re Global Cat Bond TR (SRGLTRR Index), Bloomberg US Corporate HY (LF98TRUU Index), MSCI Daily TR Net World (NDDUWI Index). Swiss Re Cat Bond Indices are based on indicative pricing only.

Helene and Milton, the strong capital position, and the benign loss activity across the first half of the year led to a global tightening of risk interest spreads in the secondary market. This created a positive mark-to-market gain, which, combined with coupon returns, allowed the index to achieve a 10.9% return over the period. These are far higher than traditional high-yield fixed-income investments, with US high-yield corporate bonds returning about 8% and 13% during the same period.

By prioritizing ESG considerations, insurance companies can improve their financial performance, reputation, and access to capital, as investors are focusing on companies that demonstrate strong ESG credentials (Dimson et al., 2020). Because of the nature of the insurance sector, ESG risk has a significant impact on the stock prices of insurance companies. It is confirmed by previous analyses of the impact of ESG scores and ratings on the stock prices and investment decisions (Saci et al., 2024; Wang & Gualberto, 2024). Di Tommaso and Mazzuca (2023) analyzed the changes in the ESG measures on the stock prices of the European companies from the insurance sector. They found a significant positive impact on increasing the ESG ratings on stock prices, and a negative relationship in the case of a decrease in the ESG ratings. Jareño et al. (2024)), by using the wavelet analysis methodology, examined the pairwise time-frequency connectedness and lead-lag relationships between ESG rating changes and insurance equity portfolios' risk exposure. They found that ESG upgrades affect portfolio risk exposure, suggesting potentially higher returns but also higher total volatility. Measures related to the E factor, which reflects the special activities of insurance companies, and the physical risks associated with global warming, can have a particularly significant impact (Wang & Kutun, 2013; Ferreira & Karali, 2015).

Measuring ESG Risk in Insurance Policies: Tools and Challenges

Institutions should consider the impact of ESG risks on all traditional financial risk categories to which they are exposed, including credit, market, liquidity, operational (including litigation), reputational, business model, and concentration risks. Thus, they use quantitative and qualitative information. Institutions should consider a sufficiently broad range of environmental factors, including, at a minimum, climate-related factors, ecosystem degradation, and biodiversity loss. They should assess transition and physical risk factors. The first step in considering climate change risks within the ORSA is assessing materiality. To conclude that climate change is not a material risk, they should explain this conclusion. Supervisors should expect undertakings to identify the materiality of their climate change risk exposure through a combination of qualitative and quantitative analyses. In practice, the assessment steps are as follows:

1. Define the context in which the insurer is exposed to climate change risks, including the description of the affected lines of business and/or insurance business, the considered time horizon, and the strategic context.
2. Examine the potential impact of climate-change-related risks on exposure and distinguish between transitional and physical risks. Discuss the potential impacts, such as on insurance products or balance sheets.
3. Assess the materiality of each climate-change-related risk on both sides of the balance sheet. Materiality considers the company's exposure, the impact of climate change on that exposure, and the probability of that impact. Materiality assessment is summarized in a materiality matrix.

Three dimensions should be considered for assessing materiality: impact, probability, and time horizon. Considering the impact of climate change and its associated probability across different time horizons is important because climate change has different effects over time. Companies should consider the impacts of climate change beyond a typical short-term horizon. Furthermore, some climate-change-related risks materialize in the short term. Companies can use the results of climate change impact analysis and present them in a materiality matrix. This allows them to observe how risks evolve over time and over which time horizons they become more significant. Moreover, this provides a forward-looking perspective.

Mapping climate-change-related risks (physical or transitional) and the aspects they effect on the balance sheet can be done using a materiality matrix and presented in terms of impact and probability of occurrence. Companies may choose to present the analysis at a more detailed level (e.g., flood risk in Germany instead of physical and groundwater risks).

ESG risks can vary by country, geographic location, insurance activity, time period, and other factors. Insurance companies can assess ESG risks and modify them using the heat maps, such as those presented by PRI in Appendix 1 and 2. These maps are modified according to the risk appetites, assessments, and portfolios. Decision processes are related to this risk, and each company

decides which risks should be focused on. ESG issues may or may not be regulated, but pose reputational or ethical challenges for insurance organizations. It is crucial to engage underwriters and stakeholders who are exposed to ESG risks to develop internal processes. As insurers are also institutional investors and some operate investment management businesses, ensuring consistency in the management of ESG issues across insurance and investment activities is important. ESG data providers are increasingly assessing insurers' performance in various fields. From an ethical perspective, risk appetite often stems from the culture and norms of an organization's home country. The host country's location determines the set of ethical principles that investors, retail clients, and/or the public expect from companies in other countries or business lines. Simultaneously, each organization must consider its financial and strategic goals and conduct a cost-benefit analysis. Some ESG risks are regulated (e.g., the UK Modern Slavery Act), whereas others are increasingly recognized as potentially financially significant (e.g., climate change, ecosystem degradation, and pollution) and may require a more rigorous response. This must be considered to ensure the adequate detection of ESG risks that a company is unwilling, unable, or unwilling to avoid. Ultimately, each company must decide how to achieve these goals. When implementing an ESG approach, existing insurance portfolios are highly likely to contain ESG risks. Proactive portfolio reviews determine exposure or enable the review of ESG factors during the policy renewal process. For long-standing clients, an engagement-based approach is preferable when ESG issues are identified.

The topic of discussion often revolves around whether the country in which a risk occurs influences the scale of ESG risks. This can influence, for example, whether human rights risks are more likely to occur or whether environmental regulations are actively enforced. Many organizations establish lists of high-risk countries for certain types of insurance (e.g., credit and surety).

Companies should consider at least two long-term climate scenarios (considering significant climate change risks), where applicable:

- A climate change risk scenario in which the global temperature increase remains below 2°C, preferably no more than 1.5°C, in line with EU commitments.
- A climate change risk scenario in which the global temperature increase exceeds 2°C.

The following analyses consider short-term scenarios because they are relevant to companies. Transition scenarios define different views on the future decarbonization of the economy and related trends and are used in the context of transition risk modeling. The selection of such scenarios involves the following steps:

- 1 **Determine general scenario requirements.** Transition risk assessments require specific scenarios that reflect transition trends. These include the energy

technology scenarios developed by the International Energy Agency and other modeling agencies. Then, these scenarios are enriched (next step) to provide information on the transition risk assessment.

- 2 **Define required scenario parameters.** After selecting the scenario type, the second step is to define the specific scenario parameters. Specifically, the key parameters include the following:
 - a Macroeconomic trends (e.g., GDP, inflation, and other potential economic shocks)
 - b Policy costs and incentives (e.g., feed-in tariffs and carbon tax)
 - c Market prices (e.g., oil and gas prices and battery costs)
 - d Production and technology (e.g., oil extraction, energy generation, and electric vehicle sales)
 - e Legal and reputational issues (e.g., litigation costs and reputational shocks)
- 3 **Select the scenario ambition.** Risk management requires future consideration. Therefore, climate transition scenarios encompass varying levels of ambition and approaches to achieve this goal. The most important scenario types include “business as usual” (e.g., 6°C warming), “mild decarbonization” (e.g., 3–4°C warming), or “ambitious decarbonization” (e.g., 2°C warming or less). Each of these scenarios has a different probability of achieving a specific range of warming.
- 4 **Choose the scenario pace.** Finally, one key distinguishing feature of scenarios is the assumption regarding the pace or “disruptiveness”/non-linearity of the transition. This element is important for risk assessment because abrupt, rapid effects are likely to pose greater risks than “mild” transitions.

Climate change scenarios examine the possible consequences of human activities on the climate in the context of various changes in socioeconomic systems.

First, “Representative Concentration Pathways” (RCPs) were developed to describe the different levels of greenhouse gases and other radiative forcing that could occur in the future. Four pathways were developed, covering several forcing in 2100 (2.6, 4.5, 6.0, and 8.5 watts per square meter); no socioeconomic “narratives” were included. IPCC RCP Description:

- RCP8.5 is a high-emissions scenario consistent with a future scenario without policy changes to reduce emissions and is characterized by rising greenhouse gas emissions, leading to high atmospheric greenhouse gas concentrations. It is broadly consistent with a current policy or “business as usual” scenario.
- RCP6.0 is a high-to-medium emissions scenario in which greenhouse gas emissions peak around 2060 and then decrease throughout the rest of the century.
- RCP4.5 is an intermediate emissions scenario consistent with a future in which relatively ambitious emission reductions and greenhouse gas emissions increase slightly and then begin to decline around 2040. Despite these

ambitious emission reduction efforts, RCP4.5 falls short of the 2°C limit/1.5°C target agreed upon in the Paris Agreement. This is broadly consistent with the greenhouse gas emission profile that arises from implementing the 2015 NDC (by 2030), followed by a rapid peak and subsequent 50% reduction in global emissions by 2080.

- RCP2.6 is the only IPCC scenario consistent with the 2°C limit/1.5°C target declared in the Paris Agreement. This RCP is consistent with ambitious greenhouse gas emission reductions that peaked around 2020, decline linearly, and become net-negative by 2100.

In addition, “Common Socioeconomic Pathways” (SSPs) are developed to model changes in socioeconomic factors over the next century. SSPs analyze five ways in which the world evolves without climate policy and how different levels of climate change mitigation are achieved by combining RCP mitigation targets with SSPs (Riahi et al., 2017). They were originally published in 2016 but are only now being used in the next round of climate modeling, known as the Coupled Model Intercomparison Project, version 6 (CMIP6), for the IPCC’s Sixth Assessment Report (IPCC, 2021).

The NGFS has developed a set of transition pathways that are particularly relevant to climate change risk.

- **Early Policy Action.** An orderly transition scenario in which the transition to a carbon-neutral economy begins early and global temperature increases remain below 20°C, consistent with the Paris Agreement. In this scenario, physical and transition risks are minimized.
- **Late Policy Action.** A disorderly transition scenario in which the global climate target is achieved, but the transition is delayed and requires more severe measures to compensate for the late start. In this scenario, physical risks emerge more quickly in the early phase, and transition risks are particularly pronounced compared with the Early Policy Action scenario.
- **Too Little, Too Late Scenario.** Physical risks stimulate a disorderly transition but are insufficient to achieve the Paris Agreement goals. Physical and transition risks are high and severe.
- **A “business as usual” scenario,** with no additional policy action (a “hot water world”), in which no previously announced policy actions are implemented. Therefore, the transition is insufficient to achieve the Paris Agreement climate goals, and physical risks are particularly pronounced.

Different greenhouse gas emission pathways engender different physical risks. A climate change scenario, based on the selected RCP model as input, describes changes in the climate system and its variables, such as temperature, wind, and rainfall, over a given time horizon and geographic area.

General circulation models (GCMs) are used to transform greenhouse gas emission pathways into physical risks. A GCM is a numerical representation of a climate system, its components, and their interactions. This approach is

Table 4.9 Impact of climate risks on financial indicators of insurance companies

<i>Type of indicator</i>	<i>Indicator</i>	<i>Type of climate risk</i>
Balance sheet	Solvency Capital Requirement	Physical and transition
	Excess of Assets over Liabilities (change of)	Physical and transition
	Asset over Liabilities (change of)	Physical and transition
	Stressed value or price change for each of the identified assets	Only transition
Profitability	Relative change of total technical provisions	Only physical
	Loss ratio	Only physical
	Overall impact on the firm's profit and loss	Physical and transition
Technical	Gross/ceded/net aggregated losses	Only physical
	Main Exposures (Sum Assured)	Only physical
	Total assets subject to transitional risks	Only transition
	Annual Probability of occurrence	Only physical
Direct	GHG emissions of Investments	Only transition

Source: EIOPA (2022).

primarily based on the laws of physics. Therefore, a GCM simulates future climate change based on RCP models used as input assumptions. The results include changes in rainfall and extreme events. The document “Methodological Framework for Insurance Stress Testing – Climate Change Component” (EIOPA, 2022) presents a list of indicators (physical risk, transition risk, or both) to provide a comprehensive picture of the main risk factors influencing the impact of selected scenarios on specific areas. To assess the impact of a scenario depending on the type of risk being assessed (physical, transition, or both), a set of indicators based on key figures is considered. These indicators provide a comprehensive picture of the main factors influencing the impact of specific scenarios on balance sheet items, solvency, or other variables. The indicators are classified as balance sheet, profitability, technical, or direct. Table 4.9 summarizes the most important ones.

Challenges in ESG Risk Management for Insurance Companies

The EIOPA and other national supervisors focus on the problems related to ESG risk management. The analysis presented shows that most of these are related to problems in measuring ESG risks and collecting datasets. Most risks related to climate change are difficult to measure because of problems in predicting certain situations. In some regions, the probability of fire, windstorms, and earthquakes is higher; however, many regions that have not experienced natural disasters still witness climate events. Insurance companies face difficulty in estimating the probability of these events, which directly influences their financial conditions. The EIOPA, in its October 2025 climate reports,

states that ESG-related risks remain stable at a medium level, although the outlook for the next 12 months indicates an increase in risk.

The next aspect relates to the information in the SFDR. Information on the structure of green investments is mostly not published by ESG data providers. The EIOPA states that, in Q1 2025, the median exposure of insurers to green bonds, as a percentage of total corporate bonds, increased to 7.6%. Median exposure to climate-relevant assets decreased slightly (from 3.4% to 3.1% of total assets). This means that most insurance companies invest in green assets; however, it is difficult to assess which assets are green and which are not. This problem is observed in most countries, but not much in Europe.

The next problem concerns ESG scores and ratings. However, many firms do not publish their non-financial statements, which directly impact insurance companies' investment policies. This is related to the various regulations in this area. It is difficult to evaluate ESG risk in particular companies, and ESG ratings and scores are sometimes greenwashed. Furthermore, the estimates show that investors pay insufficient attention to the methodologies used by ESG data providers and overlook the scope of disclosure. Many insurance companies, especially those with global operations, do not have ESG scores or ratings due to insufficient data to assess ESG risks. The EIOPA suggests that the median ESG rating for European insurers in the sample remains unchanged, according to the latest available data for 2023, with positive developments in environmental ratings and an overall unchanged picture for social and governance ratings. In recent years, ESG risk measures have been developed, and, therefore, ESG scores and ratings react slowly to the mentioned changes; most exhibit a lagged character.

The ORSA shows that ESG risks, especially climate risk, affect companies' financial conditions. Consequently, analyzing and observing ESG risks are important. This study confirms the impact of ESG risk on insurance companies' investment policies, particularly in Europe. This is due to current changes in regulations and increasing climate risk. An increase in the ESG score reduces the solvency margin. It means that these insurance companies are threatened as a safer.

The results confirm that geographical bias influences the ESG risk measurement and capital levels of financial institutions—in this case, insurance companies (H2). Size bias affects ESG risk measurement and capital adequacy (H3). The size of the company does not have a statistically significant effect on changes in the solvency margin; however, it affects investment decisions and is significant for analyzing its structure. This means that an increase in institutions directly affects the increase in the investment ratio. Sectoral bias affects ESG risk measurements and capital adequacy (H4). The presented analysis confirms different results and varying significance of ESG scores across particular types of insurance companies' activities. These effects confirm the significance of introducing new regulations in this area that are specific to particular types of activities.

An analysis of non-financial reports confirms that ESG risk influences product type. Insurance companies offer discounts on premiums for electric cars and greenhouses because they reduce the impact of climate change, fires,

and other cases. It is directly related to building a green portfolio of policies, a directly impacting solvency measures such as SCR.

ESG regulations are primarily focused on climate risk for insurance companies; however, most are similar to those presented for banks. The aforementioned situation shows that both markets recognize this risk as significant for their activities.

Conclusions

Current regulations and the activities of supervisory institutions compel insurance institutions to address climate threats. Furthermore, they encourage them to conduct ongoing sector analyses for responsible goals related to insurance and investment activities. In recent years, significant changes in the perception of sustainable development have been observed in the European market. Current COP meetings encourage increasing intervention in the economy and motivating countries and, therefore, institutions to mitigate climate risk. Simultaneously, current actions by US authorities exclude companies from activities that uphold the principles of the Paris Agreement. Therefore, the need to assess ESG risk is excluded. This is observed in the current regulations and initiatives. Additionally, this applies to insurance institutions regarding their investment policies.

