

The Relationship between ESG Factors and Corporate Credit Risk: Research Trends from a Bibliometric Perspective*

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The study reviews the literature analysing the relationship between ESG factors and corporate credit risk using bibliometric and systematic literature review methods, processing scientific publications published between 2020 and 2024. Of these, 61 relevant studies are identified and examined in detail, focusing primarily on research trends and empirical results. Due to stricter regulations and market interest, the number of articles focusing on ESG and credit risk has increased significantly. According to the majority of publications, better ESG performance reduces credit risk. Our analysis revealed several research gaps: the examination of the relationship between ESG and credit risk in the small and medium-sized enterprise sector, the impact of climate risks on corporate credit risk and credit portfolios, region-specific analyses, and the application of innovative artificial intelligence and machine learning-based methodological frameworks are areas that could generate significant added value in both academic and market contexts.

Journal of Economic Literature (JEL) codes: C10, G20, G21, Q56

Keywords: ESG, credit risk, bank, corporate finance, systematic literature review

1. Introduction

The consideration of ESG (Environmental, Social, Governance) factors in the analysis of corporate credit risks has come to the fore in recent years. Numerous international rules and guidelines have encouraged financial sector players to integrate sustainability considerations into their credit risk management frameworks.

* The papers in this issue contain the views of the authors which are not necessarily the same as the official views of the Magyar Nemzeti Bank.

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This study was prepared as part of doctoral research examining the relationship between ESG factors and corporate credit risk, with the support of the Cooperative Doctoral Programme. We would also like to express our gratitude to Gabriella Lamanda for her professional support and useful feedback.

The first version of the Hungarian manuscript was received on 5 August 2025.

DOI: <https://doi.org/10.33893/FER.24.4.96>

UN initiatives¹ have also had a major impact on exerting stronger pressure through financial intermediaries to achieve sustainability goals. During this period, international recognition of the framework supporting climate-related disclosures (Task Force on Climate-related Financial Disclosures² – TCFD) has grown stronger. In the European context, the 2019 European Green Deal,³ the EU Taxonomy Regulation⁴ (Regulation (EU) 2020/852) and the Sustainable Finance Disclosure Regulation (Regulation (EU) 2019/2088,⁵ SFDR) are particularly noteworthy. EU and Hungarian regulations specifically applicable to credit institutions and financial enterprises – such as EBA/GL/2025/01, the European Banking Authority's⁶ (EBA) guideline on ESG risk management, and Magyar Nemzeti Bank (The Central Bank of Hungary) Recommendation No. 7/2025 (VI. 23.)⁷ – clearly stipulate that financial institutions must integrate ESG factors into their credit risk management processes. As a result, the relationship between sustainability (ESG) factors and credit risk indicators has received increased attention since 2020.

It is also worth noting that, not only in the banking system and lending but also in general, investor interest in ESG considerations has grown significantly in recent years, as evidenced by the global rise of sustainable investments and the widespread adoption of responsible capital market practices (*PRI*;⁸ *OECD 2021*). The European Union's sustainable finance framework – in particular, the Taxonomy Regulation and the SFDR – further encourages the integration of ESG factors into investment decisions, which also influences the assessment of corporate credit risk. In addition, studies (e.g. *Amel-Zadeh – Serafeim 2018; Ahmad et al. 2024; Li et al. 2025*) also point out that ESG considerations are playing an increasingly important role in business and investment decision-making. Sustainability performance is no longer just a matter of reputation, but directly influences financing conditions, capital market perception and investor confidence.

¹ 2006 Principles for Responsible Investment and 2019 Principles for Responsible Banking.

² The TCFD is an international organisation supported by the United Nations that aims to standardise the disclosure of climate risks (*TCFD 2017*).

³ A comprehensive programme launched by the European Union in 2019 with the aim of achieving climate neutrality by 2050 (*European Commission 2019*).

⁴ Defines which economic activities may be considered sustainable (<https://eur-lex.europa.eu/eli/reg/2020/852/oj/eng>).

⁵ Requires financial institutions to disclose ESG risks and impacts (<https://eur-lex.europa.eu/eli/reg/2019/2088/oj/eng>).

⁶ EBA issues guidelines on prudent operation and ESG risk management for EU credit institutions (<https://www.eba.europa.eu/sites/default/files/2025-01/fb22982a-d69d-42cc-9d62-1023497ad58a/Final%20Guidelines%20on%20the%20management%20of%20ESG%20risks.pdf>).

⁷ <https://www.mnb.hu/letoltes/7-2025-esg-kerdoiv-ajanlas.pdf> (in Hungarian)

⁸ <https://www.unpri.org/>.

This study explores the research trends and patterns that can be observed in scientific publications dealing with the relationship between ESG and credit risk as a result of increasing regulatory requirements and growing investor interest in sustainability. To this end, we process publications analysing the relationship between ESG and credit risk based on keywords, and we present and systematise current research focuses and scientific results. Based on this, we also identify research gaps that could serve as a basis for further empirical analyses.

In our study, we conducted a systematic literature review and bibliometric analysis to explore the relationship between ESG and corporate credit risk. We used the Elsevier Scopus⁹ and Web of Science¹⁰ (WoS) databases for the analysis, which was performed with the Python programming language. We examined English-language publications published between 2020 and 2024 and identified 61 relevant studies. By analysing these, we identified publication trends and possible directions for further research.

