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How do ESG challenges affect default risk? An empirical analysis from the global banking sector perspective

Zbigniew Korzeb
Department of Management, Economics and Finance, Białystok University of Technology, Białystok, Poland

Renata Karkowska
Department of Banking and Financial Markets, University of Warsaw, Warszawa, Poland

Anna Matysek-Jędrych
Department of International Competitiveness, Poznań University of Economics and Business, Poznań, Poland, and

Paweł Niedziółka
Institute of Banking, SGH Warsaw School of Economics, Warsaw, Poland

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Abstract

Purpose – A review of the literature provides a solid reason to believe that an increase in environmental, social and corporate governance (ESG) activities have a positive impact on banks' default risk (DR). However, the increasing impact of climate risk on credit, operational and market risks, as well as the reduced availability of funding for banks that underperform in terms of ESG risk, is a concern. Therefore, the purpose of this study is to verify the relevance of the implementation of ESG policies to a bank's DR, against the background of macroeconomic and bank-specific factors.

Design/methodology/approach – Using a data set of 303 commercial banks from 61 countries from 2012 to 2021 and a panel regression methodology, the empirical importance of ESG activities for bank DR is documented. The two-stage generalized method of moments estimator was used to test the research questions.

Findings – Comparing different factors, the results highlight the positive impact of ESG activities on the bank's DR. However, this relationship varies according to the specific pillars of the bank's sustainability policies and changes into negative ones.

Originality/value – This paper fits the domain of DR management research, investigating whether ESG performance affects bank DR while controlling macroeconomic and market drivers. Prior literature has shown evidence on the relationship between macro and market forces and a bank's risk profile while a limited one on the non-market drivers. The main contribution is to consider ESG (in total and as separate pillars) as independent drivers of the bank risk profile.

Keywords Sustainability, Default risk, Banking, ESG score

Paper type Research paper

JEL classification – G21, G23, Q51, Q54

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1. Introduction

Due to factors such as high leverage, weakened market discipline (caused by deposit insurance and too-big-to-fail guarantees) and the ability to quickly and covertly increase their assets' risk profiles, banks have an innate propensity for taking risks. They dynamically adjust their portfolios in response to changes in risk appetite, particularly those influenced by macroeconomic fluctuations.

However, their risk appetite has attracted more attention during crises. It was widely believed that excessive risk accumulation was the root cause of the banking sector's vulnerability during the 2007–2008 crisis. The COVID-19 pandemic triggered a sudden and unexpected turn in the outlook for the functioning of the economy. Such a change could not have been without an impact on the banking sector, which is inextricably linked to the real economy as it maintains the accounts of households and businesses and provides them with credit (Karkowska *et al.*, 2023). The following challenge banks face is participating in the financing of sustainable projects. Furthermore, environmental, social and corporate governance (ESG) reporting issues are beginning to play an increasingly important role in investment processes and decisions. Emphasizing the importance of flexibility, consistency, legitimacy, comparability and a commitment to continuous improvement, Dissanayake (2021) highlights the global reporting initiative framework as a leading ESG reporting standard.

The impact of sustainability on financial performance can be explained based on stakeholder theory, agency theory, legitimacy theory and signalling theory. Mitroff (1983) and Freeman (1984), proponents of stakeholder theory, place a strong emphasis on an organization's ethical management while taking into account the various interests of its stakeholders. The cooperation of all stakeholders and their mutual trust are necessary for a company to survive over the long term (Castelo *et al.*, 2007). Freeman broadens the spectrum of a company's stakeholders by arguing that shareholder objectives cannot be achieved without also meeting the needs of other stakeholders (Galletta *et al.*, 2022), because the company is to be accountable to all stakeholders (Freeman and Dmytriyev, 2017; Donaldson and Preston, 1995). Stakeholder theory is intricately connected to corporate social responsibility, social contract theory and externalities associated with an organization's environmental impact. The premise of this theory lies in the belief that the disclosure of ESG information and the investment in mitigating ESG risks not only result in cost reductions but also bolster the competitive position, enhance the reputation and contribute to the overall value of an organization. Stakeholders also recognize that ESG performance is an essential determinant of a company's long-term success (Şeker and Şengür, 2021).

According to stakeholder theory, ESG performance is regarded as positively correlated with a company's financial performance (Bătae *et al.*, 2021; Galletta *et al.*, 2022). Conversely, principal-agent theory posits that management decisions, driven by the pursuit of their interests, may not align with those of shareholders, thereby escalating agency costs. Involvement in the ESG domain incurs expenses that erode shareholder profit, prompting a negative assessment of its ongoing impact on shareholders (Jensen and Meckling, 1976; Jensen, 1986). Implementing ESG at the corporate level emphasizes the need to consider the interests of all stakeholders (not only shareholders). This approach may conflict with agency theory, as the implementation of ESG implies a decrease in short-term profits, which contradicts the interests of shareholders (Nareswari *et al.*, 2022). Additionally, managers, whose time horizon is typically shorter than that of shareholders, may lack enthusiasm for incurring expenses aimed at enhancing the company's non-financial performance. Hence, a corporate governance mechanism and CSR and ESG reporting can mitigate agency costs (Şeker and Şengür, 2021) and reduce information asymmetry (Velte, 2016). Thus, governance quality should be positively correlated with financial performance. However, the results of some studies do not support this correlation (Bătae *et al.*, 2021). On the other hand, disclosure of ESG increases management welfare (Ness and Mirza, 1991), which can be linked to the phenomenon of managers redirecting the attention of other stakeholders towards ESG signals to gain access to capital and broaden the spectrum of investors through distortion of financial information (Şeker and Şengür, 2021).