American insurance institutions assess climate risk, which is primarily observed in the exclusion or limitation of insurance coverage or the non-insurance of certain assets in areas with varying flood, earthquake, or wildfire hazards. Therefore, climate risk affects capital requirements but does not impact investments. In Europe, a lower impact of the ESG risk ratio on capital requirements is observed, which is related to lower risks in this area and the different nature and concentration of the sector. Meanwhile, the impact of ESG risks and their changes on investment policies is observed in Europe. Therefore, the impact of climate risk on insurance companies' operations is particularly significant and provides answers to the research questions.

The market analysis indicates that the impact of new ESG regulations on local markets is lower for insurance sector participants in Europe in the near future, owing to new legislative packages. The green bond market enjoys relatively moderate interest, with green bond yields of 7–8% and green asset yields of approximately 4% in Europe, not among the highest. Investment and demand for such products are low.

Early action to protect against climate risk promotes financial stability, helps companies develop appropriate products for customers, and mitigates risks.

The European Union regulations are shaping the financial market and, in the coming years, will be crucial for ESG investments. The need for dialogue between investors and businesses will grow, and the quality of reported ESG information will increasingly determine access to capital. This will indirectly support the transformation of the entire economy toward a sustainable development approach, increasing the business attractiveness of the entire region.

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5 ESG Risk Regulations and Financial Markets

Regulatory Changes and Bond Market Reactions

The impact of sustainable development regulations on the green bond market is significant in several respects. First, the importance of regulatory oversight and transparency in the green bond market should be emphasized, as it supports genuine green investments while limiting potential abuses. Given that the certification process for bonds is a crucial aspect of the bond market, introducing regulations for green bonds can increase investor confidence and help direct capital to high-impact sectors, where it can have the greatest impact on reducing pollution. Therefore, certification can play a significant role in achieving environmental goals and supporting the credibility of climate-focused investments. Research indicates that reliable certification and verification mechanisms, a standardized reporting framework, and transparent guidelines can foster the development of the green bond market (Bachelet et al., 2019; Cheong & Choi, 2020; Li et al., 2020a). The new regulatory changes influence greenium, such that as their significance and value increase, the scope of greenium also increases (Chodnicka-Jaworska, 2025). More specifically, Dragotto et al. (2025) showed that the greenium is closely correlated with significant changes in climate change policy, indicating that in the months following the 2015 Paris Agreement, greenium widened from an average of 2 basis points to almost 15 basis points, representing 19.76% of the average yield spread in the sample.

Another factor contributing to the growing interest in green bonds, despite the same cost of financing, is government policies and regulations that promote sustainable finance and provide incentives for green bond issuance. This, in turn, fosters market growth (Saravade et al., 2022; Tolliver et al., 2019). Among the instruments identified to encourage investors, tax incentives, subsidies, and guidelines for green finance can be distinguished, all of which contribute to increased issuer interest and investor confidence in the market. For example, Fiorillo et al. (2024) found a direct positive impact of regulatory policies regarding green bonds on issuance volume, with additional analyses demonstrating that specific issuer characteristics, such as ownership type (government ownership), industry type (green industry), and sector type (financial issuer), are more responsive to policy announcements and lead to the issuance

of more green bonds. Therefore, stringent regulations have a positive and statistically significant correlation with green bond market growth, with policies targeting emissions in specific economic sectors having seen the largest increase in green bond issuance.

Still, regulations regarding sustainable investment remain highly volatile, as seen in US President Donald Trump's decision to withdraw from the Paris Agreement in January 2025. This intensified political uncertainty over decisions on green securities and sustainable investment market growth, motivating investors to diversify their investment portfolios through optimization. According to the rational investor principle, they should choose securities with higher interest rates and similar risk levels. At the same time, some financial institutions, such as green investment funds, have investment strategies that cannot be easily changed, which can positively contribute to investment stability in existing securities but may negatively constrain the growth of new green or sustainable investment funds.

Importantly, the aforementioned lack of policy stability regarding green securities, including bonds, can increase market **uncertainty**, including in the bond market, and lead to a shift toward traditional bonds. The type of market is also important in this case. For instance, the European green bond market will react differently from the US market, owing to the continued sustainable investment policy in Europe. Notwithstanding, the geopolitical situation and risks in Europe may negatively impact green bond prices, as continent's uncertainty affects investor confidence. Importantly, the largest green bond market is in Europe, and this uncertainty leads to increased investor caution and risk aversion (Adebayo et al., 2022; Rumokoy et al., 2023), resulting in a decreased demand for bonds. Investors tend to be pessimistic about adopting riskier strategies (He, 2023), while increased geopolitical risk, including regulatory instability, may contribute to bond market volatility owing to increased investor caution (Bhatia, 2019) and sentiment (Hailemariam et al., 2019; Lee et al., 2021).

The bond market's connection to **environmental policy and regulations** is also significant. Hachenberg and Schiereck (2018) argued that green bonds, owing to their close links to environmental policy and regulations, are more susceptible to geopolitical tensions. Meanwhile, geopolitical risks can influence environmental policy and regulations, directly impacting green bond values (Doğan et al., 2023), as rising geopolitical risk can lead governments to consider green investments as less important for the functioning of the economy. Uncertainty, whether regulatory or geopolitical, discourages international investors from investing in green bonds, leading to reduced liquidity in green bond investments (Ballouk et al., 2023) and impacting investor confidence in the market (Falcone, 2020). What this suggests is that uncertainty in international capital flows caused by regulatory risk may limit the **growth perspectives of the green bond market** (Iyke et al., 2022), as well as impact bond prices.

From a rational investor's perspective, it is important to assess the returns of investing in green bonds. Some studies indicate that green bond investment

not only offers high returns but also improves environmental performance (Baker et al., 2018; Flammer, 2020; Zerbib, 2019), and that green bonds are considered more stable during times of **geopolitical uncertainty** (Kanamura, 2020; Li et al., 2023; Li & Cheng, 2024). Green bonds also outperform conventional bonds in terms of environmental and social impact, attracting more environmentally conscious investors (Guo & Zhou, 2021) and contributing to portfolio diversification (Huynh et al., 2020). Dragotto et al. (2025) pointed out that the election of US President Donald Trump and his subsequent decision to withdraw the United States from the Paris Agreement coincided with a period of gradual decline and eventual disappearance of green bonds. This shows that the US withdrawal and policy change in this area can contribute to the same investor returns from conventional bonds as from green bonds. This entails that green bonds are also conditioned by changes in investor demand.

Notably, the cost of capital plays a key role in green bond market growth (Agliardi & Agliardi, 2019; Zhang et al., 2021), such that if the cost of issuing green bonds is comparable to or lower than that of conventional bonds, this encourages issuers to use the green bond market to finance environmentally friendly projects. This suggests that the demand for green investments from institutional investors, asset managers, and individual investors may fuel the growth of the green bond market (Sangiorgi & Schopohl, 2021; Tang & Zhang, 2020).

Seltzer et al. (2022) indicated that companies with unfavorable environmental profiles have higher yield spreads, particularly when regulatory enforcement is more stringent and climate-related risks are present. Therefore, green bonds, as financial instruments with a significant environmental component, may exhibit lower yield spreads during significant climate events. Moreover, Umar et al. (2024) demonstrated a link between total return and bond market volatility, highlighting that volatility increased significantly in response to major systemic events, such as the 2008 crisis, the European sovereign debt crisis, the Paris Agreement on Climate Change, Trump's presidential election victory, the COVID-19 pandemic, and the Russia–Ukraine war. These findings corroborate the impact of policy volatility on green investments in the United States. Consequently, geopolitical events and regulatory changes can drive market volatility and increase uncertainty, affecting bond yields, prices, and overall market sentiment (Doğan et al., 2023; Dong et al., 2023; Sohag et al., 2022; Tang et al., 2023).

Additionally, changes to sustainable finance regulations may not have an immediate, linear effect on the bond market. Mertzanis and Tebourbi (2025) suggested that this situation occurs amid geopolitical risk situations, denoting delays in investors' recognition of new opportunities arising from changes in risk, as well as differences in the types of risks that materialize, the maturity of the green bond market, and the impact of specific events such as natural disasters or public health crises. According to some studies, geopolitical risk and uncertainty are broad, complex factors that may influence the growth of the green bond market (Alsagr et al., 2023; Caramichael & Rapp, 2022). Analyzing

the impact of regulatory risk on the green bond market compared to conventional bonds, the conclusion that begets is that the differences stem from the nature of green investments, the investor base, and global policies regarding sustainable development (Hachenberg & Schiereck, 2018). In fact, green bonds are often more directly affected by changes in environmental policies and regulations, which can be influenced by geopolitical tensions (Doğan et al., 2023; Lee et al., 2021). Green bonds attract a global group of investors who are particularly interested in environmental sustainability (Ballouk et al., 2023; Banga, 2019), and their investments are driven by the aforementioned tax breaks, incentives, and legal requirements. Therefore, regulatory uncertainty may discourage issuers from entering the market or cause delays in issuance, while investors fearing unpredictable policy changes, especially those affecting green investments, may be hesitant to engage in the green bond market. Past literature indeed unveils that the anticipation of regulatory instability may lead investors to adopt a more cautious approach, reducing their risk appetite (Das et al., 2019), and that the positive impact of environmental regulations on incentives for green financing typically occurs through a path-dependent process (Hafner et al., 2020).

It is important to note that green bond issuance is driven not only by domestic but also by foreign regulations, with European regulations having a particularly significant global impact (Redondo Alamillos & de Mariz, 2022). The consequences of global regulations play a key role in supporting green bond adoption, largely owing to market cointegration. However, no studies have yet been conducted on the impact of US President Donald Trump's policy decisions on the European green bond market, including its volume and size. Sheenan (2023) found that in periods of high volatility, geopolitical risk significantly affects green bonds, but does not do so in conventional bond markets. Green bond markets are significantly affected by sovereign and corporate bonds in both regimes, with stronger effects from corporate bonds evident during periods of high volatility. This suggests that green bonds behave differently from conventional bonds and may be more susceptible to geopolitical risk and contagion.

The described literature review suggests that the changes in ESG risk regulation influence the greenium and the size of the green bond market (H5). Most green bonds are issued by financial institutions. Issuing large bonds by SPVs creates a problem related to the estimation of the greenium because of the lack of data for the conventional bonds. The next problem is related to the homogeneity of the market, related to the characteristic features of the bond, i.e., tenor, issuer currency, level of coverage, value of credit ratings, type of the issuer, region, etc. For the analysis, the greenium, the daily yields, issuance data, and mentioned characteristics of both green and conventional bonds issued in euros from LSEG for 2015–2025 were collected for the European and US markets. For estimating the bond's yield curve, the Nelson-Siegel- Svenson model has been used, according to the presented formula:

$$r(T) = \beta_0 + \beta_1 \left[\frac{1 - \exp\left(-\frac{T}{\lambda_0}\right)}{\frac{T}{\lambda_0}} \right] + \beta_2 \left[\frac{1 - \exp\left(-\frac{T}{\lambda_0}\right)}{\frac{T}{\lambda_0}} - \exp\left(-\frac{T}{\lambda_0}\right) \right] \\ + \beta_3 \left[\frac{1 - \exp\left(-\frac{T}{\lambda_1}\right)}{\frac{T}{\lambda_1}} - \exp\left(-\frac{T}{\lambda_1}\right) \right]$$

where $\beta_0, \beta_1, \beta_2, \beta_3, \lambda_0$ and λ_1 are the constant parameters, and T is the time to maturity in annual units. The effect of estimation for the US and European markets for the financial institutions has been presented in Figures 5.1 and 5.2.

At first, it can be observed that the impact of the changes in regulations on the bond market and greenium. It is related to the interest of financial institutions. If a demand for green bonds is observed, due to regulations related to ESG risk management and the need to estimate ESG risk for capital adequacy, an increased trend in issuing green bonds is noticed. The greenium is also strictly related to the “add-on” in ESG risk estimation for the capital adequacy. If the “add-on” is higher, the greenium may increase. The described indirect reaction

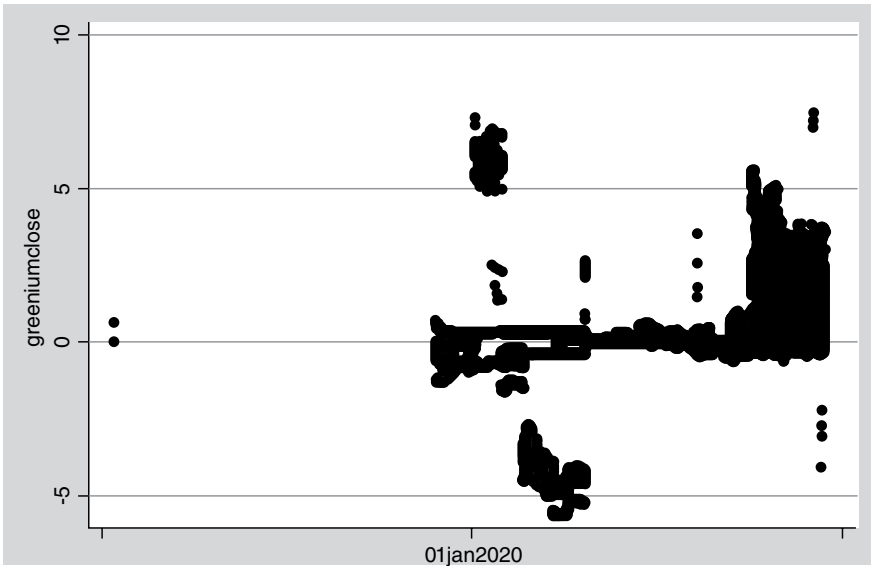


Figure 5.1 Greenium in the European market for financial institutions.

Source: Author's own elaboration based on the LSEG Workspace.

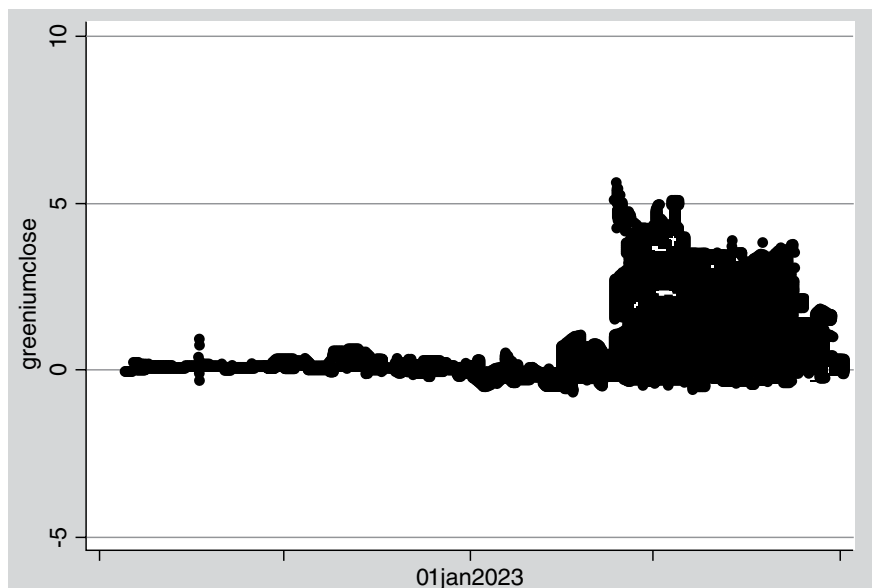


Figure 5.2 Greenium in the US market for financial institutions.

Source: Author's own elaboration based on the LSEG Workspace.

is evident in the US market. The United States' withdrawal from the Paris Agreement and decision not to implement the ESG risk measures during the estimation of the capital adequacy caused the demand for green bonds to be lower. The lower interest on the green bonds creates pressure for a similar premium from new green and brown bonds; as a result, the greenium decreases. The opposite situation is observed for the European market. Current regulations, like CRR3, CRD6, and revised Solvency II, put pressure on financial institutions to estimate ESG and climate risks in their capital adequacy measures. One of the safe investments with a lower level of ESG risk is green bonds. It is a reason why the greenium on the bond market in Europe is still observed. This study shows that it increases the geographical bias between the European and US markets, which is an effect of changes in regulations. It also confirms that the changes in ESG risk regulation influence the greenium and the size of the green bond market (H5). The future reaction of the European market will be a result of the value of “add-ons” created by European supervisors and regulators.