To the best of our knowledge, there has been no comprehensive, structured literature review that specifically examines the relationship between ESG factors and corporate credit risk management using a systematic literature review methodology. This study aims to fill this gap.

Our article is structured as follows. Following the introduction, *Section 2* presents the methodology used in the research, while *Section 3* presents the results in three sub-sections. *Sub-Section 3.1* focuses on research trends, changes over time, the geographical relevance of the research and journals, and identifies the main research topics and areas of focus. *Sub-Section 3.2* details publications analysing the relationship between ESG and credit risk, with a particular focus on ESG components (E, S, G, disclosure) and credit risk indicators (e.g. credit rating, CDS spread, probability of default). In *Sub-Section 3.3*, we summarise the results and methods of the most influential research in the field as well as the variables examined. Finally, in *Section 4*, we formulate our most important conclusions.

⁹ <https://www.scopus.com>.

¹⁰ <https://www.webofscience.com>.

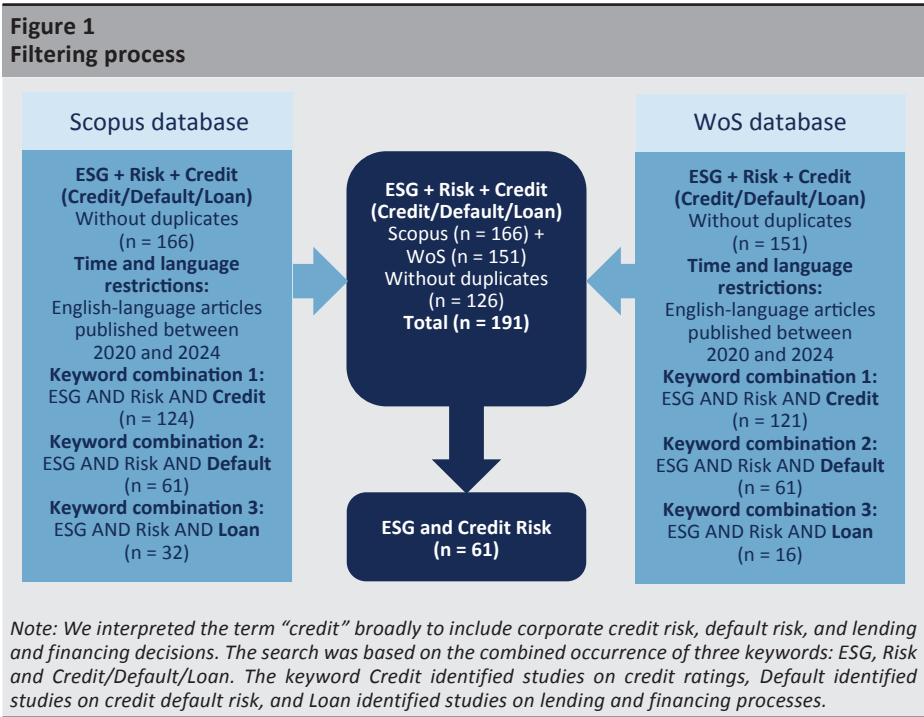
2. Methodology

We used systematic literature search and bibliometric analysis in this study. We took publications found in the Elsevier Scopus and Web of Science (WoS) databases as our data sources. The analysis was performed using the Python programming language. The search covered publication titles, abstracts and keywords. In addition, we applied further restrictions: we only considered English-language, “article” type publications published between 2020 and 2024. The chosen time interval was justified by the fact that the number of scientific publications analysing the relationship between ESG and corporate credit risk has increased significantly since 2020 (see *Figure 3*).

One important step was selecting the appropriate keywords, which we determined based on our primary research question and a preliminary review of the literature on the subject. In the course of our research, we narrowed down the range of relevant publications in two search and filtering cycles. First, we searched for publications examining the relationship between sustainability and risk using the keywords “ESG AND Risk”. As a second step, we narrowed down the “ESG AND Risk” search even further and ran three targeted queries that focused on exploring the relationship between ESG + Risk + Credit, Default, Loan. We interpreted the concept of credit in a broad sense in this context, using several keywords, as it encompasses both corporate credit risk and default risk as well as lending and financing processes (Loan). Accordingly, the search examined the co-occurrence of the three keywords in three rounds, with the third keyword containing three different expressions:

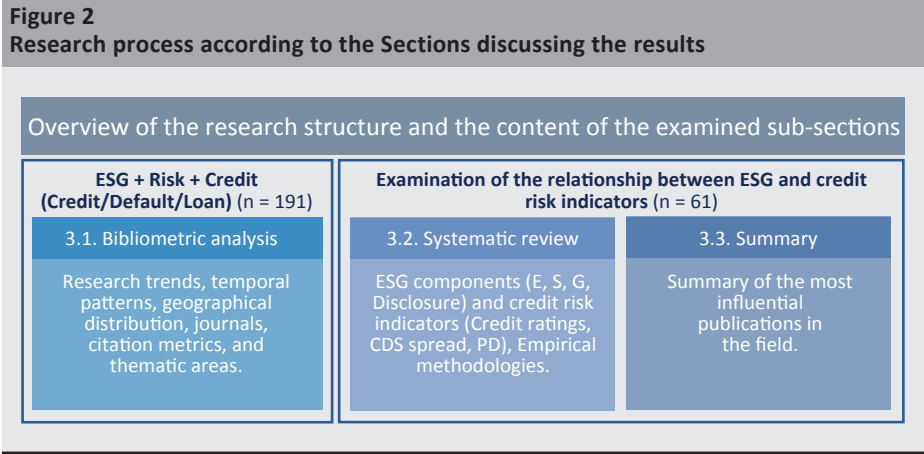
- “ESG AND Risk AND Credit” – we used the keyword “Credit” to identify studies focusing on credit ratings, credit markets in general and credit premiums;
- “ESG AND Risk AND Default” – the keyword “Default” covers research examining the probability of default, bankruptcy risk or PD indicators;
- “ESG AND Risk AND Loan” – the keyword “Loan” typically captures studies related to lending conditions, credit supply and financing decisions.

Finally, we systematically reviewed and categorised the results of the three keyword searches, in order to identify articles dealing with the relationship between ESG and credit risk. This step allowed us to filter out publications that touched on the topics of “ESG”, “Credit” and “Risk” but did not directly address the correlations between ESG and credit risk, which is the focus of our research.



Using the filtering criteria shown in *Figure 1*, we identified 191 relevant studies from the Scopus and Web of Science databases based on combinations of the keywords ESG + Risk + Credit, Default, Loan.

In the course of our research (*Figure 2*), we categorised the articles according to several criteria; the results are presented accordingly.



We first analysed the entire set of results (191 publications) based on a bibliometric analysis according to temporal and geographical (affiliation and research area) criteria, journals and main research topics. We then paid particular attention to the correlations between ESG components (E, S, G and ESG disclosure), credit risk and credit risk indicators (61 publications), to the main research results in this sub-area, and to the classification and analysis according to the methodologies used.

It should be noted that our study only collected English-language publications corresponding to the keywords, as the filtering of the Scopus and Web of Science databases does not include publications published in Hungarian-language journals, books or study volumes; therefore, these are not included in the analysis. At the same time, we found several Hungarian-language or Hungarian-origin studies that are closely related to the topic in a given subfield, such as climate risk or green finance, but these were not included in the search results. For example, *Ritter (2022)* analyses the impact of climate risks on the credit exposure of banks and bank branches operating in Hungary. *Várgedő (2022)* presents the methodology and results of a climate risk stress test conducted on Hungarian credit institutions. *Tamásné Vőneki – Lamanda (2020)* provide a comprehensive discussion of how ESG and climate risks manifest in the financial intermediary system. *Hajnal et al. (2022)* examine the risk correlations between energy certificates and housing loans. Finally, it is important to note that we are also aware of a systematic literature review in English that covers research trends in green finance and climate risks (*Muchiri et al. 2022*): it examines areas related to our research, but was published using different keywords, as well as relevant bibliometric and science history research that is not available in the form of journal articles (*Sárvári 2024*). We return to this when presenting the limitations of our study.

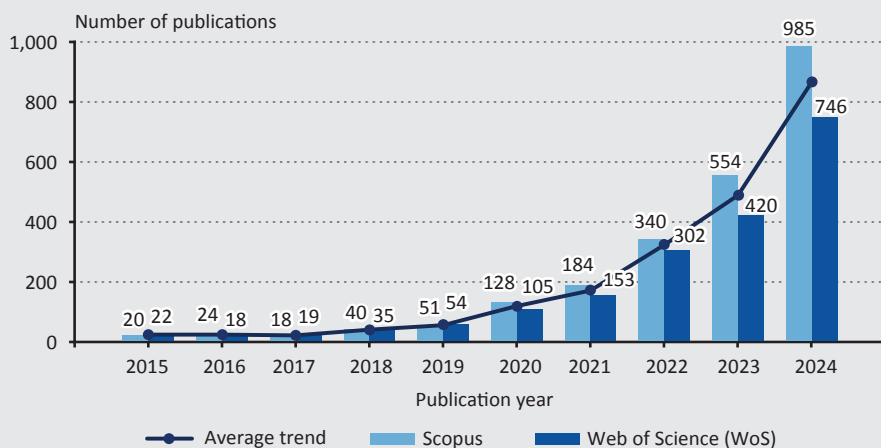
3. Results

The results are presented in three sub-sections, narrowing the focus of the research in parallel (*Figure 2*). In *Sub-Section 3.1*, based on articles filtered by ESG + Risk + Credit, Default, Loan, we analyse research trends, changes over time, geographical distribution and journals, and we present the main thematic areas and research focuses. *Sub-Section 3.2* discusses research examining the relationship between ESG and its components and credit risk indicators, supplemented by an analysis of methodological approaches. Finally, in *Sub-Section 3.3*, we summarise the most influential and most cited articles analysing the relationship between ESG and credit risk.