According to the legitimacy theory, businesses can only function with ensuring their legitimacy in society, which is why they make an effort to enhance their reputation and image. At the same time, legitimacy should be linked to the belief that the company's activity is desirable and appropriate within a socially constructed system of norms, values, beliefs and definitions (Suchman, 1995). In this situation, more than presenting financial statements is required; ESG reports are necessary to establish legitimacy. ESG reports are used to improve image, to convince stakeholders of the congruence of a company's values and actions with those of its interlocutors, to prevent social pressure or to neutralize poor-quality financial statements so that legitimacy is not ultimately lost (Gray *et al.*, 1988). Legitimacy theory also indicates that high-quality CSR reporting is used as a factor to compensate for low-quality governance (Erragragui, 2018). If the company's actions do not respect social and moral values, the entity is sanctioned by society (Schiopoiu and Popa, 2013). Signalling theory, on the other hand, assumes that companies (agents) can send additional signals (information) to stakeholders to neutralize the problem of information asymmetry (Spence, 1973). Positive ESG signals are supposed to confirm that the company's performance is satisfactory.

The credibility of the information provided is, in this case, a critical condition for reducing asymmetry. The credibility of the information provided is, in this case, a crucial condition for reducing asymmetry. Credibility lies in sending consistent signals (Hughes, 1986); hence, ESG performance may increase the quality of financial disclosures. By presenting ESG achievements, their scope and their accuracy, the company wants to demonstrate the quality of its management. ESG reports should therefore be considered a positive signal. The consistency mentioned is that companies with high-quality ESG disclosures are also those with high financial standing, and the presentation of ESG data has a positive impact on reputation (Gray, 2005). However, it should be noted that sometimes reports indicating high ESG performance serve to divert attention from deteriorating financial performance.

In this paper, we focus on the relevance of ESG factors in predicting bank financial distress. A focus on ESG in the financial sector seems reasonable for at least four reasons. First, a successful energy transition depends on the financial sector's policy towards renewable and fossil fuel sectors (Choudhury *et al.*, 2023a; Choudhury *et al.*, 2023b). Second, as Palmieri *et al.* (2023a) pointed out, wholesale and retail banks can reduce default risk (DR) through improvements in ESG performance (the environmental pillar).

In contrast, investment banks can take advantage of risk reduction by strengthening the governance pillar. Therefore, the focus on improving ESG performance contributes to the stability of individual institutions and, thus, the financial system as a whole. At the same time, Maquieira *et al.* (2022), among others, contend that ESG risk influences the DR of non-financial entities (i.e. the higher the ESG risk, the higher the DR). Thus, ESG has both direct and indirect effects (through the financial standing of borrowers) on banks' DR. Third, actions are currently the subject of extensive research by international financial market regulators, including the European Banking Authority, resulting in the recommendation that ESG should be incorporated into the toolkits of regulatory authorities' supervision mechanisms. Fourth, the corporate concerns of ESG reflect the growing importance of investors and the general public attention to the sustainability issue. Finally, while the total exposure of the world's 60 largest banks to the fossil fuel industries in 2022 compared to 2021 decreased by approximately US$132bn, some systemically important banks (including

JP Morgan Chase, Citi and Wells Fargo) augmented their portfolios in this area (Rainforest Action Network, 2023). For the entities identified above, fossil fuel assets account for 149% to 175% of their funds. If exposure to fossil clients is considered stranded assets, this implies a significant risk not only to the stability of these entities or potential DR but also to systemic risk.

By recognizing ESG and incorporating them into their strategies, banks can also contribute to developing a sustainable financial system. By engaging in ESG projects, banks can generate stable returns over time, which can help mitigate DR (Caiazza *et al.*, 2023; Lee *et al.*, 2022). Many governments and regulators promote and encourage environmentally friendly investments. Banks that engage in such activities can benefit from supportive policies, subsidies or tax incentives, which can further improve their financial performance and reduce the risk of insolvency. Their commitment to environmental investment can improve their reputation and attract environmentally conscious customers. As sustainability and responsible investment become increasingly important to consumers, banks aligned with these values can gain a competitive advantage (Quang Trinh *et al.*, 2023).

The above points are of concern and raise the critical questions of what the real impact of the ESG score reflecting ESG risk on the probability of bank DR is and what the relevance of the implementation of ESG policies to a bank's DR is while controlling macroeconomic factors and bank-specific characteristics. The research problem we identify therefore boils down to determining whether banks' ESG activity contributes to risk reduction, whether this impact is similar for the different pillars of ESG, and when and why ESG investments can negatively impact a bank's standing.