Regulatory Changes and Stock Market Reactions

The existing literature suggests that stock markets may react to regulatory change announcements. According to the efficient market hypothesis, stock prices may react to new information available in the market, including environmental regulations, albeit studies on this topic in relation to green bonds remain scarce or highly localized. This means that there is still much

uncertainty about the impact of implementing environmental regulations on short- and long-term firm performance, especially in consideration of the varying nature of these regulations across industries, which then leads to mixed results (sectoral bias, geographic location bias, and size bias) in relevant studies. This inconsistency in the available evidence may also be related to the number of regulations presented, as the more regulations there are, the more investors may become accustomed to the current situation and react more limitedly to the changes. While there is emerging research on the impact of environmental regulations on various stock markets, such as those in France, the United States, China, Germany, Italy, and Singapore (Lena et al., 2022; Pham, Nguyen, Ramiah, Mudalige, & Moosa, 2019a; Pham, Nguyen, Ramiah, Saleem, & Moosa, 2019b; Pham, Ramiah, & Moosa, 2019c; Ramiah et al., 2015a, 2015b), the impact of regional environmental regulations, such as the EU ETS and national environmental regulations, on risk and returns continues undocumented.

The importance of these environmental regulations and regulatory changes may stem from several aspects:

- According to neoclassical theory, stringent environmental regulations can negatively impact productivity owing to high investment costs and associated financial risks, as well as a lag effect on green investments, leading to investor conservatism (Chen & Ma, 2021).
- According to Porter's theory, effective environmental regulations can improve company performance by improving pro-environmental practices, which ultimately benefits both society and companies (Porter, 1991).

Accordingly, attention should be paid to the issue of **market overregulation or under-regulation**, as this seems to determine which of the aforementioned theories prevails. Researchers should further study **cost optimization**, referring here to whether marginal benefits equal marginal costs and whether they have a positive impact on productivity and competitiveness (Lena et al., 2022).

The stock market's reaction to changes in environmental regulations also depends on **investors' perceptions of companies** (Chen et al., 2023). If investors emphasize ESG activities as strengthening social capital and trust in the company, this leads to increased loyalty and a greater propensity to hold shares amid increased regulation (Cardillo et al., 2022). A different situation arises when investors perceive new regulations in this area as an increase in the company's operating costs. Various studies have examined the impact of environmental data disclosure on stock market behavior (Hamilton, 1995; Klassen & McLaughlin, 1996; Lanoie et al., 1998; Lorraine et al., 2004; Pham, Nguyen, Ramiah, Mudalige, & Moosa, 2019a; Pham, Nguyen, Ramiah, Saleem, & Moosa, 2019b; Pham, Ramiah, & Moosa, 2019c; Ramiah et al., 2013; White, 1995). More recent ones, like those by Ramiah et al. (2013) and Pham, Nguyen, Ramiah, Mudalige, and Moosa (2019a); Pham, Nguyen, Ramiah, Saleem, and Moosa (2019b); Pham, Ramiah, and Moosa (2019c), found mixed abnormal returns following environmental regulation announcements in various

countries. Ramiah et al. (2013) analyzed 19 environmental regulatory announcements for stocks listed on the Australian Stock Exchange between 2005 and 2011, while Yang et al. (2023) focused on how the Canadian stock market perceives and prices climate change mitigation policies. Engle et al. (2020) and Faccini et al. (2021) examined how stock markets price climate risk, while Borghesi et al. (2022) analyzed the behavior of green and brown portfolios in the context of environmental policy announcements (i.e., specifically GPAs) issued by major European governments in 2020. Pham et al. (2019b) examined the impact of the 2016 Paris Climate Agreement on the German stock market. These cited studies generally find that stock markets react negatively (positively) to announcements of unfavorable (positive) environmental news, and that companies with more robust environmental management experience higher stock returns and significantly positive abnormal returns.

Due to emerging pressures, or their lack thereof, manufacturing companies may react differently to changing market conditions. Investor expectations about these companies may change (Chen & Ma, 2021), which then leads to differential effects on sectors. This phenomenon was confirmed by Antoniuk and Leirvik (2024), who showed that different sectors experience unique effects stemming from environmental events, and that stock market investors also quickly adapt to new environmental information. The problem here is that these studies did not directly address laws and regulations, but rather the reactions of investors to market information. Meanwhile, Ramelli et al. (2021) assessed stock price reactions at both the industry and intra-industry levels, but reported mixed results. Pham et al. (2019a) examined the Singapore stock market at the sector level, finding that government-imposed environmental regulations and policies effectively achieve their objectives. Furthermore, Ramiah et al. (2016) examined abnormal returns on British stocks associated with the introduction of environmental regulations, while Li et al. (2020b) investigated whether and how the stock market reacts to environmental regulations in China. Overall, the market reactions in these studies are ambiguous, while cross-sectional tests show that stocks in polluting industries significantly underperform other stocks. Zeng et al. (2021) used an event study approach to examine the Chinese capital market's reaction to the implementation of CEPI, with one of their key findings being that CEPI causes negative capital market reactions owing to the environmental pressure it places on companies; that is, the capital market will experience significantly negative abnormal returns owing to the signals sent by CEPI.

Research on the European market also confirms this relationship. Birindelli and Chiappini (2021) examined whether the EU's climate change policies create or destroy shareholder value between 2013 and 2018. All sectors were affected by at least one climate policy announcement, with negative impacts being more frequent than positive, especially after the entry into force of the Paris Agreement. Similarly, Bratis et al. (2025) assessed the reaction of equity markets in the ESG and energy sectors of Germany, Italy, Spain, Sweden, the United Kingdom, Greece, the Netherlands, and Poland to earlier "unexpected" announcements (i.e., readiness to implement the European Green Deal through new environmental regulations, as well as the anticipation of costs and subsidies

for companies) at the European level. The cited authors also considered the timing of the European Commission's legislative proposal and the official national announcement (legislation), thereby constituting a progressive sensitivity analysis tracking the initial market reaction from the European to the national level. The analysis of individual countries revealed few statistically significant abnormal returns on the event date, but mainly cumulative abnormal returns showing a persistent trend. Furthermore, there is heterogeneity between the effects on the "green" ESG sector and the energy sector, and the European Commission's announcement was more important than the timing of implementation in national legislation. In another study, Mueller et al. (2023) used an event-study methodology to examine how European large- and mid-cap stocks reacted to both the leak of information about the European Green Deal 12 days before its official announcement and the formal announcement itself. They document significantly negative abnormal returns surrounding the leak and find that the subsequent official announcement – despite emphasizing financial support and a green-growth narrative – did not trigger any positive market reaction. Moreover, Gavrilakis and Floros (2024) analyzed the factor loadings of the CAPM, the Fama-French three-factor model (FF3), and the five-factor model (FF5) for European ESG leader index-based portfolios. Overall, the empirical evidence on the impact of green regulation announcements on stock markets is mixed; market-wide reactions vary in sign and magnitude, particularly owing to the aforementioned differences between sectors (Birindelli & Chiappini, 2021; Clarkson et al., 2015; Mueller et al., 2023; Ramiah et al., 2013).

Above, the impact of overregulation on the stock market was mentioned. Luger and Temkin (2000), in measuring excessive environmental regulation and defining "overregulation" as regulation that goes beyond what is necessary to achieve environmental or development goals, showed the impact of such overregulation on the stock market. Berg and Murn (2009) also found that increasing regulation increases administrative and compliance costs for 57 companies, regardless of their size.

Considering the evolving US policy environment regarding sustainable development, there are some related studies worth mentioning. Ramiah et al. (2015a) examined the relationship among capital markets, environmental regulations, and the Obama administration's political leadership in support of the implementation of green initiatives in the United States. Nerger et al. (2021) examined the industry-level stock market reaction to Trump's election, observing that while the coal industry experienced positive abnormal returns, other sectors experienced negative or mixed results. Moreover, Pham et al. (2023) demonstrated significant abnormal returns, volatility, and trading volume responses in US green firms from significant climate policy events, highlighting the importance of firm-specific factors.

Wei et al. (2025) analyzed the impact of the economic and political shock associated with Trump's election victory, finding that the US market reacted negatively to stocks with higher ESG scores during both events. Furthermore, they found that the economic shock did not significantly impact ESG returns on stocks held by institutional or retail strategic investors. In the case of the political shock, the reaction was observed primarily for stocks with higher

corporate governance scores, and the study demonstrated an impact of Trump's anti-ESG narrative on returns. Similar results were obtained by Cosma et al. (2025), who showed the significant impact of Trump's election: the worst short-term performance around the period of the election was attributed to companies with better environmental performance, which may indicate a correction in investor evaluation criteria due to President Trump's anti-climate policies, reduced transition risks for "brown" companies, and lower returns for companies with excellent environmental performance.

The studies cited above emphasize several research issues in this area. They depict a lack of comprehensive research on the impact of ESG policy changes on stock market returns, particularly for financial institutions, and a bulk of studies focusing on individual countries. There is also a dearth of thorough analyses of capital flows, with most analyses being historical in nature. Therefore, this study aimed to analyze the impact of political decisions related to sustainable development, including their announcements, on the financial sector in Europe and the United States. Specifically, it examined the impact of American policy changes, announcements, and the implementation of the EU level using the event-study methodology.

The analysis was prepared for three events:

- The US elections on November 5, 2024, when President Donald Jr. Trump was elected. This period was associated with campaign promises related to withdrawing from the Green Deal framework.
- The US withdrawal from the Paris Agreement on January 20, 2025.
- The presentation of the Omnibus proposal by the European Commission on February 26, 2025.

These three periods represent the most significant moments of the past two years, which reshaped the structure of green investment policies. The dataset was collected from the LSEG database and covers the period from 2024 through the end of 2025. The analysis focuses on changes in turnover and rates of return for all stocks listed on stock exchanges in Europe and the United States. The sample was divided into:

- Sectors: (1) academic and educational services, (2) basic materials, (3) consumer cyclicals, (4) consumer non-cyclicals, (5) energy, (6) financials, (7) healthcare, (8) industrials, (9) real estate, (10) technology, (11) utilities.
- Size: small and large companies were distinguished, where a large company is defined as one whose total reported assets exceed the mean in a particular country.
- ESG score: companies that received an ESG score from LSEG and those that did not.
- Scope: companies whose ESG score is based on the scope of disclosure (clean ESG score) and those whose score is not disclosure-based (green-washed ESG score).

The analysis has been made for the event window, which is the one day before the moment of publication of information plus three working days after. The research has not been prepared for the pre-event window and post-event window because of the high frequency of the events. Ten working days impact, after and before the event window, has been tested because of the character of the event. To the presented model have been used logarithm of daily rates of return on the stock prices and logarithm of turnover. As a basic model was used the market model described by the following equation:

$$R_{i,t} = \alpha_{i,t} + \beta_{i,t}RM_{i,t} + \varepsilon_{i,t}$$

where $R_{i,t}$ are the logarithmic rates of return on the stock prices of the company i in period t ; $RM_{i,t}$ are the logarithmic rates of return on the benchmark for the company i in period t .

$$\hat{R}_{i,t} = \bar{R}_{i,t}$$

$$\hat{\alpha}_{i,t} = \frac{1}{T-1} \left(\sum_{t=1}^{T-1} R_{i,t} - \hat{\beta}_{i,t} \sum_{t=1}^{T-1} RM_{i,t} \right)$$

$$\hat{\beta}_{i,t} = \frac{\sum_{t=1}^{T-1} (R_{i,t} - \bar{R}_{i,t})(RM_{i,t} - \overline{RM}_{i,t})}{\sum_{t=1}^{T-1} (R_{i,t} - \bar{R}_{i,t})(RM_{i,t} - \overline{RM}_{i,t})}$$

In the next step there were defined the abnormal stock rates of return on the stock prices as a difference between the real and the forecast value (limited by the information set in the estimating window Ω_{EW})

$$AR_{i,t} = R_{i,t} - E(R_{i,t} | \Omega_{EW})$$

The average abnormal rates of return during t period are estimated according to:

$$\overline{AR}_{i,t} = \frac{\sum_{t=1}^N AR_{i,t}}{N}$$

where N is the size of the research sample. The standard deviation $\hat{\sigma}$ is estimated by:

$$\hat{\sigma}_{AR} = \sqrt{\frac{1}{N-1} \sum_{t=1}^N (\overline{AR}_{i,t} - \overline{AR}_{i,t})^2}$$

Next, in the pre-event window, event window and post-event window were tested the hypothesis. To verify the hypothesis has been used the t-Student test.

$$t_{STAT} = \frac{\frac{1}{N} \sum_{t=1}^N AR_{t,t}}{\hat{\sigma}_{AR}}$$

The use of a more advanced model, considering the heterogeneity of the variance of the random component and the autocorrelation, would require a longer estimation window. The same type of model was prepared for turnover.

The market reaction to these three events varies across sectors, geographic locations, and the presence or absence of ESG scores and their quality (Table 5.1). In the case of the US election, the market anticipated the change of president before the official announcement of the results and reacted again afterward, mostly among large institutions that do not have ESG scores. This reaction was stronger for companies engaged in ESG-related activities with ESG scores, but it was also observed among companies that received greenwashed ESG scores. In Europe, the reaction was mostly observed during the post-event window. As a result, European companies, especially large ones, reacted negatively to the results mentioned, particularly among institutions without ESG scores. Among the institutions that received greenwashed and clean ESG ratings, no reaction was observed. The presented results show several findings:

- The US market discounted the effects of the election before and mostly after the announcement of the results. The results also suggest the possibility of instability in the financial market.
- In the United States, smaller companies with ESG scores reacted the most, but the effect was also significant for larger entities. As a result, this may be related to expectations of capital transfers to entities not connected with ESG activity.
- The size of the reaction also suggests that the market may place stronger emphasis on financial indicators than on non-financial measures. Initial decisions may be based primarily on financial performance, while non-financial activity becomes a secondary objective.
- The announcement of the US election affected the European market after the presentation of financial results. In the group of companies with ESG scores, both clean and greenwashed, the impact was not observed, but a reaction was noticed among large and small companies without ESG scores. This may indicate that the European market does not assess the impact of changes in US policy related to the green framework on the European market directly, but rather assesses the uncertainty in the relationship between these markets. This raises a question about capital transfers between the US and European markets as a potential effect of this decision.

Table 5.1 Impact of political decisions related with green policy on the rates of retruns on the stock market in Europe and in the United States.

<i>Economic</i>	<i>Europe</i>									<i>USA</i>								
	<i>Event window</i>			<i>Pre-event window</i>			<i>Post-event window</i>			<i>Event window</i>			<i>Pre-event window</i>			<i>Post-event window</i>		
	<i>_cons</i>	<i>t-test</i>	<i>N</i>	<i>_cons</i>	<i>t-test</i>	<i>N</i>	<i>_cons</i>	<i>t-test</i>	<i>N</i>	<i>_cons</i>	<i>t-test</i>	<i>N</i>	<i>_cons</i>	<i>t-test</i>	<i>N</i>	<i>_cons</i>	<i>t-test</i>	<i>N</i>
The US election																		
Lack of ESG Score																		
Large																		
1										0.106**	-4.51	9	0.140*	-2.64	9	0.00961	-0.65	9
2	0.00914	-0.79	14	0.0223	-1.53	14	-0.0312*	(-2.38)	14	0.0587	-1.14	21	-0.241	(-1.00)	21	-0.0129	(-1.03)	21
3	0.00913	-1.9	89	-0.0144	(-1.30)	89	-0.0141	(-1.78)	89	0.0252***	-4.2	244	-0.0066	(-0.53)	244	-0.0308	(-1.84)	244
4	0.0247	-0.99	94	-0.00117	(-0.08)	94	-0.0363**	(-2.86)	94	0.00111	-0.24	218	-0.0158**	(-2.70)	218	-0.0037	(-0.73)	218
5	0.0129	-1.95	103	0.0186**	-2.72	103	-0.00124	(-0.13)	103	0.0200*	-2.38	264	0.0108	-1.68	264	0.0335***	-5.88	264
6	0.00785	-0.71	81	0.0239*	-2.51	81	-0.0291	(-1.16)	81	0.0319***	-3.64	200	-0.00963	(-0.99)	200	-0.00196	(-0.36)	200
7	0.0294	-1.6	11	0.0287	-1	11	-0.0331	(-1.27)	11	-0.02	(-1.11)	118	-0.00598	(-0.62)	118	-0.0689***	(-4.39)	118
9	-0.0392*	(-2.38)	115	-0.0176	(-1.48)	115	-0.00756	(-1.06)	115	-0.00341	(-0.33)	436	-0.0409***	(-4.99)	436	-0.017	(-1.40)	436
10	0.0358	-1.17	14	-0.0908	(-0.83)	14	-0.0465	(-0.95)	14	0.0250**	-2.63	523	-0.0229***	(-4.85)	523	-0.00562	(-0.59)	523
11	-0.0157***	(-3.96)	63	-0.0119*	(-2.22)	63	-0.00217	(-0.37)	63	0.00301	-0.61	121	-0.0283***	(-5.76)	121	0.00466	-0.93	121
Small																		
1	-0.00442	(-0.16)	16	0.0133	-0.5	16	-0.0255	(-1.18)	16	0.0465	-0.49	13	-0.114	(-1.69)	13	0.0132	-0.06	13
2	-0.00013	(-0.02)	321	0.0156	-1.64	321	-0.0204*	(-2.33)	321	-0.0356**	(-3.09)	913	0.00285	-0.12	913	-0.0816***	(-5.34)	913
3	-0.00435	(-1.08)	862	0.00779	-0.8	862	-0.0197***	(-4.03)	862	-0.0229	(-0.82)	473	0.042	-1.14	473	-0.012	(-0.43)	473
4	-0.0106*	(-2.41)	398	-0.00414	(-0.41)	398	-0.0134	(-1.94)	398	-0.0436	(-1.03)	240	0.0604	-1.11	240	-0.0182	(-0.36)	240
5	-0.00768	(-0.85)	202	0.0366**	-3.2	202	-0.0462*	(-2.43)	202	0.00427	-0.12	242	-0.085	(-1.58)	242	0.0684*	-2.09	242
6	-0.0173	(-1.36)	1390	0.00909	-0.62	1390	0.0239*	-2.25	1390	0.00523	-0.45	1116	-0.0229	(-1.54)	1116	-0.0163	(-1.42)	1116
7	-0.0217	(-0.92)	483	-0.0133	(-0.61)	483	0.00686	-0.32	483	0.0345	-0.92	844	0.00127	-0.01	844	0.0334	-0.4	844
8	0.000296	-0.04	458	-0.000672	(-0.05)	458	-0.00839	(-0.63)	458	0.0367	-0.88	255	-0.168	(-1.32)	255	-0.118*	(-2.36)	255
9	-0.0107	(-1.14)	422	-0.0104	(-0.65)	422	-0.0354*	(-2.02)	422	0.00963	-0.47	130	-0.00638	(-0.28)	130	-0.0258	(-1.12)	130
10	0.00123	-0.12	821	-0.0159	(-0.77)	821	0.0164	-1.08	821	-0.0323	(-0.79)	721	0.0111	-0.25	721	0.0369	-0.66	721
11	-0.0487	(-1.49)	159	0.000849	-0.07	159	-0.0198	(-0.51)	159	-0.0134	(-0.30)	96	-0.0512	(-1.89)	96	-0.0108	(-0.73)	96