3.1. Research trends and thematic areas

Based on keyword research, the topic of ESG was already present in the academic discourse before 2011. However, until 2020, only about 20 to 50 publications were produced each year that focused on the relationship between sustainability and risk. After 2020, in parallel with the strengthening of regulatory requirements, the number of publications on this topic began to increase dramatically, which is why we chose 2020 as the starting point for our systematic analysis (*Figure 3*).

Figure 3
Number and growth trend of scientific publications on ESG and risk between 2015 and 2024



Source: Compiled based on Scopus and Web of Science

Within the ESG and risk topic, relatively few studies have specifically addressed the issue of credit risk management. However, the number of such studies rose dynamically between 2020 and 2024 (*Figure 4*), which clearly shows that the relationship between ESG and credit risk is becoming an increasingly important area of research in the financial literature. The increase of scientific interest essentially coincides with the entry into force of the sustainability regulations presented earlier and the change in market attitudes.

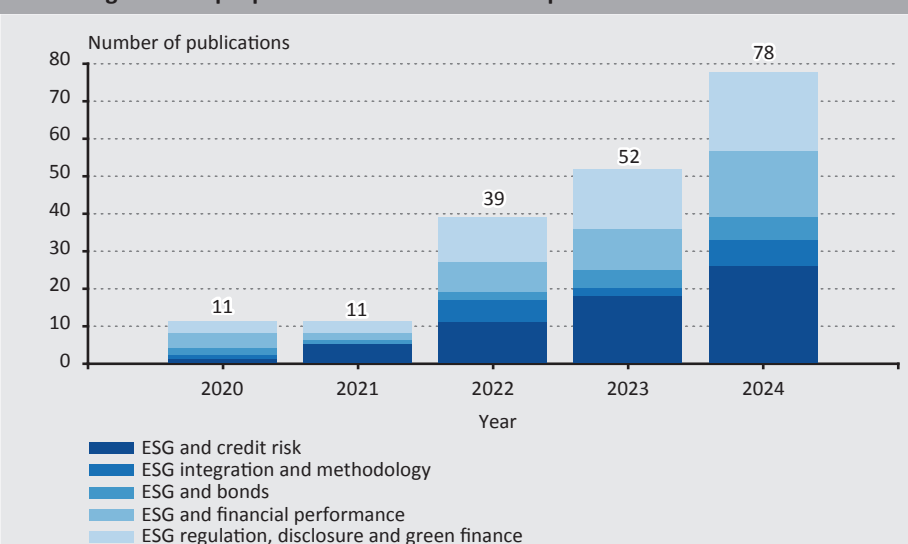
In the following, we only analyse studies published from 2020 onwards on the topic of ESG + Risk + Credit, Default, Loan.

Based on author affiliation, it can be established that 85 per cent of publications in the examined period can be linked to ten countries, meaning that a significant proportion of global publication activity is concentrated in a few larger countries. More than one-half of the publications come from researchers in Asian countries, with China standing out in particular.

Looking at the geographical focus of the studies, we found that most of the research has a global focus (52 articles). Among the regional analyses, Asia (63 articles) and Europe (37 articles) are the most frequently studied regions, with a significant number of articles also focusing on the Americas (32 articles). In terms of countries, China (21 articles) and the United States (27 articles) stand out, but there were also a smaller number of studies on Latin America (5 articles), India, Malaysia, Kazakhstan, Thailand, Ukraine, Russia, and Arab and African countries (1–3 articles). It can be concluded that advanced economies continue to dominate ESG credit risk research, but scientific interest in emerging or developing markets is now almost equally significant. We found a total of 7 articles on the Central and Eastern Europe (CEE) region and individual countries (4 on Poland, 1 on the Czech Republic, 1 on Ukraine and 1 on Romania), which indicates a gap in research. Research conducted on the entire CEE region, but specifically on the Hungarian corporate market, can provide significant added value for a deeper understanding of the interrelationships and for exploring region-specific characteristics, problems and risks.

The 191 publications examined may also be analysed thematically. Based on research focus, we identified the following thematic areas: ESG and credit risk; ESG and bonds; ESG and financial performance; ESG and regulation, disclosure and green finance; ESG and integration and methodology. *Figure 4* shows the dynamics of these thematic areas and the significant increase in the proportion of studies directly examining the relationship between ESG and credit risk.

Figure 4
Trends in the number of scientific publications on ESG + Risk + Credit, Default, Loan and changes in the proportion of main research topics between 2020 and 2024