(Continued)

Table 5.1 (Continued)

Economic	Europe									USA								
	Event window			Pre-event window			Post-event window			Event window			Pre-event window			Post-event window		
	_cons	t-test	N	_cons	t-test	N	_cons	t-test	N	_cons	t-test	N	_cons	t-test	N	_cons	t-test	N
ESG Score																		
Large Scope																		
2	-0.00119	(-0.18)	52	-0.0133	(-1.64)	52	-0.0106	(-1.02)	52	-0.0115	(-1.31)	118	0.00718	-0.95	118	-0.0248***	(-4.07)	118
6	0.0118**	-2.68	70	0.00774	-1.28	70	-0.0115	(-1.86)	70	0.00818	-0.8	295	-0.00657	(-0.87)	295	-0.00679	(-1.94)	295
7	0.0156	-1.24	15	-0.0144	(-1.47)	15	-0.0162	(-0.76)	15	-0.00377	(-0.44)	109	-0.00341	(-0.31)	109	-0.0305***	(-3.62)	109
8	0.0260*	-2.37	21	-0.0127	(-1.40)	21	-0.0158	(-1.26)	21	0.0444***	-4.81	44	-0.00863	(-0.98)	44	-0.00241	(-0.24)	44
10	0.00425	-0.22	60	-0.0416	(-1.64)	60	-0.0310*	(-2.54)	60	0.0537***	-6.26	30	-0.0470*	(-2.69)	30	-0.00327	(-0.23)	30
Lack of scope																		
2										0.0252	-1.08	22	-0.00648	(-0.31)	22	-0.047	(-1.67)	22
6	0.00878	-2.12	10	-0.0565	(-1.64)	10	-0.0108	(-0.54)	10	0.112***	-12.28	410	-0.000564	(-0.18)	410	0.0169***	-4.86	410
7	-0.00885	(-4.37)	2	0.0481	-4.73	2	0.0206	-0.7	2	0.00932	-0.3	73	0.05	-1.14	73	-0.0714*	(-2.05)	73
8										0.0351	-1.11	13	-0.0151	(-0.95)	13	0.00647	-0.25	13
10	0.0359	-0.58	4	-0.0479	(-1.51)	4	-0.106	(-1.08)	4	0.103*	-2.4	13	-0.126	(-1.92)	13	0.0645	-1.42	13
Small Scope																		
2	-0.00411	(-0.68)	30	-0.00297	(-0.25)	30	-0.0143	(-1.42)	30	-0.0261	(-1.97)	30	-0.0613	(-1.64)	30	-0.0543***	(-4.25)	30
6	-0.00713	(-1.37)	71	-0.0314*	(-2.61)	71	-0.0148	(-1.84)	71	0.01000**	-3.12	124	-0.0280***	(-7.47)	124	-0.00838*	(-2.22)	124
7	0.0228	-0.54	7	-0.0279	(-1.70)	7	-0.0339	(-0.47)	7	-0.00228	(-0.05)	9	0.027	-0.38	9	-0.0317	(-1.00)	9
8	0.013	-1.24	115	0.0148	-0.82	115	-0.0106	(-0.81)	115	0.00857	-0.23	92	0.0344	-0.38	92	-0.0149	(-0.50)	92
10	0.0165	-1.66	104	-0.0075	(-0.54)	104	-0.00865	(-0.63)	104	0.0117	-0.15	3	0.016	-1.34	3	-0.0173	(-0.44)	3
Lack of scope																		
2	-0.0344	(-0.62)	9	-0.17	(-0.97)	9	-0.224	(-1.46)	9	-0.0191	(-1.08)	51	-0.0475	(-1.67)	51	-0.0579**	(-3.06)	51
6	0.0167**	-2.78	54	0.0178	-0.99	54	-0.00791	(-1.61)	54	-0.0427	(-1.01)	131	-0.0343	(-0.80)	131	0.051	-1.48	131
7	-0.153	(-0.84)	13	0.00429	-0.1	13	-0.116	(-2.12)	13	0.029	-1.2	235	0.0242	-0.93	235	-0.0597*	(-2.02)	235
8	0.0574	-1.59	24	0.132	-1.66	24	-0.0216	(-0.28)	24	0.0353	-1.49	82	-0.0424	(-1.38)	82	-0.0568	(-1.78)	82
10	0.0307	-1.39	65	-0.0208	(-0.77)	65	-0.0086	(-0.31)	65	0.0019	-0.06	30	-0.0805**	(-3.36)	30	-0.000768	(-0.03)	30

US' withdrawal from Paris Agreement

Lack of ESG Score

Large																		
2	-0.0182	(-1.03)	11	0.0101	-0.54	11	0.0213	-0.94	11	-0.0259	(-0.92)	6	-0.00277	(-0.08)	6	0.0766	-1.85	6
3	-0.00249	(-0.38)	66	-0.0169	(-1.40)	66	0.00405	-0.49	66	-4.78E-05	(-0.01)	68	-0.0199	(-1.88)	68	-0.0191	(-1.57)	68
4	-0.0179	(-1.02)	78	-0.0251	(-1.41)	78	-0.0252	(-0.72)	78	0.0058	-1.5	86	-0.0142*	(-2.16)	86	0.00951	-1.51	86
5	-0.0183**	(-3.42)	72	0.0131	-1.26	72	-0.0215**	(-2.95)	72	-0.0167***	(-4.11)	107	0.0174**	-2.99	107	-0.0321***	(-4.50)	107
6	0.00732	-1.01	79	0.0115	-0.72	79	0.0179	-1.21	79	-0.00147	(-0.25)	39	0.00478	-0.62	39	-0.0158	(-1.31)	39
7	-0.032	(-1.39)	5	-0.0388	(-2.15)	5	-0.023	(-0.55)	5	0.0242*	-2.34	33	0.0161	-1.24	33	0.0433	-1.9	33
9	-0.0046	(-1.26)	91	-0.00487	(-0.45)	91	0.0194**	-3.31	91	-0.0026	(-0.62)	80	-0.00566	(-1.34)	80	0.0189**	-3.12	80
10	0.0499	-1.81	10	0.0234	-0.85	10	0.0293	-0.73	10	-0.0112*	(-2.15)	186	-0.000712	(-0.11)	186	-0.0281**	(-2.80)	186
11	-0.0111*	(-2.21)	52	-0.00486	(-1.15)	52	-0.00359	(-0.61)	52	-0.00113	(-0.43)	47	0.00781	-1.42	47	-0.0128	(-1.65)	47
Small																		
1	0.00477	-0.26	16	0.0098	-0.36	16	0.00216	-0.08	16	0.061	-1.48	3	0.0704	-2.5	3	-0.0269	(-0.45)	3
2	-0.00758	(-1.14)	349	0.0182	-1.81	349	-0.00908	(-1.21)	349	0.00674	-0.92	779	0.0476***	-4.95	779	0.0573***	-6.16	779
3	0.00123	-0.29	854	0.000303	-0.07	854	-0.00714	(-1.41)	854	0.0118	-1	109	0.0291	-1.79	109	-0.000389	(-0.03)	109
4	0.000968	-0.23	398	0.00695	-0.93	398	0.00473	-0.61	398	0.0178	-0.71	78	0.0459*	-2.15	78	0.0266	-1.32	78
5	-0.00937	(-0.71)	185	0.000697	-0.04	185	-0.0293	(-1.57)	185	-0.0189	(-1.43)	104	0.0138	-0.45	104	-0.024	(-1.05)	104
6	-0.00443	(-0.54)	1309	0.0150*	-2.26	1309	-0.0118*	(-2.19)	1309	0.00213	-0.17	207	0.0462*	-2.21	207	-0.0158	(-1.18)	207
7	-0.00911	(-0.59)	420	0.014	-0.67	420	-0.00318	(-0.31)	420	0.0163	-0.87	157	0.0276	-1.03	157	-0.0363	(-1.36)	157
8	0.00523	-0.78	475	0.0177	-1.42	475	0.00557	-0.62	475	0.00818	-0.29	84	0.0802	-1.83	84	0.0113	-0.29	84
9	-0.000789	(-0.12)	388	0.00297	-0.29	388	0.00687	-0.98	388	0.00138	-0.1	32	0.00996	-0.38	32	0.0207	-1.02	32
10	0.00574	-0.85	753	0.0175	-1.75	753	-0.00608	(-0.75)	753	-0.0576	(-1.07)	194	-0.0893	(-0.74)	194	-0.109***	(-4.53)	194
11	-0.0199*	(-2.03)	137	0.00245	-0.14	137	0.0201	-0.99	137	-0.0125	(-1.48)	23	-0.0102	(-1.19)	23	-0.0198*	(-2.29)	23
ESG Score																		
Large																		
Scope																		
2	-0.000124	(-0.02)	39	-0.00933	(-1.35)	39	0.00575	-0.22	39	0.00408	-0.41	47	0.0175*	-2.3	47	0.0249	-1.62	47
6	-0.00425	(-1.04)	63	0.0135*	-2.05	63	-0.0140*	(-2.17)	63	-0.00115	(-0.41)	82	0.0134*	-2.06	82	-0.00655	(-1.14)	82
7	0.00837	-0.85	12	-0.0237	(-2.16)	12	0.00262	-0.2	12	-0.00138	(-0.06)	25	0.0199	-1.45	25	0.00697	-0.34	25
8	0.00217	-0.21	15	-0.0344**	(-3.80)	15	-0.0154	(-0.91)	15	0.0205	-1.35	9	0.0181	-0.76	9	-0.0283	(-0.80)	9
10	0.012	-1.37	45	0.00562	-0.43	45	0.0510***	-4.8	45	-0.0231	(-0.65)	9	-0.0258	(-1.73)	9	-0.113	(-1.48)	9
Lack of scope																		
2	-0.00265	(-0.21)	10	0.0352	-1.18	10	-0.00386	(-0.47)	10	-0.0332**	(-6.09)	5	0.0366	-1.31	5	0.0887*	-4.48	5
6										0.00672	-1.09	27	-0.0053	(-0.64)	27	-0.013	(-0.99)	27
10	-0.00075	(-0.51)	2	-0.0405	(-0.76)	2	0.0868	-2.36	2	-0.0486*	(-3.36)	5	-0.0178	(-0.32)	5	-0.155*	(-2.87)	5

(Continued)

Table 5.1 (Continued)

Economic	Europe									USA								
	Event window			Pre-event window			Post-event window			Event window			Pre-event window			Post-event window		
	_cons	t-test	N	_cons	t-test	N	_cons	t-test	N	_cons	t-test	N	_cons	t-test	N	_cons	t-test	N
Small																		
Scope																		
2	0.00517	-0.54	27	-0.00484	(-0.37)	27	0.00466	-0.44	27	-0.0163	(-1.55)	22	0.0284*	-2.16	22	0.0639***	-3.9	22
6	0.00878	-1.06	61	-0.0113	(-1.60)	61	0.0105	-1.66	61	-0.000882	(-0.27)	48	0.0139**	-2.81	48	0.00857	-1.62	48
7	-0.0393	(-2.54)	5	0.0336	-1.1	5	0.0267	-0.6	5									
8	0.0104	-0.5	104	-0.0207	(-0.89)	104	0.00992	-0.76	104	-0.0483	(-1.53)	22	-0.037	(-0.62)	22	-0.0463	(-0.89)	22
10	0.00358	-0.42	93	-0.0242*	(-2.45)	93	-0.0272**	(-2.77)	93									
Lack of scope																		
2	0.0365	-0.55	9	0.0422	-0.69	9	0.0474	-0.69	9	0.0115	-0.5	27	-0.0386	(-1.39)	27	-0.0026	(-0.07)	27
6	-0.00277	(-0.47)	53	-0.00176	(-0.28)	53	-0.000409	(-0.07)	53	0.00626	-1.06	25	0.00059	-0.07	25	-0.00358	(-0.62)	25
7	-0.0418	(-1.29)	10	0.112	-0.75	10	0.0517	-0.83	10	-0.0334	(-1.91)	5	-0.0376	(-0.43)	5	0.138	-1.46	5
8	0.0219	-0.38	23	0.0556	-0.9	23	0.0151	-0.27	23	-0.0513	(-1.17)	10	-0.0582	(-1.30)	10	-0.0865*	(-2.55)	10
10	0.00163	-0.13	62	0.00835	-0.38	62	0.00267	-0.21	62	0.013	-0.78	2	-0.00829	(-1.93)	2	-0.0625	(-1.92)	2
Omnibus Package																		
Lack of ESG Score																		
Large																		
1										-0.0275	(-0.96)	9	-0.0845**	(-3.70)	9	-0.117*	(-2.81)	9
2	-0.0218	(-1.51)	13	-0.00336	(-0.29)	13	0.018	-1.14	13	-0.0328**	(-3.49)	22	0.00476	-0.35	22	0.0501**	-3.39	22
3	-0.0151**	(-3.24)	93	-0.00815	(-0.89)	93	-0.0255**	(-2.91)	93	-0.0520***	(-9.40)	253	-0.0118*	(-2.11)	253	-0.0464***	(-7.36)	253
4	0.00419	-0.86	93	0.00423	-0.47	93	0.00875	-1.2	93	-0.00157	(-0.41)	216	0.0355***	-5.3	216	0.000337	-0.07	216
5	-0.0250***	(-5.13)	106	-0.0158*	(-2.16)	106	0.0282**	-3.36	106	-0.0648***	(-9.68)	261	-0.00336	(-0.77)	261	0.0288***	-6.02	261
6	0.000953	-0.19	81	0.000462	-0.08	81	-0.00294	(-0.48)	81	-0.0125*	(-1.98)	184	0.0117	-1.2	184	-0.00599	(-0.56)	184
7	-0.0324	(-1.74)	11	0.026	-2.01	11	0.0564*	-3.11	11	-0.0418***	(-3.78)	110	-0.00117	(-0.11)	110	0.00236	-0.21	110
8	-0.0261	(-0.45)	2	0.0403	-0.27	2	-0.00905	(-0.45)	2	-0.201	(-1.38)	2	-0.166	(-0.97)	2	-0.237	(-0.96)	2
9	-0.00893**	(-2.97)	93	-0.0166**	(-3.10)	93	-0.00396	(-0.58)	93	0.0111***	-3.65	422	0.00772	-1.86	422	0.00499	-0.51	422
10	-0.0144	(-0.49)	13	0.0141	-0.3	13	0.0275	-0.73	13	-0.0432***	(-9.93)	535	-0.0167**	(-2.90)	535	0.00363	-0.63	535
11	-0.00949*	(-2.62)	61	0.0013	-0.21	61	0.0177**	-2.86	61	0.0226***	-3.48	122	0.0232***	-4.05	122	0.00354	-0.76	122

Small																		
1	-0.0224	(-0.82)	15	-0.00617	(-0.19)	15	0.000105	0	15	-0.46	(-1.03)	15	0.114	-0.43	15	0.284	-1.02	15
2	-0.0204***	(-3.52)	350	-0.00142	(-0.18)	350	0.0148*	-1.98	350	-0.0396***	(-4.53)	966	0.0148	-1.63	966	0.0476***	-5.39	966
3	-0.0195***	(-5.07)	921	0.0119**	-2.63	921	0.00059	-0.15	921	-0.049	(-1.93)	469	0.00291	-0.1	469	-0.0327	(-1.08)	469
4	-0.0145***	(-4.16)	427	0.00773	-1.1	427	0.00194	-0.33	427	-0.00508	(-0.21)	228	-0.0139	(-0.19)	228	0.00821	-0.15	228
5	-0.0257	(-1.74)	201	-0.00138	(-0.08)	201	-0.00813	(-0.63)	201	0.012	-0.27	232	-0.0277	(-0.49)	232	0.019	-0.53	232
6	-0.0142***	(-5.36)	1315	-0.00706	(-1.95)	1315	-0.00831*	(-2.09)	1315	-0.014	(-1.40)	1020	-0.00125	(-0.12)	1020	-0.00162	(-0.16)	1020
7	-0.00836	(-0.35)	459	0.00265	-0.25	459	-0.0245**	(-2.71)	459	-0.0435**	(-2.62)	797	0.00666	-0.26	797	0.0464	-1.9	797
8	-0.00468	(-0.46)	508	0.0115	-0.99	508	0.00704	-1.04	508	-0.0493*	(-2.27)	263	-0.0788*	(-1.99)	263	0.0285	-1.03	263
9	-0.0118**	(-2.70)	392	0.00794	-0.72	392	-0.00135	(-0.15)	392	-0.0108	(-0.25)	109	-0.0864	(-0.99)	109	0.0108	-0.43	109
10	-0.0138**	(-3.05)	784	-0.00214	(-0.31)	784	-0.00909	(-1.16)	784	-0.0864***	(-5.17)	716	-0.0730**	(-2.93)	716	-0.0215	(-1.07)	716
11	-0.00484	(-0.79)	156	0.00771	-0.54	156	0.0249*	-2.41	156	-0.0326	(-1.92)	89	0.0314	-0.93	89	0.0467	-1.31	89
ESG Score																		
Large																		
Scope																		
2	-0.00102	(-0.15)	52	-0.00105	(-0.10)	52	0.0267*	-2.58	52	-0.0254***	(-5.34)	122	-0.000424	(-0.05)	122	0.0724***	-6.96	122
6	0.00993*	-2.33	69	0.000348	-0.07	69	0.0148	-1.59	69	-0.00756*	(-2.11)	277	-0.0129***	(-3.55)	277	-0.0236***	(-4.66)	277
7	0.0129	-0.78	15	0.000891	-0.05	15	-0.0229	(-1.50)	15	-0.0131	(-1.49)	103	0.00678	-0.62	103	0.0071	-0.85	103
8	-0.0314*	(-2.60)	22	0.0287	-1.9	22	0.0717***	-4.8	22	-0.0395***	(-4.55)	43	-0.0138	(-1.06)	43	0.0354**	-3.33	43
10	-0.0185**	(-2.89)	58	-0.00295	(-0.25)	58	0.0157	-1.51	58	-0.0527***	(-3.70)	32	-0.00644	(-0.41)	32	0.0272	-1.41	32

(Continued)

Table 5.1 (Continued)

Economic	Europe									USA								
	Event window			Pre-event window			Post-event window			Event window			Pre-event window			Post-event window		
	_cons	t-test	N	_cons	t-test	N	_cons	t-test	N	_cons	t-test	N	_cons	t-test	N	_cons	t-test	N
Lack of scope																		
2										-0.0387*	(-2.44)	21	-0.0015	(-0.09)	21	0.0553*	-2.31	21
6	8.79E-06	0	10	0.00194	-0.14	10	-0.0203	(-0.62)	10	0.00165	-0.57	375	-0.0178***	(-6.75)	375	-0.0194***	(-6.91)	375
7	-0.0634	(-1.25)	2	-0.0154	(-0.48)	2	0.0159	-0.37	2	-0.0557***	(-5.33)	70	-0.00362	(-0.33)	70	0.0316**	-3.11	70
8										-0.035	(-1.84)	13	-0.0854	(-1.75)	13	0.0935*	-2.8	13
10	-0.0393	(-1.55)	4	-0.112	(-1.49)	4	-0.0475	(-1.23)	4	-0.0725*	(-2.59)	13	-0.0572	(-1.97)	13	0.0772	-1.58	13
Small Scope																		
2	-0.0174	(-1.84)	29	0.026	-1.75	29	0.0499**	-3.65	29	-0.0270**	(-3.61)	31	-0.027	(-1.44)	31	0.104***	-5.36	31
6	0.00322	-0.69	72	-0.00595	(-0.96)	72	0.0126	-1.53	72	0.0164***	-4.95	126	-0.00105	(-0.29)	126	-0.00609	(-1.71)	126
7	0.0171	-0.34	7	0.0273	-0.51	7	0.0172	-0.5	7	-0.0435	(-1.41)	9	-0.0333	(-0.56)	9	0.0284	-1.03	9
8	0.00108	-0.16	113	0.0126	-1.19	113	0.0319***	-3.89	113	-0.0147	(-1.87)	93	-0.0142	(-1.76)	93	0.0136	-1.35	93
10	-0.0109	(-1.46)	99	0.0117	-1.59	99	0.0421**	-2.66	99	-0.113	(-1.91)	3	0.0178	-0.11	3	-0.0211	(-2.07)	3
Lack of scope																		
2	0.0512	-0.96	9	-0.0297	(-0.38)	9	-0.049	(-0.70)	9	-0.0444***	(-5.54)	52	-0.0432	(-1.95)	52	0.0687**	-3.29	52
6	-0.00845	(-1.60)	53	0.0105	-1.37	53	0.0151	-1.28	53	0.0287*	-2.35	121	-0.0214	(-0.60)	121	0.0443	-1.16	121
7	0.0461	-0.78	12	-0.162	(-0.95)	12	-0.0214	(-0.41)	12	-0.0403	(-1.68)	216	0.00324	-0.24	216	0.0585*	-2.05	216
8	-0.0181	(-1.34)	23	-0.0325	(-1.39)	23	0.0528	-1.52	23	-0.0363***	(-4.34)	83	-0.0633***	(-5.30)	83	0.0341**	-3.34	83
10	-0.0251	(-1.82)	64	-0.0211	(-1.07)	64	0.0185	-1.18	64	-0.0681***	(-3.67)	30	-0.0535	(-2.03)	30	-0.0172	(-0.81)	30

Source: Author's own elaboration based on the LSEG Workspace.

Notes: N - number of companies; t-test - student test results; *p<0.05; **p<0.01; ***p<0.001

(1) academic and educational services, (2) basic materials, (3) consumer cyclicals, (4) consumer non-cyclicals, (5) energy, (6) financials, (7) healthcare, (8) industrials, (9) real estate, (10) technology, (11) utilities. Grey shades indicate whether the event had a statistically significant impact on abnormal stock returns.

The reaction of particular sectors is presented in Table 5.2. In the case of the US withdrawal from the Paris Agreement, the reaction was stronger than in response to the presidential election. The US market generally viewed the decision positively, with abnormal returns, especially among smaller companies. This effect can be observed in both the pre- and post-event windows. The stronger reaction was observed for smaller companies without ESG ratings than for those with ESG ratings. In the group with greenwashed ESG ratings, the effect was only negative. This relationship may be explained by the high costs for smaller entities related to the introduction of ESG regulations.

In the case of larger US entities, the reaction is more varied. Institutions with relationships with the European market may assess this issue in two ways. They will still need to introduce certain regulations for the European market, so they may be interested in partially maintaining them. This may explain why, in some sectors, the decision is assessed negatively. It is also related to investor policy. In the group of companies with clean ESG scores, the decision was assessed positively because they had already implemented regulations and could decide not to introduce additional measures. The strongest impact was observed among entities with greenwashed ESG ratings. This may be linked to the loss of reputational benefits from introducing ESG regulations.

The decision to withdraw the US from the Paris Agreement was viewed negatively in Europe for several reasons. First, it may be related to additional financial costs and geographic bias, which can influence company efficiency and competitive conditions between the European and US markets. This reaction was stronger for companies with clean ESG ratings than for those without them. It was not observed among entities with greenwashed ESG ratings.

Regarding sectoral effects, the negative impact was observed mainly in sectors such as energy, basic materials, technology, and utilities. These sectors are largely connected with non-ESG-related investment areas. In addition, a significant impact was observed in the financial sector, largely due to instability in the regulatory environment.

The final part of the analysis focused on the presentation of the Omnibus proposal and its impact on stock market returns. The results suggest that, for US companies without ESG ratings, both small and large institutions assessed the change mostly negatively, especially smaller entities. This is related to the need to introduce the mentioned regulations if these companies have business relationships with the European market. It is also connected with expectations regarding the relationship between the US and European markets and the impact of US regulations on European policies. This may be interpreted as greater regulatory loosening. Among larger European companies without ESG scores, the effect was smaller than in the US entity group. This confirms the previous observations.

Among entities with ESG ratings, reactions to the Omnibus proposal varied. In Europe, the event generated positive abnormal returns among

Table 5.2 Sectoral reaction on political decisions related with green regulations on the rates of retruns on the stock market in Europe and the United States.

[illegible]

US' withdrawal from Paris Agreement												
Lack of ESG score												
2												
4												
5												
6												
7												
9												
10												
11												
ESG score, scope												
2												
6												
8												
10												
ESG score, lack of scope												
2												
8												
10												
OMNIBUS package												
Lack of ESG score												
1												
2												
3												
4												
5												
6												
7												
8												

(Continued)

Table 5.2 (Continued)

Sector	Europe			USA			Europe			USA		
	Event	Pre	Post	Event	Pre	Post	Event	Pre	Post	Event	Pre	Post
9												
10												
11												
ESG score, scope												
2												
6												
8												
10												
ESG score, lack of scope												
2												
6												
7												
9												
10												

Source: Author's own elaboration based on the LSEG Workspace.

Notes: (1) academic and educational services, (2) basic materials, (3) consumer cyclicals, (4) consumer non-cyclicals, (5) energy, (6) financials, (7) healthcare, (8) industrials, (9) real estate, (10) technology, (11) utilities. Grey shades indicate whether the event had a negative statistically significant impact on abnormal stock returns. Black shades indicate whether the event had a positive statistically significant impact on abnormal stock returns.

companies with clean ESG ratings and no reaction among those with greenwashed ESG scores. This confirms the positive perception of simplified regulations, which may be associated with lower costs for these companies. In the US market, the reaction among entities with greenwashed and clean ESG scores was mostly negative during the event window and stronger for larger companies. This suggests that US investors do not differentiate between clean and greenwashed ESG ratings and do not pay attention to the scope of disclosure. It also confirms the previously described phenomenon.

The next part of the study relies on testing changes in trading volume, which is one of the measures of liquidity in the financial market (Table 5.3). Financial theory suggests that the effect of significant events should be observed as positive abnormal changes in liquidity. This reaction was observed in this case. It was more evident in the United States than in Europe during the presidential election, which is consistent with theory and practical experience. In Europe, the reaction was generally stronger during the event window, especially for larger companies without ESG ratings. For the same group, negative and significant reactions were observed among smaller entities before the event. In the US market, abnormal movements were observed before the event for larger companies and at the time of the election results announcement for both smaller and larger entities.

The reaction to the presidential election in the group of entities with ESG ratings was similar but weaker than in the group of companies without ESG ratings. In Europe, this effect was not observed for the stocks of larger companies that received greenwashed ESG ratings. In the case of the US withdrawal from the Paris Agreement, the reaction was much weaker than in the presidential election. This may be the result of earlier discounting. In some cases, the reaction was weaker than the changes in the index, which confirms the previous analysis.

The last part of the analysis focused on the presentation of the Omnibus proposal and its impact on stock market liquidity in relation to index liquidity. The obtained results suggest that in the case of US companies without ESG ratings, both small and large institutions assessed the mentioned change mostly negatively in relation to changes in index liquidity, especially smaller entities. In the group of larger European companies without ESG scores, the effect was smaller than in the group of US entities. This confirms the previous observations.

In the case of entities with ESG ratings, the reaction to the Omnibus proposal was varied. In Europe, the event generated positive abnormal returns among larger companies with clean ESG ratings and no reaction among those with greenwashed ESG scores; for smaller entities, the positive reaction was observed in both groups. In the US market, the reaction among entities with greenwashed and clean ESG scores was mostly stronger during the event and

Table 5.3 Impact of political decisions related with green policy on the liquidity on the stock market in Europe and in the United States.

Economic	Europe									USA								
	Event window			Pre-event window			Post-event window			Event window			Pre-event window			Post-event window		
	_cons	t-test	N	_cons	t-test	N	_cons	t-test	N	_cons	t-test	N	_cons	t-test	N	_cons	t-test	N
The US election																		
Lack of ESG score																		
Large																		
1										0.509*	-3.19	9	-0.0405	(-0.08)	9	-0.513**	(-3.39)	9
2	0.584	-1.8	14	-0.212	(-0.68)	14	0.132	-0.63	14	0.467	-1.57	21	-0.604	(-1.59)	21	-0.27	(-0.89)	21
3	0.128	-1.1	89	0.09	-0.73	89	-0.061	(-0.43)	89	0.232**	-2.67	244	0.248*	-2.5	244	-0.106	(-1.36)	244
4	0.254**	-2.85	94	0.0401	-0.4	94	0.0323	-0.39	94	0.116	-1.03	218	0.00353	-0.03	218	0.0432	-0.44	218
5	0.0104	-0.09	103	0.19	-1.55	103	0.0761	-0.59	103	0.109	-1.86	264	-0.220*	(-2.39)	264	0.0781	-1	264
6	0.114	-0.74	81	0.294	-1.27	81	-0.0738	(-0.36)	81	0.049	-0.34	200	0.376*	-2.04	200	0.0755	-0.54	200
7	0.127	-0.4	11	-0.0403	(-0.08)	11	0.101	-0.28	11	0.525**	-3.3	118	0.0953	-0.42	118	-0.0751	(-0.69)	118
9	0.0927	-1	115	-0.0504	(-0.45)	115	-0.0509	(-0.57)	115	-0.0559	(-0.86)	436	0.331***	-4.27	436	-0.0441	(-0.73)	436
10	0.276	-1.49	14	0.183	-0.81	14	-0.096	(-0.42)	14	0.311***	-4.27	523	0.187	-1.59	523	0.00147	-0.02	523
11	0.451**	-3.11	63	0.0531	-0.36	63	0.0333	-0.35	63	-0.271*	(-2.19)	121	0.00262	-0.02	121	0.0613	-0.51	121
Small																		
1	0.352	-0.6	16	-0.774	(-0.74)	16	1.108	-1.08	16	0.142	-0.23	13	0.559	-0.81	13	0.525	-0.92	13
2	0.0879	-0.75	321	-0.277*	(-2.03)	321	-0.167	(-1.41)	321	0.0442	-0.68	913	-0.356***	(-4.90)	913	-0.0638	(-0.95)	913
3	0.292***	-4.98	862	-0.223**	(-3.12)	862	0.0273	-0.39	862	0.384***	-4.13	473	-0.0891	(-0.96)	473	-0.065	(-0.84)	473
4	1.058	-1.19	398	-0.085	(-0.80)	398	-0.0302	(-0.26)	398	0.509***	-3.73	240	-0.127	(-0.76)	240	0.0416	-0.28	240
5	0.237	-1.66	202	0.265	-1.48	202	0.338*	-2.54	202	0.314*	-2.41	242	-0.127	(-0.85)	242	0.125	-1.11	242
6	0.149	-1.22	1390	-0.12	(-1.09)	1390	-0.0974	(-0.68)	1390	0.239**	-3.15	1116	-0.032	(-0.46)	1116	0.000461	-0.01	1116
7	0.228**	-2.81	483	-0.400***	(-3.72)	483	0.0276	-0.3	483	0.262***	-3.93	844	0.0186	-0.21	844	0.0789	-1.23	844
8	-0.00105	(-1.00)	458	-0.00343	(-1.00)	458	0.00311	-1	458	0	(.)	255	0	(.)	255	0	(.)	255
9	0.132	-1.86	422	-0.0591	(-0.65)	422	0.0156	-0.2	422	-0.145	(-0.87)	130	0.319	-1.84	130	0.0311	-0.17	130
10	0.273***	-3.42	821	-0.0304	(-0.35)	821	0.00556	-0.07	821	0.396***	-3.76	721	-0.0379	(-0.25)	721	0.184	-1.22	721
11	0.164	-1.4	159	-0.225	(-1.79)	159	-0.142	(-1.22)	159	-0.0331	(-0.19)	96	0.192	-0.84	96	-0.0238	(-0.15)	96