Note: $n=191$

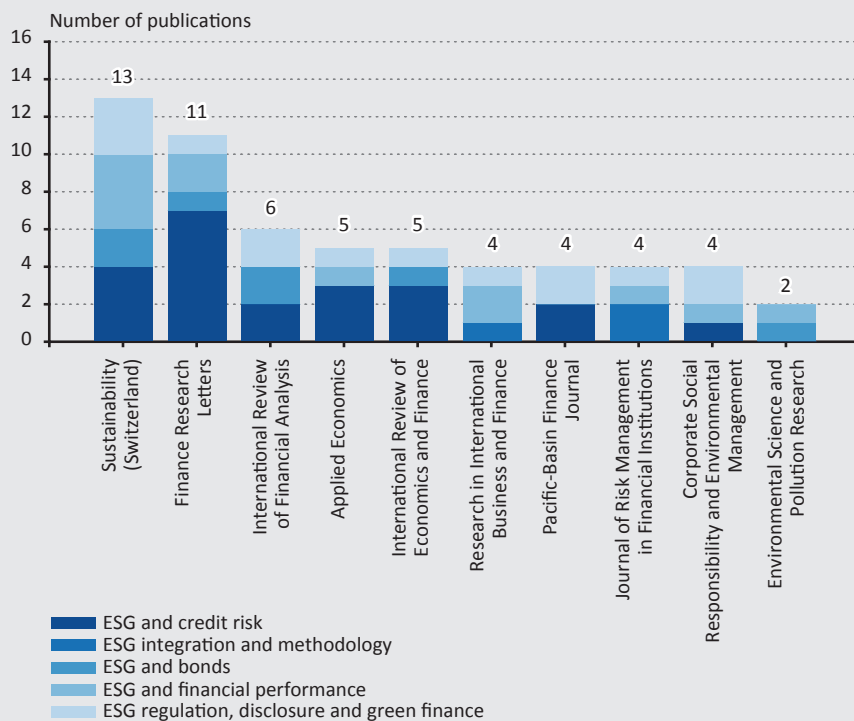
Source: Compiled based on Scopus and Web of Science

Looking at the examined five years (2020–2024), the largest thematic area overall (61 studies) examined the direct relationship between “*ESG factors and credit risk*”. The central question in these articles is whether high ESG performance reduces the probability of default and improves credit ratings. These studies are presented in more detail in *Sub-Section 3.2* below. The second most significant topic area is “*ESG regulation, disclosure and green finance*”, which comprises 55 studies. These studies examined the role of sustainability requirements, reporting obligations and green finance instruments, with a particular focus on market integration, the risks of so-called “greenwashing”,¹¹ and the impact of ESG factors on credit and bond market risks. The 43 studies analysing the relationship between “*ESG and financial performance*” discussed the relationship between ESG performance and corporate profitability, valuation and risk profile, examining whether sustainable practices represent a financial advantage or a cost for companies. 16 studies analysed the relationship between “*ESG and bonds*”, and bond markets, presenting the impact of ESG factors on bond yields, risk premiums and funding costs. 16 studies also addressed the topic of “*ESG integration and methodology*”. These studies developed new models, assessment frameworks and risk estimation methods for the systematic integration of ESG considerations into investment and credit decision-making. The aim of these studies was to improve the measurability of ESG factors and integrate them into quantitative models, thereby facilitating the objective assessment of ESG considerations in risk management.

Figure 5 shows the distribution of articles published by the journals with the most publications on the subject and their publishers, broken down by topic. Looking at the journals, a significant proportion of the articles appeared in journals focusing on finance, economics and sustainability, and the role of journals focusing on business ethics and corporate governance issues is also significant, reflecting the interdisciplinary nature of the relationship between ESG and credit risk. The journals with the most publications are: “Sustainability” (13 articles) and “Finance Research Letters” (11 articles). The former tends to integrate sustainability aspects into economic analyses, while the latter approaches the topic from a financial and investment perspective. “International Review of Economics and Finance” (6 articles) also has a significant share as an economics journal that has published several articles on the topic. According to the SCImago Journal Rank classification, the journals with the most publications belong to the categories of “Economics”, “Econometrics” and “Finance”, which confirms the financial and economic focus of the topic.

¹¹ “Greenwashing” is a deceptive practice whereby a company presents its sustainability performance as better than it actually is for marketing or communication purposes (*European Parliament Think Tank 2022*).

Figure 5
Top 10 journals and the number of publications published in different thematic areas



Source: Compiled based on Scopus and Web of Science

3.2. Examining the relationship between ESG and credit risk indicators, and methodologies

In the following sub-section, we further narrow down the research related to ESG, Risk and Credit, analysing 61 studies that specifically examine the relationship between ESG and corporate credit risk. As a first step, we show what types of credit risk indicators the studies examined used to measure credit risk and how they integrated ESG factors (as an aggregate indicator or as separate E, S or G components) into their research. Based on this, we were able to identify research gaps. At the end of the sub-section, we grouped the publications based on the methodology used.

Table 1 summarises the analysis based on credit risk indicators and ESG dimensions.

Table 1
Grouping of publications based on the credit risk indicators and ESG factors examined (n = 61)

Credit risk indicators / ESG factors	E	ESG	Total
(1) Structural / modelled credit risk indicators	4	25	29
(2) Credit rating-based indicators	3	13	16
(3) Market-based risk indicators	2	7	9
(4) Financing / bank-based risk indicators	1	6	7
Total	10	51	61

Note: The colouring of non-summing cells containing numbers indicates frequency of occurrence; darker shades indicate higher frequency, lighter shades indicate lower frequency.

Source: Compiled based on Scopus and Web of Science

When examining ESG factors, studies examining environmental factors (E) typically drew conclusions through the analysis of carbon dioxide emissions, environmental performance indices and climate exposure. Among these, several studies (e.g. *Palmieri et al. 2023; Danisman – Tarazi 2024; Wadhwani 2022; Ginglinger – Moreau 2023; Kim – Kim 2024; Schult et al. 2024; van der Walt et al. 2024*) showed that better environmental performance and lower carbon intensity had a positive impact on credit risk indicators, while high emissions or climate exposure increased risk. Only five of the studies specifically addressed the impact of climate or climate policy risk on credit risk (*Liu et al. 2023; Sun et al. 2024; Kim – Kim 2024; Hrazdil et al. 2024; Penikas – Vasilyeva 2023*).