ESG score																		
Large																		
Scope																		
2	0.238	-1.78	52	-0.0294	(-0.19)	52	-0.178	(-1.14)	52	0.234*	-2.3	118	-0.105	(-0.91)	118	-0.0914	(-0.96)	118
6	0.073	-0.72	70	-0.13	(-0.83)	70	-0.123	(-1.57)	70	-0.118	(-1.76)	295	0.033	-0.37	295	0.0285	-0.39	295
7	0.104	-0.5	15	-0.247	(-0.72)	15	0.0377	-0.17	15	0.202	-1.39	109	0.242	-1.63	109	0.0876	-0.7	109
10	0.431**	-2.75	60	-0.19	(-1.29)	60	-0.00547	(-0.05)	60	0.607	-1.62	30	-0.308	(-0.71)	30	0.166	-0.91	30
Lack of scope																		
2										-0.116	(-0.46)	22	0.685	-1.3	22	-0.00216	(-0.02)	22
6	-0.258	(-0.99)	10	0.461	-1.4	10	-0.0976	(-0.28)	10	0.352***	-5.88	410	-0.0219	(-0.31)	410	-0.149*	(-2.59)	410
7	-1.151	(-3.86)	2	0.904	-5.24	2	0.0953	-0.13	2	0.261*	-2.27	73	0.108	-0.67	73	0.00752	-0.05	73
10	-0.236	(-0.35)	4	0.258	-0.73	4	-0.183	(-1.23)	4	0.401	-1.03	13	0.0528	-0.2	13	-0.0564	(-0.21)	13
Small																		
Scope																		
2	0.301	-1.62	30	-0.597**	(-3.07)	30	-0.469	(-1.84)	30	0.13	-0.84	30	-0.287	(-0.90)	30	-0.232	(-1.17)	30
6	0.0949	-1.01	71	0.00825	-0.07	71	-0.0246	(-0.19)	71	-0.267*	(-2.36)	124	0.115	-0.76	124	0.332**	-2.75	124
7	0.00286	0	7	0.625	-0.86	7	-0.423	(-0.83)	7	-0.583	(-1.08)	9	-0.167	(-0.61)	9	0.508	-0.66	9
10	0.246*	-2.15	104	-0.322*	(-2.17)	104	-0.003	(-0.02)	104	0.106	-0.17	3	0.843	-1.42	3	0.401	-2.92	3
Lack of scope																		
2	0.284	-0.41	9	-0.651	(-1.32)	9	-1.072	(-1.24)	9	0.243	-1.65	51	-0.228	(-1.10)	51	-0.0738	(-0.42)	51
6	0.223	-1.79	54	-0.358*	(-2.02)	54	0.282	-1.44	54	0.117	-1.29	131	0.0884	-0.78	131	-0.0198	(-0.20)	131
7	1.814*	-3.01	13	-1.705**	(-3.25)	13	-0.493	(-1.77)	13	0.379***	-4.38	235	0.0449	-0.47	235	-0.115	(-1.73)	235
10	0.491*	-2.55	65	-0.0695	(-0.31)	65	-0.15	(-0.78)	65	0.363*	-2.05	30	-0.145	(-0.69)	30	0.184	-1	30
US' withdrawal from Paris Agreement																		
Lack of ESG score																		
Large																		
2	0.0587	-0.25	11	0.0573	-0.11	11	-0.025	(-0.15)	11	2.18	-1.78	6	-0.123	(-0.11)	6	-1.851	(-2.10)	6
3	-0.224	(-1.55)	66	0.104	-0.93	66	0.085	-0.51	66	-0.284	(-0.96)	68	-0.375	(-1.29)	68	-0.0268	(-0.08)	68
4	0.12	-1.3	78	-0.0852	(-0.82)	78	-0.11	(-0.78)	78	0.135	-0.6	86	-0.188	(-0.92)	86	0.211	-1.03	86
5	0.0157	-0.13	72	-0.592***	(-3.55)	72	0.0597	-0.42	72	-0.069	(-0.54)	107	-0.0453	(-0.23)	107	-0.122	(-0.85)	107
6	0.102	-0.59	79	0.0776	-0.37	79	0.0304	-0.16	79	0.804*	-2.2	39	-0.445	(-1.83)	39	0.0457	-0.15	39
7	0.844	-0.74	5	-0.185	(-0.46)	5	-0.128	(-0.20)	5	0.176	-0.49	33	-0.0399	(-0.07)	33	0.461	-1.37	33
9	-0.172	(-1.18)	91	-0.251*	(-2.04)	91	0.176	-1.13	91	-0.197	(-0.76)	80	-0.0519	(-0.25)	80	0.618	-1.98	80
10	0.38	-0.7	10	0.315	-0.61	10	-0.0136	(-0.04)	10	-0.431	(-1.72)	186	-0.612	(-1.15)	186	0.484	-1.68	186
11	0.02	-0.15	52	-0.284*	(-2.27)	52	0.0965	-0.82	52	-0.275	(-1.59)	47	0.0833	-0.4	47	0.114	-0.6	47

(Continued)

Table 5.3 (Continued)

	Europe									USA								
	Event window			Pre-event window			Post-event window			Event window			Pre-event window			Post-event window		
Economic	_cons	t-test	N	_cons	t-test	N	_cons	t-test	N	_cons	t-test	N	_cons	t-test	N	_cons	t-test	N
Small																		
1	-0.572	(-1.45)	16	0.932	-1.12	16	1.058	-1.48	16	-3.039	(-1.09)	3	0.0615	-0.13	3	1.388	-0.82	3
2	-0.081	(-0.83)	349	-0.174	(-1.48)	349	0.0828	-0.82	349	0.0644	-0.93	779	-0.0563	(-0.71)	779	0.13	-1.79	779
3	-0.0792	(-1.35)	854	-0.128	(-1.76)	854	0.0341	-0.51	854	-0.11	(-0.56)	109	-0.152	(-0.60)	109	0.202	-0.97	109
4	-0.0138	(-0.17)	398	-0.311**	(-3.05)	398	-0.0183	(-0.22)	398	-0.694**	(-2.76)	78	-0.0909	(-0.32)	78	0.939**	-3.24	78
5	-0.055	(-0.43)	185	-0.189	(-1.06)	185	-0.302*	(-2.15)	185	-0.178	(-1.09)	104	-0.372	(-1.90)	104	-0.208	(-1.16)	104
6	0.0765	-1.28	1309	-0.073	(-1.00)	1309	0.0525	-0.61	1309	-0.107	(-0.75)	207	0.274	-1.71	207	-0.125	(-0.80)	207
7	-0.106	(-1.19)	420	-0.236*	(-2.58)	420	-0.0358	(-0.36)	420	0.0584	-0.33	157	-0.259	(-1.35)	157	0.144	-0.87	157
8	0.00146	-1	475	0.000826	-1	475	0.00187	-1	475	0	(.)	84	0	(.)	84	0	(.)	84
9	-0.00166	(-0.02)	388	-0.00758	(-0.10)	388	-0.0821	(-0.92)	388	-0.118	(-0.26)	32	-0.218	(-0.45)	32	0.491	-1.31	32
10	-0.108	(-1.40)	753	-0.259**	(-2.77)	753	0.2	-1.65	753	-0.194	(-1.54)	194	-0.215	(-1.31)	194	-0.268	(-1.92)	194
11	-0.00264	(-0.02)	137	-0.144	(-1.15)	137	-0.00755	(-0.07)	137	0.0723	-0.24	23	-0.944	(-1.59)	23	0.177	-0.52	23
ESG score																		
Large																		
Scope																		
2	0.11	-0.54	39	-0.128	(-0.60)	39	0.328	-1.49	39	-0.0282	(-0.11)	47	-0.454*	(-2.09)	47	0.137	-0.5	47
6	-0.121	(-1.53)	63	-0.105	(-1.03)	63	0.124	-1.38	63	-0.519**	(-2.64)	82	0.228	-1.24	82	0.0657	-0.38	82
7	-0.0815	(-0.30)	12	-0.0556	(-0.16)	12	0.397	-0.92	12	0.00665	-0.01	25	-0.421	(-1.02)	25	0.38	-1.84	25
10	-0.00012	(-0.00)	45	0.00869	-0.08	45	0.192	-0.83	45	0.917	-2.14	9	0.862	-1.33	9	-0.547	(-0.99)	9
Lack of scope																		
2										0.0253	-0.03	5	0.598	-1.35	5	-1.087	(-1.36)	5
6	0.25	-0.95	10	-0.118	(-0.76)	10	-0.425	(-1.68)	10	-0.103	(-0.38)	27	0.0699	-0.26	27	-0.506*	(-2.06)	27
7										-0.493	(-1.01)	3	-0.656	(-0.45)	3	3.281	-4.06	3
10	0.161	-2.73	2	-0.417	(-0.46)	2	-0.479	(-0.48)	2	-0.512	(-1.61)	5	-0.504	(-0.52)	5	0.779	-0.6	5
Small																		
Scope																		
2	0.551*	-2.4	27	-0.324	(-1.49)	27	-0.393	(-1.52)	27	0.029	-0.09	22	0.268	-1	22	0.0663	-0.26	22
6	-0.0575	(-0.43)	61	0.166	-1.42	61	0.103	-0.91	61	-0.432	(-1.63)	48	0.756**	-2.98	48	0.374	-1.37	48
7	0.0235	-0.05	5	0.035	-0.07	5	0.000745	0	5									
10	-0.168	(-0.97)	93	0.0316	-0.21	93	0.409	-1.82	93									

Lack of scope																		
2	0.975	-2.05	9	-0.757	(-1.43)	9	-0.131	(-0.32)	9	0.141	-0.63	27	-0.164	(-0.65)	27	0.104	-0.41	27
6	0.0765	-0.58	53	0.174	-1.04	53	0.0827	-0.8	53	-0.154	(-0.56)	25	0.19	-0.64	25	-0.165	(-0.63)	25
7	-0.541	(-1.64)	10	0.438	-0.71	10	-0.142	(-0.43)	10	-0.448	(-0.98)	5	-0.83	(-1.43)	5	-0.138	(-0.17)	5
10	0.00739	-0.04	62	-0.405	(-1.69)	62	0.407*	-2.61	62	-0.502	(-1.79)	2	1.51	-3.6	2	0.839	-0.63	2
OMNIBUS package																		
Lack of ESG score																		
Large																		
1										-0.0751	(-0.30)	9	-0.207	(-0.44)	9	-0.0243	(-0.13)	9
2	0.386	-0.96	13	0.00881	-0.06	13	0.125	-0.38	13	-0.273	(-0.91)	22	-0.417	(-1.08)	22	0.0149	-0.06	22
3	-0.19	(-1.61)	93	0.250*	-2.13	93	0.188	-1.49	93	0.0912	-0.88	253	0.0142	-0.13	253	-0.208	(-1.95)	253
4	-0.0403	(-0.46)	93	0.248	-1.91	93	-0.0769	(-0.84)	93	0.0764	-1	216	0.128	-1.12	216	-0.232**	(-2.82)	216
5	0.121	-1.1	106	-0.154	(-1.27)	106	0.032	-0.24	106	0.288***	-4.35	261	0.0146	-0.23	261	-0.286***	(-4.22)	261
6	0.233	-1.47	81	-0.253	(-1.46)	81	-0.311*	(-2.30)	81	0.0195	-0.19	184	0.163	-1.38	184	-0.103	(-0.93)	184
7	0.174	-0.5	11	0.155	-0.92	11	0.155	-0.45	11	0.0885	-0.79	110	-0.101	(-0.73)	110	-0.213	(-1.36)	110
9	-0.356**	(-3.23)	93	0.217	-1.96	93	0.239	-1.61	93	0.182**	-3.04	422	0.079	-1.02	422	-0.269***	(-3.87)	422
10	0.512	-1.99	13	-0.459	(-1.50)	13	-0.117	(-0.54)	13	0.0722	-1.22	535	0.00502	-0.06	535	-0.229**	(-3.09)	535
11	0.0972	-0.77	61	0.0505	-0.56	61	-0.244	(-1.75)	61	0.22	-1.97	122	0.00784	-0.06	122	-0.331*	(-2.51)	122
Small																		
1	0.724	-1.23	15	-0.856	(-1.45)	15	-0.822	(-1.32)	15	-0.487	(-1.53)	15	-0.0623	(-0.10)	15	-0.243	(-0.39)	15
2	0.0331	-0.36	350	-0.187	(-1.50)	350	-0.0348	(-0.30)	350	-0.135*	(-2.13)	966	0.00758	-0.11	966	0.131*	-2.18	966
3	-0.0588	(-1.12)	921	0.0491	-0.77	921	-0.041	(-0.61)	921	0.151	-1.82	469	0.0133	-0.14	469	-0.313***	(-3.57)	469
4	-0.0184	(-0.31)	427	-0.0265	(-0.33)	427	0.126	-1.56	427	-0.245	(-1.97)	228	0.0429	-0.25	228	-0.104	(-0.70)	228
5	-0.0236	(-0.19)	201	0.131	-0.71	201	-0.119	(-0.73)	201	0.0887	-0.77	232	0.0371	-0.26	232	-0.139	(-1.03)	232
6	-0.0726	(-1.30)	1315	-0.025	(-0.33)	1315	-0.0112	(-0.14)	1315	0.166**	-2.94	1020	0.0099	-0.14	1020	-0.396***	(-5.94)	1020
7	0.0622	-0.69	459	-0.0239	(-0.24)	459	-0.00791	(-0.08)	459	0.00101	-0.02	797	0.0404	-0.6	797	-0.262***	(-3.77)	797
8	-0.0053	(-1.00)	508	0.000755	-1	508	0.00508	-1	508	0	(.)	263	0	(.)	263	0	(.)	263
9	-0.142	(-1.90)	392	0.201*	-2.56	392	0.213**	-2.68	392	0.0389	-0.23	109	-0.0123	(-0.06)	109	-0.573*	(-2.46)	109
10	0.0291	-0.38	784	-0.3	(-1.33)	784	-0.187	(-1.03)	784	0.00766	-0.11	716	0.144	-1.83	716	-0.226**	(-3.18)	716
11	0.111	-0.88	156	-0.241	(-1.51)	156	0.00467	-0.03	156	0.268	-1.35	89	-0.169	(-0.99)	89	-0.373*	(-2.14)	89

(Continued)

Table 5.3 (Continued)

	Europe									USA								
	Event window			Pre-event window			Post-event window			Event window			Pre-event window			Post-event window		
	_cons	t-test	N	_cons	t-test	N	_cons	t-test	N	_cons	t-test	N	_cons	t-test	N	_cons	t-test	N
Economic																		
ESG score																		
Large																		
Scope																		
2	0.269	-1.7	52	-0.108	(-0.61)	52	-0.286*	(-2.25)	52	0.283*	-1.98	122	-0.0415	(-0.21)	122	-0.244*	(-2.28)	122
6	0.264**	-2.75	69	-0.0954	(-0.86)	69	0.0294	-0.31	69	0.0958	-1.15	277	0.0126	-0.16	277	-0.11	(-1.19)	277
7	0.112	-0.54	15	-0.0782	(-0.48)	15	-0.129	(-0.54)	15	-0.0374	(-0.20)	103	0.242	-1.63	103	-0.217	(-1.51)	103
10	0.19	-1.47	58	-0.113	(-0.63)	58	-0.137	(-1.31)	58	0.197	-0.79	32	-0.16	(-0.59)	32	-0.984*	(-2.68)	32
Lack of scope																		
2										-0.048	(-0.20)	21	0.0478	-0.33	21	-0.336	(-1.92)	21
6	0.196	-1.19	10	0.262	-2.01	10	0.262	-0.88	10	0.0354	-0.62	375	-0.0274	(-0.40)	375	-0.261***	(-4.45)	375
7	-2.512	(-1.23)	2	-0.833	(-0.65)	2	0.83	-6.14	2	0.189*	-2.47	70	0.181	-1.48	70	-0.307**	(-3.39)	70
10	0.234	-0.92	4	-0.241	(-0.79)	4	0.578*	-4.52	4	-0.136	(-0.63)	13	-0.494	(-0.82)	13	-0.426	(-1.45)	13
Small																		
Scope																		
2	-0.0302	(-0.13)	29	0.442	-1.77	29	0.397	-1.75	29	-0.018	(-0.07)	31	-0.0922	(-0.38)	31	-0.0261	(-0.11)	31
6	-0.195	(-1.99)	72	0.061	-0.53	72	0.148	-1.23	72	0.0546	-0.49	126	-0.0968	(-0.72)	126	-0.028	(-0.24)	126
7	-0.0943	(-0.19)	7	0.163	-0.24	7	-0.482	(-0.56)	7	0.518	-0.74	9	0.0983	-0.21	9	-0.440*	(-3.03)	9
10	-0.00862	(-0.06)	99	0.0769	-0.52	99	0.26	-1.72	99	-0.816	(-2.60)	3	-0.375	(-0.89)	3	-0.185	(-1.87)	3
Lack of scope																		
2	-0.434	(-1.39)	9	0.304	-0.69	9	0.185	-0.57	9	0.0829	-0.55	52	-0.0521	(-0.26)	52	0.0134	-0.1	52
6	-0.244*	(-2.16)	53	0.304*	-2.3	53	0.0819	-0.56	53	0.258*	-2.54	121	0.025	-0.21	121	-0.229	(-1.93)	121
7	0.428	-1.51	12	0.393	-0.97	12	-0.147	(-0.40)	12	0.209**	-2.98	216	0.00807	-0.11	216	-0.426***	(-6.37)	216
10	-0.114	(-0.83)	64	0.0082	-0.04	64	0.00581	-0.04	64	0.0834	-0.72	30	0.0643	-0.38	30	-0.358**	(-2.95)	30

Source: Author's own elaboration based on the LSEG Workspace.

Notes: N - number of companies; t-test - student test results; *p<0.05; **p<0.01; ***p<0.001

(1) academic and educational services, (2) basic materials, (3) consumer cyclicals, (4) consumer non-cyclicals, (5) energy, (6) financials, (7) healthcare, (8) industrials, (9) real estate, (10) technology, (11) utilities. Grey shades indicate whether the event had a statistically significant impact on abnormal stock returns.

post-event windows for larger companies. This also confirms the previously described phenomenon. For smaller entities, the effect was observed mainly among greenwashed companies.

Results for the particular sectors are presented in Table 5.4.

Systemic Effects and Sectoral Correlations of ESG Shocks: US and EU Interdependencies

The ongoing ESG regulatory changes are a direct result of the United States' decision to withdraw from the Paris Agreement once again. Following the United States' withdrawal, to avoid hampering the competitiveness of European economies, the European Commission proposed the Omnibus package in February 2025. Amendments to the Corporate Sustainability Reporting Directive and the Corporate Sustainability Due Diligence Directive constitute the core of this first Omnibus package, aiming to simplify and standardize sustainability reporting practices. It reduces the complexity of the proposed regulations, including by eliminating reporting and due diligence requirements for many companies, introducing greater flexibility for companies still subject to mandatory requirements, and protecting smaller companies from excessive information demands from larger companies. Reducing these burdens will free up resources for investment. This is a consequence of the limited scope of the Sustainable Development Directive and the future changes to the ESRB.

According to press reports, there is pressure from the United States on non-EU companies to present strategies to reduce CO₂ emissions and adapt to climate change, and to amend environmental regulations across supply chains. This is intended to reverse climate change policies. One of the first studies on the relationship between green equity markets was conducted by Chakrabarti and Sen (2021), who found significant volatility contagion from the local market to US and European green equities, with strong global market integration. Meanwhile, green equities in the Asia-Pacific region exhibited a different behavior, experiencing no spillovers from the domestic market and insufficient integration with the global market. Gaies and Chaâbane's (2024) study shows that the financial instability in the US not only affects the US green stock market but also has a significant impact on the EU market, and vice versa, suggesting the existence of a Euro-American contagion mechanism. Interestingly, the results of this study also reveal a positive correlation between financial instability and the performance of green stock markets under normal market conditions, suggesting a potential feedback effect. Yfanti et al. (2025) demonstrated the influence of macroeconomic changes and crises on contagion in green stock market indices, with climate change-related risks and political considerations serving as strong catalysts for both countercyclical and procyclical cross-border spillovers to sustainable development. Meanwhile, there was a stronger correlation between European and North American indices, and a weaker one between Europe and Japan, Australia, and Brazil. Financial contagion was a type of interdependence identified for most pairs of stability and crisis episodes.

Table 5.4 Sectoral reaction to political decisions related to green regulations on the liquidity of the stock market in Europe and in the United States

[illegible]

7												
9												
10												
11												
ESG score, scope												
2												
6												
ESG score, lack of scope												
6												
10												
OMNIBUS package												
Lack of ESG score												
2												
3												
4												
5												
6												
7												
9												
10												
11												
ESG score, scope												
2												
6												
7												
10												
ESG score, lack of scope												
6												
7												
10												

Source: Author's own elaboration based on the LSEG Workspace.

Notes: (1) academic and educational services, (2) basic materials, (3) consumer cyclicals, (4) consumer non-cyclicals, (5) energy, (6) financials, (7) healthcare, (8) industrials, (9) real estate, (10) technology, (11) utilities. Grey shades indicate whether the event had a negative statistically significant impact on abnormal stock returns. Black shades indicate whether the event had a positive statistically significant impact on abnormal stock returns.

Some research addresses the interdependencies and contagion effects between individual markets and the stock market. The recent linkage of green assets with various financial sectors is seen as a key indicator of the growing integration of sustainability principles into the broader financial architecture (Reboredo & Ugolini, 2022). What this interdependency indicates is shifting market preferences, with sustainability becoming a central factor in investment decisions and potentially leading to significant changes in traditional equity portfolios, underscoring the transformative potential of green finance (Tang & Zhang, 2020). Indeed, Naeem et al. (2024) conducted a study on the interdependencies between green stocks, bonds, cryptocurrencies, and carbon markets, depicting robust interconnections within asset classes and limited interconnections between markets. Moreover, Dai et al. (2023) analyzed extreme contagion effects between high-carbon stocks, green bonds, and WTI crude oil, highlighting a high rate of risk contagion: green bonds and WTI crude oil were net recipients of systemic shocks, exhibiting asymmetric behavior in up and down markets. In other studies, under extreme market conditions, the association between high-carbon stocks, green assets, and crude oil has been shown to increase (Antonakakis et al., 2018; Wen et al., 2020). There is also a body of research examining the relationships between green and conventional stocks (Lundgren et al., 2018), clean energy and stock prices (Nguyen et al., 2020), green and corporate bond markets (Ferrer et al., 2021; Gao et al., 2021; Reboredo, 2018), and green and sovereign bond markets (Ferrer et al., 2021; Reboredo, 2018). Still, in the context of the impact of green policy changes in European and American markets, it is important to note the differences in research findings on the relationship between classic and green financial markets; some studies indicate a growing influence of green assets on traditional markets (Chai et al., 2022; Lundgren et al., 2018; Tang & Zhang, 2020), while others suggest that this influence flows mainly from conventional to green markets (Hammoudeh et al., 2020; Mensi et al., 2022; Pham, 2016; Reboredo, 2018; Reboredo & Ugolini, 2020). This discrepancy in findings indicates a complex and dynamic relationship between green and conventional finance that is influenced by factors such as external events and market conditions (Jiang et al., 2023).

Conclusions

The presented analysis of the market reaction to the changes in the regulations shows the significant relationship. The mentioned changes significantly influence the green bond market and level of greenium. The increase in the restrictiveness of regulations related to the climate risk and ESG risk estimation in estimating the capital adequacy influence on the demand for green bonds by financial institutions and increasing greenium. It is noticed the strong geographical bias, which is an effect of the increasing mentioned regulation in Europe – as a result, the greenium is stable and large – and the United States' withdrawal from the Paris Agreement and reduction of implementation regulations related to ESG, which causes the decrease in the demand for green

bonds and greenium decreases. The stability of the ESG risk regulations is the main factor in the development of green bonds. The presented study shows that the large volatility of the regulations can create problems with lower liquidity of the bond market and decrease the size of the primary market. Next, the significant impact has got the value of “add-ons.” If they are too large, it can create greenium and decrease the market efficiency.

The analysis of stock shows that the market reaction to the three examined events – the US presidential election, the US withdrawal from the Paris Agreement, and the Omnibus proposal – varied depending on region, firm size, and the presence and quality of ESG ratings. In the case of the presidential election, the US market partially priced in the outcome before the official announcement and reacted again after the results were released. The strongest reactions were observed among smaller firms and entities without ESG ratings. In Europe, the effect was mainly visible after the announcement and was predominantly negative, particularly among companies without ESG scores. The election was also accompanied by increased market liquidity, especially in the United States.

A much stronger reaction was observed following the decision to withdraw the United States from the Paris Agreement. In the United States, the decision was generally assessed positively, resulting in positive abnormal returns, particularly among smaller firms without ESG ratings. In contrast, the European market reacted negatively, especially in sectors such as energy, basic materials, technology, utilities, and financials. Companies with greenwashed ESG ratings often experienced negative reactions, suggesting that the market does not treat such ratings as a credible source of reputational protection.

In the case of the Omnibus proposal, the usual reaction in the United States was negative, particularly among firms without ESG ratings. In Europe, however, companies with clean ESG ratings recorded positive abnormal returns, which may reflect a favorable perception of regulatory simplification and lower compliance costs. The results also suggest that US investors do not clearly differentiate between clean and greenwashed ESG ratings.

Overall, the findings indicate that markets react more strongly to concrete regulatory changes than to political events alone, and that financial considerations dominate over non-financial factors in valuation decisions. Clear differences are also visible between the US and European markets, with smaller firms appearing more sensitive to regulatory changes.

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Main Conclusions and Implications

The aim of this book was to provide a comprehensive analysis of ESG risk, focusing on the impact of regulations and initiatives related to ESG risk estimation on non-banking financial institutions, especially investment funds and insurance companies, and their business strategies. The study confirms that the European financial market is sensitive to US market decisions related to ESG risk (H1). It is observed that geographical, size, and sectoral biases affect ESG risk measurement and capital adequacy of insurance companies (H2, H2, H4). Changes in US regulatory policy under the Trump administration affected the activity of investment funds (H5). Changes in ESG risk regulation influence the greenium and the size of the green bond market (H6).

The conducted analysis indicates that ESG risk has become a significant and persistent component of risk management in financial institutions, particularly in investment funds and insurance undertakings. The evolution of this concept – from a normative, ethics-based approach to an integrated element of financial risk – has been driven by both regulatory developments and the increasing materiality of environmental, social, and governance factors for financial stability and long-term value creation. The nature and transmission channels of ESG risk differ substantially between investment funds and insurance undertakings. Insurers are more directly exposed to the effects of physical and climate-related risks, which affect underwriting processes, the valuation of technical provisions, and solvency. Investment funds, by contrast, experience ESG risk primarily indirectly – through changes in asset valuations, increased market volatility, liquidity risk, and reputational risk, particularly in the context of greenwashing.

A particularly significant challenge remains the quality and comparability of ESG data. Numerous limitations of ESG ratings and scores have been identified, including strong methodological divergence, a lack of transparency in rating algorithms, differences in data coverage, and biases related to firm size, sector, and geographic location. As a result, ESG ratings do not always reflect actual exposure to ESG risk, which may lead to capital misallocation and rating inflation. The findings also confirm that greenwashing – both qualitative and quantitative – constitutes a key threat to the credibility of ESG ratings. Selective disclosures, imputation of missing data, and excessive aggregation of

indicators contribute to halo effects, distorting the assessment of the actual ESG performance of rated entities.

From a risk management perspective, a comprehensive approach to ESG risk management is critical, encompassing identification, measurement, management, monitoring, and the integration of ESG factors into decision-making processes. The analysis confirms that effective ESG risk management requires combining qualitative and quantitative methods, employing climate scenarios, and developing internal analytical capabilities rather than relying uncritically on external ratings.

From a practical point, the results underscore the need for financial institutions to move beyond a purely compliance-based approach to ESG and to fully integrate ESG risk into their overall risk management frameworks and strategic decision-making processes. Investment funds and insurance companies should treat ESG risk as a material financial risk affecting asset valuation, risk assessment, liquidity management, and capital allocation, rather than merely as a reputational or reporting issue.

The dynamic development of regulations, reporting standards, and international initiatives indicates a shift in ESG from the domain of voluntary practices and reputation toward a mandatory, regulation-embedded component of risk management. In the case of investment funds, ESG regulations significantly affect portfolio construction, investment strategies, and investor communication. Fund classification under SFDR and ESMA guidelines on fund naming enhances market transparency but simultaneously constrains managerial flexibility and increases regulatory risk stemming from inconsistencies between declared strategies and actual investment practices. Practitioners, therefore, need to adopt a holistic and forward-looking approach that integrates ESG risk into existing governance, risk management, and reporting frameworks. The expanding scope and complexity of ESG regulations – particularly in the European Union – imply that financial institutions should invest in robust internal systems for ESG data collection, validation, and analysis. Exclusive reliance on external ESG ratings is becoming increasingly insufficient given documented methodological divergences and regulatory scrutiny. The development of internal ESG risk assessment models, supported by high-quality data and sector-specific expertise, is essential to meet regulatory expectations and to manage transition and physical risks effectively. The growing issuance of sustainability-linked financial instruments, including green bonds, sustainability-linked bonds, and loans, highlights the strengthening link between ESG performance and the cost of capital. For issuers, transparent and credible ESG disclosures can improve access to financing and reduce funding costs, whereas poor ESG risk management may lead to higher capital requirements, exclusion from investment markets, or reputational losses.

The analysis confirms that ESG risk, and climate risk in particular, has become a core element of the insurance sector's functioning and a key factor influencing the financial stability of insurance and reinsurance undertakings. The evolution of EU regulations points to a lasting shift from voluntary ESG

initiatives toward a mandatory, prudentially embedded risk management component. Climate risk affects the insurance sector through a dual channel – on the asset side (investments, market and credit risk, and stranded assets) and on the liability side (underwriting risk, technical provisions, and the frequency and severity of catastrophic losses). Consequently, the insurance sector occupies a particularly vulnerable position with respect to climate change, justifying strong regulatory interest in long-term scenarios, stress testing, and the recalibration of capital requirements.

The analysis also reveals numerous challenges associated with the practical implementation of ESG regulations. These include limited data availability, low comparability of non-financial information, high costs of climate models, and the lack of standardized methods for measuring transition and physical risks. In this context, EIOPA initiatives aimed at developing open models and shared data repositories should be assessed as an important step toward lowering entry barriers and enhancing analytical consistency. The findings further indicate that despite the growing importance of climate risk, the “S” and “G” components of ESG risk remain less developed both methodologically and regulatorily. EIOPA recognizes this issue and is gradually mapping social risks onto existing Solvency II risk categories; however, their quantification and impact on solvency still require further conceptual and empirical work.

The analysis confirms that socially responsible investment (SRI) funds and ESG funds do not constitute a homogeneous investment category, despite the use of similar marketing terminology. Heterogeneity in investment objectives, ESG integration methods, data selection, and portfolio strategies poses significant regulatory challenges, particularly regarding product comparability and investor protection. In practice, this hampers both effective supervision and unambiguous assessment of ESG risk at the fund level.

From a practical perspective, the three-stage ESG risk integration process – identification, assessment, and integration – has become a *de facto* market standard. However, its degree of sophistication varies substantially across asset classes. The most advanced approaches are observed in equity investments, whereas debt portfolios – especially sovereign bonds – are dominated by simplified methods based on exposure analysis and macroeconomic indicators. This limits the comparability of ESG risk across funds with different investment strategies.