The research most often focused on evaluating the relationship between overall ESG performance and credit risk (48 articles). None of the studies focused exclusively on the social (S) or corporate governance (G) pillars. However, according to *Hua Fan – Michalski (2020)* and *Al Mutairi – Bakar (2023)*, strong governance structures and high transparency have a risk-reducing effect. The analysis of social (S) factors focused on the effects of CSR activities and ethical violations (Corporate Social Irresponsibility – CSI). *Fauser – Gruener (2020)*, *Quang Trinh et al. (2023)*, *Ngamvilaikorn et al. (2024)* and *Ubeda et al. (2024)* all found in respect of this topic that responsible operation is associated with lower bankruptcy and reputational risk, while social irresponsibility is associated with higher risk in this regard.

Looking at the other dimension, the credit risk indicators examined can be divided into four main categories. The use of *(1) structural or modelled credit risk indicators* is the most common (29 articles). These include risk measures based on internal financial and accounting data that examine the financial stability and probability of default of companies. These include indicators such as Probability of Default (PD),¹²

¹² Probability of default: the chance that a debtor will fail to meet their payment obligations within a given period. It is a key indicator of bank risk management, also used in the Basel framework (*Bessis 2015; Basel Committee on Banking Supervision (BCBS 2006)*).

Expected Default Frequency (EDF),¹³ the Altman Z-score¹⁴ and the Merton model.¹⁵ The results of these studies showed that higher ESG performance was typically associated with lower PD and a more favourable Z-score, i.e. better sustainability performance of companies was accompanied by lower credit risk (see, for example, *Atif – Ali 2021; Brogi et al. 2022*). The second most common category is (2) *credit rating-based indicators* (16 publications). These studies were based on ratings assigned by credit rating agencies (e.g. S&P, Moody's, Fitch) and changes in those ratings. Most of the studies concluded that higher ESG ratings – especially the corporate governance (G) component – had a positive impact on credit ratings, reducing the likelihood of downgrades and funding costs (*Jeon 2021; Chodnicka-Jaworska 2021*). The third category consists of (3) *market-based risk indicators* (9 publications). These include indicators derived from investor pricing, such as bond yields and Credit Default Swap (CDS)¹⁶ spreads. These indicators directly reflect the credit risk perceived by the market and respond well to changes in ESG performance. Numerous empirical studies have shown that better ESG performance significantly reduces CDS spreads and bond market risk premiums, indicating a lower level of risk perceived by investors (*Jang et al. 2020; Barth et al. 2022; Lian et al. 2023; Bannier et al. 2022*). Finally, the fourth group includes (4) *financing and bank-based risk indicators* (7 publications). These studies examined companies' access to credit, their tax financing costs or the ratio of non-performing loans¹⁷ (NPL) as indirect manifestations of credit risk. The results showed that companies with higher ESG ratings were viewed more favourably by banks, which led to better credit terms and lower funding costs (*Luo et al. 2023; Quang Trinh et al. 2023*).

Based on the ESG factors and credit risk indicators examined, a number of research gaps emerge. Most of the studies analysed focused on the large enterprise segment, while small and medium-sized enterprises (SMEs) are key players in terms of economic value added and employment.¹⁸ Since sustainability goals cannot be achieved without the involvement of this sector, it would be justified and useful to expand research on the ESG activities and risk profiles of the SME sector. In our opinion, such studies could promote the development of practical guidelines and processes that could help smaller businesses achieve sustainable operations.

¹³ The probability of default estimated by Moody's KMV model, which determines the expected frequency of default based on the market value of the company's assets and the ratio of liabilities (*Kealhofer 1995*).

¹⁴ A discriminant analysis model based on the company's financial ratios, which predicts the probability of insolvency (*Altman 1968*).

¹⁵ A structural credit risk approach that treats the value of a company as an option and signals bankruptcy when the value of assets falls below liabilities (*Merton 1974*).

¹⁶ Credit risk premium, which shows how much it costs to buy insurance against a debtor's default; one of the main indicators of risk perceived by market participants (*Hull et al. 2004*).

¹⁷ Non-performing loan, where the debtor has not paid interest or principal for more than 90 days; a category defined by the European Central Bank guidelines (*ECB 2017*).

¹⁸ According to data published by the European Commission (*European Commission 2022*), the importance of small and medium-sized enterprises: in 2019, micro and small enterprises (employing fewer than 50 persons) accounted for 99.8 per cent of all enterprises in the EU non-financial business sector, SMEs accounted for nearly 64 per cent of total employment, while SMEs (including micro-enterprises) generated around 52 per cent of total value added.

Second, the vast majority of studies examined aggregate ESG indicators, while analysis of the independent impact of the social (S) and governance (G) components is practically absent, even though the literature emphasises their potential risk-reducing role. Third, the examination of financing and bank-based indicators is also underrepresented, even though these are key to exploring the impact of ESG factors on financial stability. Finally, the integration of climate risk into credit risk models may also be a promising area of research.

Table 2 shows the classification of the above articles based on the methodology. In addition to panel and cross-sectional econometric analyses, approaches based on machine learning, natural language processing and quasi-experimental designs are also becoming increasingly common.

Table 2 Methodological distribution based on ESG and credit risk research		
Methodological category	Description / content	Number of studies
Empirical econometrics – cross-section	Static regressions based on a given point in time or a short period; snapshot analysis of the relationship between ESG and credit risk.	23
Empirical econometrics – panel	Fixed or random effects models covering multiple periods; they enable the analysis of temporal dynamics and company-specific effects.	16
Theoretical and synthesising (SLR/ policy)	Literature reviews, studies presenting theoretical frameworks or policy concepts that do not perform empirical analysis.	16
Machine learning / text analysis	AI- and NLP-based methods that reveal non-linear patterns by processing unstructured data (e.g. ESG reports, news).	2
Questionnaire-based / qualitative	Research based on interviews, questionnaires or case studies that examines management practices and the institutional side of ESG integration.	2
Quasi-experimental / event-based	Natural experiments, event studies or difference-in-differences analyses that examine causal effects (e.g. crises, regulatory shocks).	2
Note: n=61, Systematic Literature Review: SLR Source: Compiled based on Scopus and Web of Science		

Empirical econometrics studies may use cross-sectional and panel data. *Cross-sectional studies* (e.g. Kanno 2023; Wu – Xie 2024) examined whether higher ESG performance improves the creditworthiness of companies over a given period. These studies clearly demonstrate the relationship, but do not show how it develops over time. *Panel-based analyses*, however, are capable of examining dynamic processes and taking hidden corporate characteristics into account. Li et al. (2022), for example, showed that higher ESG scores are associated with lower bankruptcy risk, while Luo et al. (2023) found that better ESG results increased the likelihood

of obtaining trade credit and reduced information asymmetry. The findings of *Habermann and Fischer (2023)* also pointed out that social performance increases costs in the short term, but leads to more sustainable operations in the longer term. The *theoretical and synthesising* studies (16 in total) focused primarily on reviewing the literature, developing conceptual frameworks and policy recommendations, without empirical analysis. These works placed ESG as a risk dimension in theoretical models of financial stability and corporate financing, contributing to the conceptualisation of the research area. In recent years, more advanced approaches based on *machine learning and text mining* have also emerged, revealing new patterns through the analysis of unstructured data. *Bonacorsi et al. (2024)* used LASSO and Random Forest algorithms to predict credit risk, while *Hajek et al. (2024)* used natural language processing (NLP) to estimate corporate credit ratings from the text of ESG reports. These methods complement traditional econometric models by revealing non-linear relationships, but their use still lags far behind that of conventional econometric models. *Qualitative and questionnaire-based* research is rare but provides additional insight. *Gumerov and Rizvanova (2023)* analysed the ESG integration of the Russian banking system through a case study, demonstrating how ESG considerations can be incorporated into risk management. Finally, *quasi-experimental* and event-based studies represent a new direction in exploring causal effects. *Tang et al. (2024)* used the Kyoto Protocol, and *Danisman – Tarazi (2024)* used financial crises as natural experiments, and their results show that companies with higher ESG performance are more resilient in crisis situations. *Chodnicka-Jaworska (2021)* also found a positive relationship between ESG improvement and credit ratings. Therefore, these methods allow for a more accurate examination of the causal relationships between ESG and credit risk.

Based on the methodological pattern, another research gap also emerges. The vast majority of the studies examined used a traditional econometric approach, while the proportion of machine learning, text analysis and quasi-experimental methods was extremely low. This suggests that the exploration of the relationship between ESG and credit risk is still primarily based on linear, static models, which are of limited use in capturing complex, non-linear relationships. Few studies have examined ESG effects in a causal framework to determine whether improvements in ESG performance actually cause a reduction in risk or merely correlate with it.

3.3. Summary, key research in the field

In summary, we analysed the ten most influential studies from the group of articles discussing the relationship between ESG and credit risk, ranked by their average annual citations. *Table 3* summarises the focus, methodology and key findings of each study.