Empirical findings indicate that negative screening remains the dominant ESG strategy in market practice, particularly in Europe. Although relatively easy to implement and aligned with retail investor expectations, this strategy entails reduced portfolio diversification and potentially lower risk-adjusted returns. At the same time, regulators signal that sector exclusions alone may be insufficient, particularly in the context of defense-related activities.

From a financial stability perspective, ESG and SRI funds exhibit weaker sensitivity of flows to performance. Lower investor responsiveness to short-term underperformance reduces the risk of sudden redemptions and fire sales, which may have a stabilizing effect on markets, particularly during periods of

stress. At the same time, higher liquidity of assets with high ESG ratings reduces funds' vulnerability to liquidity shocks.

However, the analysis also identifies significant regulatory risks related to greenwashing and green window dressing. Practices involving temporary portfolio adjustments to meet disclosure requirements undermine the effectiveness of regulations based on periodic reporting. Empirical evidence suggests that funds may improve their "green" profile during reporting periods and subsequently revert to more profitable but less sustainable assets. This phenomenon justifies increasing disclosure frequency, using high-frequency data, and strengthening supervisory oversight of consistency between declared strategies and actual portfolio allocations.

The analysis of total expense ratios and management fees indicates that the cost structure of investment funds varies significantly across asset classes, investment strategies, and geographic regions. The lowest cost levels are consistently observed in money market and bond funds, while the highest are found in the alternative funds segment. This confirms the hypothesis that greater financial instrument complexity and lower asset liquidity translate into higher management costs.

The findings show that the impact of ESG strategies on cost levels is not uniform and strongly depends on asset class. Funds employing impact, positive and negative screening, and ESG strategies often exhibit lower expense ratios and management fees than conventional funds in bonds, alternative assets, commodities, and money market instruments. Conversely, funds investing in equities, mixed assets, and real estate typically incur higher costs, which may reflect greater analytical effort, portfolio selectivity, and the need to monitor ESG risk at the issuer level.

An important conclusion is the reversal of this pattern in SRI funds, which more frequently exhibit higher costs in asset classes where other ESG strategies generate cost savings. This points to the absence of a uniform cost model for sustainable funds and underscores the need for caution in interpreting the claimed "cost efficiency" of ESG products from an investor-protection perspective.

Geographic analysis reveals clear regional differentiation. Funds operating in the United States exhibit, on average, lower costs than European funds, regardless of investment strategy. The highest costs are observed in Central and Eastern and Southern Europe, while the lowest are found in Northern and Western Europe and in the United States. These results suggest a strong structural component related, among other factors, to capital market development, fund scale, and the degree of competition.

The analysis also confirms that regulatory instability – particularly visible in US climate policy and non-financial reporting – indirectly affects the European market, for example, through reduced data availability and the influence on deregulatory initiatives such as the Omnibus package. As a result, investment funds face difficulties in constructing portfolios that align with their declared ESG strategies, thereby increasing the risk of greenwashing and window dressing.

A key practical conclusion is the limited ability of current analytical tools to assess the real impact of investments on the achievement of the Sustainable Development Goals and climate objectives. The dominance of retrospective approaches and relative benchmark comparisons precludes an unambiguous evaluation of portfolio contributions to economic transformation. In this context, the importance of forward-looking approaches, science-based targets, and net-zero portfolio concepts is increasing.

The analysis confirms that ESG risk is a significant, multidimensional factor affecting the financial stability of the insurance sector, manifesting through both regulatory channels (Solvency II, ORSA) and market channels (reputation, stakeholder expectations, and customer behavior). Climate risk plays a particularly important role, as physical and transition risks directly affect asset values, investment portfolio structures, and the capital adequacy of insurance undertakings. From a regulatory perspective, the findings indicate that the current Solvency II framework – particularly Pillar I and SCR mechanisms – remains a key tool for absorbing ESG risks; however, its effectiveness depends on data quality, modeling approaches, and the integration of climate risk into ORSA processes. The high share of climate-sensitive assets in insurers' portfolios and stress test results indicating significant long-term valuation declines underscore the need to further develop climate scenarios and stress testing in supervisory practice.

The analysis shows that the level and structure of own funds, including the dominant role of Tier 1 capital, remain crucial for insurers' ability to absorb losses arising from the materialization of ESG risks. At the same time, the growing importance of environmental and social risks increases pressure to diversify portfolios and to use risk-mitigation instruments such as reinsurance and adaptive mechanisms. In this context, the availability of reinsurance and public-private cooperation becomes an essential element of catastrophic risk management.

From a market practice perspective, the analysis confirms strong differentiation in ESG risk exposure across regions, countries, and business lines. The highest ESG scores are observed in countries with the most restrictive non-financial regulations, highlighting the importance of the institutional environment and regulatory culture. At the same time, high volatility of ESG outcomes and controversy indicators in highly developed countries suggests that greater transparency and reporting intensity also increase the visibility of reputational risks. A key regulatory conclusion is the confirmed impact of ESG scores on capital adequacy measures. Descriptive results indicate that insurers actively integrating ESG exhibit, on average, lower solvency margins, particularly after 2019, coinciding with the intensification of SFDR and CSRD regulations. This suggests that ESG integration may generate additional short-term capital pressures related to adjustment costs, portfolio restructuring, and more conservative risk valuation. However, literature and empirical evidence indicate that in the long term, higher ESG scores support financial stability, reduce systemic risk, and enhance insurers' reputations – an effect particularly

pronounced for reputational risks and ESG controversies, which have a stronger impact on perceived credibility and capital access in the insurance sector than in many other industries.

The analysis also confirms that ESG risk should be assessed separately across business lines. The lowest ESG scores observed in property and casualty insurance, combined with high exposure to catastrophic risks, justify the need for sector-specific underwriting guidelines and differentiated regulatory approaches across insurance products.

The analysis confirms that ESG risk – particularly environmental risk – significantly affects both insurers' solvency and the structure of their investment portfolios. Empirical results indicate that increases in ESG scores, especially in the environmental dimension, influence solvency margins and investment decisions in ways that vary by sector, region, and time, with important implications for regulatory framework design. From a regulatory perspective, a particularly important finding is that an increase in the environmental score (E-score) leads to a reduction in solvency margins, especially in life insurance and property and motor insurance. This suggests that integrating climate and environmental risks into ORSA processes and capital models may, in the short term, lead to more conservative risk valuations and increased capital pressure. This effect strengthens after 2020, indicating the growing importance of ESG factors in both regulatory and market environments.

The analysis also reveals significant differences between European and US markets. In the United States, changes in ESG indicators – particularly environmental ones – have a stronger impact on solvency margins, reflecting greater exposure to physical climate risks. At the same time, the influence of ESG on investment structures in the United States is weaker or even negative. In Europe, by contrast, a clear positive impact of rising ESG scores on investments in real estate and investment assets is observed, indicating more effective regulatory influence on insurers' allocation decisions.

From a financial supervision perspective, these results confirm the need for further differentiation of regulatory approaches to ESG risk depending on the type of insurance activity. The strongest responses are observed in life insurance and property insurance, justifying the introduction of sector-specific guidelines for climate risk management, stress testing, and insurance product design. A universal approach to ESG risk may lead to underestimation of risks in some market segments and excessive regulatory burdens in others.

The analysis demonstrates that sustainability-related regulations have become a key structural factor shaping the dynamics of the green bond market, affecting issuance volumes, pricing, investor behavior, and contagion effects across markets. While regulatory frameworks have effectively supported the development of the green bond market – particularly in Europe – their increasing volatility and sensitivity to geopolitical factors generate new sources of systemic risk that require careful regulatory calibration. From a regulatory perspective, the results highlight the critical importance of stable, predictable, and credible sustainability policies. Regulatory initiatives supporting green

bond issuance – such as standardized certification, transparent reporting frameworks, and clear eligibility criteria – enhance investor confidence and facilitate capital allocation to projects with genuine environmental impact. Conversely, abrupt regulatory shifts, exemplified by the United States' withdrawal from the Paris Agreement, increase uncertainty, amplify market volatility, and weaken incentives for long-term green investment. This implies that regulatory credibility and continuity are as important as policy ambition.

A comparison of US and European markets reveals asymmetric regulatory transmission mechanisms. More coherent and consistent sustainable finance frameworks in Europe have fostered the development of a deeper and more resilient green bond market, while regulatory volatility in the United States has increased investor uncertainty and reduced the relative attractiveness of green bonds compared with conventional instruments. These differences suggest that fragmentation of regulatory approaches may weaken global integration of green finance and constrain cross-border capital flows. Greater international coordination – particularly between the EU and the United States – could reduce regulatory arbitrage and strengthen the global green bond market.

The results also have important implications for financial stability and macroprudential supervision. Green bonds exhibit greater sensitivity to geopolitical risk and regulatory uncertainty than conventional bonds, making them more vulnerable to shocks during periods of political and regulatory tension. As green bonds become increasingly integrated into the broader financial system, regulators should monitor contagion channels between green and traditional assets, particularly during systemic events. Incorporating green assets into stress tests and macroprudential surveillance tools may help identify emerging systemic vulnerabilities.

From the perspective of investors and issuers, regulatory uncertainty affects allocation decisions and issuance strategies. Rational investors tend to shift capital toward conventional bonds amid inconsistent policy signals, while issuers may delay or abandon green bond issuance amid unclear regulatory prospects.

Finally, heterogeneous equity market reactions to environmental regulatory announcements indicate that sectoral factors and firm-specific characteristics play a crucial role in shaping market responses. Uniform regulatory instruments may therefore produce differentiated effects across industries, potentially exacerbating distributional consequences. Policymakers should thus design flexible regulatory tools that account for sector-specific transition risks while maintaining overarching climate objectives.

In conclusion, the findings indicate that sustainable finance regulations effectively support the development of the green bond market, provided that they are coherent, transparent, and internationally coordinated. At the same time, regulatory volatility and geopolitical uncertainty may weaken these positive effects by increasing market risk and constraining market participant activity. Regulatory frameworks grounded in stability, proportionality, and credible data are essential not only for the continued development of the green bond market but also for ensuring broader financial stability.

Appendix 1

ESG risks and economic sectors heat map

CRITERIA	THEME	RISK CRITERIA	RISK MITIGATION EXAMPLES & GOOD PRACTICE	ECONOMIC SECTORS																					
				Agriculture/Livestock	Agriculture/Fishing	Agriculture/Paper & Forestry	Chemicals	Defence	Electronics/Technology	Energy	Construction/Coal	Construction/Hydro Dams	Construction/Nuclear	Exploration & Construction/Oil & Gas	Production of Fuels/ Derivatives	Finance (depending on client and/or transaction)	Gambling	Healthcare/Pharma/ Biotech/Life Science	Infrastructure/Construction	Food/Beverage Manufacturing	Garment Manufacturing	Real Estate	Utilities (Waste & Water)	Mining	Transport/Shipping/Logistics
Environment	Climate change	Air pollution, greenhouse gas emissions, and transition risks	Disclosure of climate-related emissions in operations and/or products (e.g. CO2, CH2, N2O, HFCs, PCFs, SF6)																						
			Breakdown of fuel/material/carbon intensity mix relevant to the client or transaction (e.g. power generating mix or by economic sector intensity)																						
			Environmental & social impact assessment (ESIA) covering negative health impacts, mitigation and decommissioning where relevant																						
		Decarbonisation transition plan/targets, customers fitting new emission mitigation technology, TCFD disclosures																							
	Environmental degradation	Physical risks (e.g. heat, wildfire, extreme precipitation, flood, windstorm, tropical cyclones, sea level rise, water stress)	Nature-based solutions (e.g. sustainable flood or coastal defence management, broader climate resilience adaptation plans)																						
			Exposure to unconventional mining practices (e.g. mountain top removal, riverine tailings dumping, deep sea mining)																						
		Deforestation or controversial site clearance (e.g. palm oil on peatlands or fragile slopes, illegal fire clearance/logging, biodiversity loss, dam construction)	Certification for palm oil, paper, etc. Dam construction standards: IHA Hydropower Sustainability Assessment Protocol, UNEP Dams & Development, Equator Principles																						
			Soil pollution	ESIA covering possible negative health impacts, mitigation measures and decommissioning plans where relevant																					
		Water pollution / over consumption	Water management practices (e.g. tackling quality, scarcity, overconsumption). Effective ESIA process covering water pollution. External audits/certification																						
			Impacts on World Heritage Sites or other protected areas	ESIA that covers impacts on endangered species and sites including mitigation. Specialist lists: Ramsar, UNESCO World Heritage Sites, High Conservation Value sites.																					
Protected sites/species	Impacts on species on IUCN Red List of Threatened Species	ESIA that covers impacts on endangered species and sites including necessary mitigation measures																							
	Exposure to unconventional energy practices (e.g. Arctic oil, hydraulic fracturing, tar sands, deep sea drilling)	Various energy initiatives: IPIECA, IFC EH&S Guidelines, Energy & Biodiversity Initiative for Oil & Gas, Arctic Council, Oil Sands Leadership Initiative																							

[illegible]

Appendix 2

ESG risks and lines of business heat map

CRITERIA	THEME	RISK CRITERIA	RISK MITIGATION EXAMPLES & GOOD PRACTICE	Agribusiness	Property	Liability	Product Liability	Worker Compensation	Construction	Credit & Surety	Cyber	Directors & Officers	Financial Lines	Marine Hull	Protection	Aviation	Cargo	PRINCIPLES			
																		SDGs	UNGC	PSI	PRI
Environment	Climate change	Air pollution, greenhouse gas emissions, and transition risks	Disclosure of climate-related emissions in operations and/or products (e.g. CO2, CH2, N20, HFCs, PCFs, SF6)		■	■			■	■		■						13	8	4	6
			Breakdown of fuel/material/carbon intensity mix relevant to the client or transaction (e.g. power generating mix or by economic sector intensity)		■	■			■	■		■						7, 12	7, 8, 9	1, 2, 3	3
			Environmental & social impact assessment (ESIA) covering negative health impacts, mitigation and decommissioning where relevant		■	■			■	■		■						3.1	7, 8, 9	1, 2, 3	1, 5
			Decarbonisation transition plan/targets, customers fitting new emission mitigation technology, TCFD disclosures		■	■			■	■		■						7	7, 8, 9	1, 2, 3	1, 5
	Environmental degradation	Physical risks (e.g. heat, wildfire, extreme precipitation, flood, windstorm, tropical cyclones, sea level rise, water stress)	Nature-based solutions (e.g. sustainable flood or coastal defence management, broader climate resilience adaptation plans)		■	■			■	■		■						9, 13	7, 8, 9	1, 2, 3	2
			Exposure to unconventional mining practices (e.g. mountain top removal, riverine tailings dumping, deep sea mining)		■	■			■	■		■						7, 9, 12, 13	7, 8	1, 2	2, 5
			Deforestation or controversial site clearance (e.g. palm oil on peatlands or fragile slopes, illegal fire clearance/logging, biodiversity loss, dam construction)	■	■	■			■	■		■						12, 15	7, 8	1, 2	4, 5, 6
			Soil pollution	■	■	■			■	■		■						3.1	7, 8	1, 2, 3	1.5
	Protected sites/ species	Water pollution / over consumption	Water management practices (e.g. tackling quality, scarcity, overconsumption). Effective ESIA process covering water pollution. External audits/certification	■	■	■			■	■		■						6, 13	7, 8	1, 2, 3	3, 6
			ESIA that covers impacts on endangered species and sites including mitigation. Specialist lists: Ramsar, UNESCO World Heritage Sites. PSI-WWF-UNESCO guide to protect World Heritage Sites	■	■	■			■	■		■						11, 15	7, 8	1, 2, 3	2, 5
			ESIA that covers impacts on endangered species and sites including necessary mitigation measures	■	■	■			■	■		■						14, 15	7, 8	1, 2, 3	2, 5
			Various energy initiatives: IPIECA, IFC EH&S Guidelines, Energy & Biodiversity Initiative for Oil & Gas, Arctic Council, Oil Sands Leadership Initiative	■	■	■			■	■		■						9	7, 8, 9	1, 2, 3	4
Environment	Unsustainable practices	Illegal fishing vessels, controversial fishing practices or aquaculture techniques	PSI-Oceana guide on illegal, unreported & unregulated (IUU) fishing, IUU fishing lists, Aquaculture/Marine Stewardship Council certification	■	■	■			■	■		■		■	■	■		12, 14, 17	7, 8	1, 2, 3	5, 6
			PSI guide on the risks of plastic pollution, marine plastic litter and microplastics to the insurance industry	■	■	■			■	■		■		■	■	■		3, 6, 12, 14	7, 8, 9	1, 2, 3	1, 2, 3

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