Table 3 Most cited studies on the relationship between ESG and credit risk					
Article	Citations (annual average)	Focus	Data source, sample and period	Methodology	Main results / conclusions
Luo <i>et al.</i> (2023)	44.0	Impact of ESG on corporate access to trade credit	Panel data on companies listed on the Chinese stock exchange, 2011–2019	Empirical econometrics – cross-section	ESG performance increases companies' access to trade credit.
Li <i>et al.</i> (2022)	38.3	Impact of ESG practices on the credit risk of Chinese listed companies	ESG ratings and financial data of Chinese listed companies, 2010s	Empirical econometrics – panel	Higher ESG ratings reduce companies' credit risk.
Atif – Ali (2021)	35.3	Relationship between ESG disclosure and credit risk	Data from US non-financial companies, 2006–2017	Empirical econometrics – cross-section	ESG disclosure is positively correlated with "Merton's distance to default" value and negatively correlated with "credit default swap spreads", indicating lower credit risk.
Habermann – Fischer (2023)	34.5	Integration of ESG considerations into bank risk management	USA Refinitiv ESG database, 6,696 firm-years of observation, 2010–2019	Empirical econometrics – panel	During an upturn, an increase in CSP raises the probability of default.
Cohen (2023)	27.5	Correlations between ESG dimensions and financial risks	USA – S&P500 companies, 2019–2021	Empirical econometrics – cross-section	E and S risks increase the probability of default, G is not significant.
Li <i>et al.</i> (2023)	24.5	Role of ESG indicators in estimating corporate default risk	Panel data from Chinese A-share companies, 2010s	Empirical econometrics – panel	CPU increases bankruptcy risk, but better ESG and greater corporate governance mitigate it.
Anwer <i>et al.</i> (2023)	23.0	Correlations between ESG dimensions and financial risks	Global: 158 energy companies in 16 countries, 2010–2021	Empirical econometrics – panel	Inverted U-shape: low ESG is associated with higher risk, while high ESG is associated with lower risk.
Meles <i>et al.</i> (2023)	22.5	Examining the relationship between green innovation and credit risk	Europe: 26,904 firm-years of observations across 35 European countries, 2003–2019	Empirical econometrics – panel	Green innovation reduces corporate credit risk, especially in market-oriented countries, but not significantly for IPO companies.
Bonnier <i>et al.</i> (2022)	21.3	Examining the relationship between corporate social responsibility and credit risk	USA and Europe: corporate panel data, 2003–2018	Theoretical / synthesising (SLR/policy)	In the United States, only environmental aspects are negatively associated with credit risk, while in Europe, both environmental and social aspects are negatively associated with credit risk.
Tian – Tian (2022)	17.0	Impact of corporate sustainability on trade credit financing	ESG and financial data of Chinese listed companies, 2009–2020	Theoretical / synthesising (SLR/policy)	Better ESG performance is associated with lower information and operational risks, which increases corporate trade credit financing.
Note: Corporate Social Performance: CSP, Climate Policy Uncertainty: CPU, Initial Public Offering: IPO					
Source: Compiled based on data from Scopus and Web of Science					

These studies show methodological diversity, as along with the predominance of panel and cross-sectional econometric models, we also find theoretical models and synthesising approaches. Empirical studies have generally shown a significant and typically negative relationship between ESG values and credit risk. Their results consistently suggest that higher ESG performance contributes to the financial stability of companies, resulting in lower bankruptcy risk, more favourable credit ratings and lower funding costs.

4. Conclusion

Our analysis shows that the relationship between ESG and corporate credit risk has become a rapidly expanding area of research during the examined period (2020–2024). The surge in the number of publications coincides with the emergence of sustainability regulations and supervisory guidelines, particularly the strengthening of European initiatives and banking supervisory expectations, which has significantly encouraged the inclusion of this thematic area on the academic and practical agenda.

The vast majority of the research found in the course of our search is global, focusing on Asia and the US; there are fewer analyses on Europe, and the Central and Eastern European region is underrepresented, even though sustainability requirements also have a significant impact on these regions. The measurement basis of the selected studies typically relies on large corporate databases; SMEs are rarely examined, and although this certainly poses measurement difficulties, analysing them would be of particular importance in terms of economic value added.

Most empirical studies link the aggregate (total) ESG dimension to structural/ modelled credit risk indicators (e.g. PD), credit ratings and market-based indicators (e.g. CDS spread). The methodological toolkit consists predominantly of cross-sectional and panel econometrics procedures, supplemented to a lesser extent by text mining, machine learning and quasi-experimental approaches. Overall, the most influential articles indicate a significant association: better ESG performance is generally associated with lower bankruptcy risk, more favourable credit ratings and lower risk premiums, although the independent effects of individual dimensions (particularly “S” and “G” or, within “E”, climate risk) are less well explored.

The research gaps identified offer several directions for further exploration: (i) Targeted research on ESG measurement and credit risk correlations in the mid-cap sector and SMEs in general would fill a gap and could provide direct input for banking practice. (ii) Regionally embedded studies are needed in the CEE region, including systematic exploration of local-language research, taking into account regulatory, market and data-specific characteristics. (iii) The causal mechanisms linking financing and bank-based indicators (e.g. NPL ratios) and ESG have been

researched to a minor extent, even though they are also key to commercial banks' credit risk measurement practices. (iv) A promising but under-researched area is the integration of climate risk into credit risk models, as well as (v) the wider use of AI, quasi-experimental and event study methods that better capture non-linear effects.

Our study has limitations. We analysed only English-language article-type publications published in scientific journals between 2020 and 2024, and the search relied on two databases (Scopus, Web of Science) and predefined keywords. These filters necessarily limit the comprehensiveness of the study and may contribute to certain geographical and thematic biases.

Overall, our results confirm that ESG factors provide meaningful information on corporate credit risk and that the systematic integration of ESG considerations into risk management, lending and pricing practices is justified, especially in the context of increasing regulatory requirements. Future research should give greater emphasis to analyses focusing on the medium-sized enterprise segment and the CEE region, models incorporating climate risk channels, and frameworks that are suitable for identifying causality between ESG and credit risk and are based on newer, advanced data analysis techniques.

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