As the probability of banks' DR increases in proportion to the economic climate and the performance of companies, the study compares several factors that may be relevant to the banking sector. Finally, our focus is on post-financial and pandemic crises, given the reforms introduced and implemented nationally and internationally to improve bank corporate governance. We examine the correlation between a bank's ESG performance and the probability of DR in commercial banks between 2012 and 2021. Specifically, this study uses a sample of 303 publicly traded banks in 61 developed and emerging markets.

This paper contributes to the literature in several ways. First, there is very limited research in the literature on ESG in the context of bank DR. For comparative analysis in the study, we also consider several other factors that may generate DR in the banking sector. In addition, we investigate whether individual ESG pillars contribute to banks' DR. Second, we verify the relationship between ESG scores and bank defaults during the period triggered by the COVID-19 pandemic. Third, our investigation is based on a sample of banks in developed and developing countries, as the number of banks involved in ESG initiatives can vary between groups. Therefore, this would have important implications for bank managers and policymakers when reviewing ESG measures for risk in the banking system. To the best of our knowledge, this is the first such attempt. Nevertheless, our findings will add more evidence on ESG measures to the existing literature on the banking system internationally. In particular, our original contribution is the finding that a rapid improvement in the ESG area, reflected in an increase in ESG scoring, translates into an increment in DR. Also, the lack of harmonization in ESG implementation hurts the bank's overall risk. Our results also show that the algorithms describing a bank's DR during a pandemic crisis are different, and that paradoxically (due to the liberalization of credit and investment policies and overly optimistic expectations), an expansion of the economy is a period in which a bank's DR goes up.

The rest of the paper is organized as follows: in Section 2, we review relevant literature and develop hypotheses. Section 3 describes the methodology and data. Section 4 reports our empirical results and Section 5 concludes them.

2. Literature and hypothesis development

The factors affecting DR can be assigned to the following groups:

- macroeconomic factors;
- idiosyncratic variables related to the bank's financial performance, like its size, quality of assets and profitability; and
- non-financial assessment carried out in terms of sustainability goals.

Additionally, to develop respective hypotheses, we have reviewed the literature dedicated to the banks' DR response to the COVID-19 outbreak. We treat the last strand of research in terms of analysing the impact of extraordinary factors specific to the period in which they materialized. Their conclusions have limited predictive validity.

2.1 Impact of macroeconomic variables on bank default risk

The business cycle affects the quality of banks' portfolios. Economic growth, approximated by a gross domestic product (GDP) increase, is the most critical macroeconomic factor affecting non-performing loans (NPLs) and determining a bank's DR. A weak macroeconomic background can often signal an increase in bad loans, as it strongly affects borrowers' repayment capacity. However, the high rate of credit and GDP growth may reflect credit expansion due to the relaxation of credit standards and thus may lead to an increase in NPLs (Nikola and Vujanović, 2022). Garcia *et al.* (2022) show that GDP growth significantly negatively affects DR (a sample of 109 European banks). In turn, Chodnicka-Jaworska and Jaworski (2017), analysing European and US commercial banks, suggest that GDP growth has an insignificant impact on credit default swap (CDS) spreads as DR measures. Washington (2014), using a sample of Kenyan banks, identifies a significant negative impact of GDP per capita on bank DR, but only in the short run. Also, De-Ramon *et al.* (2020) and Phan *et al.* (2019) prove that GDP is negatively correlated with bank risk, which is coherent with the results of Benbouzid *et al.* (2017), whose research based on 118 banks from 30 countries during the period 2004–2011 found that higher CDS spreads are associated with periods of low GDP growth and high inflation. Ötker-Robe and Podpiera (2010) indicate that the DR is related to the entire structure of the capital adequacy, asset quality, management capability, earnings, liquidity and sensitivity to market risk and market views on economic growth prospects.

Based on the results presented above, as well as assuming that stable economic growth should have a positive impact on the quality of loan and investment portfolios and, thus, a reduction in bank DR, we have formulated the following research hypothesis:

H1. Economic growth measured by the use of GDP is negatively associated with a bank's default risk.

2.2 Bank-specific determinants of default risk

Bank-specific DR coefficients include asset quality, profitability, bank size and capital adequacy.

Deterioration in asset quality reduces a bank's bottom line and contributes to a decline in its funds. Thus, the NPL ratio should positively correlate with DR. According to Puspitasari *et al.* (2020), NPLs and credit quality affect the DR of Indonesian banks. The NPL ratio as one of the most critical factors affecting a bank's DR is also indicated by Puspitasari *et al.* (2021), Parrado-Martínez *et al.* (2019), Benbouzid *et al.* (2017) and Drago *et al.* (2017). In addition, Adeleke *et al.* (2023) and Budiarto (2020) confirm that the quality of assets affects the performance of a bank and DR. Following the results of the above-mentioned, we have assumed that:

H2. The quality of bank loans is negatively associated with default risk.

Another potential coefficient is profitability, which is characterized, inter alia, by revenues' structure and cost efficiency and thus profitability. According to Garcia *et al.* (2022), a bank's profitability is negatively related to its DR. Kabir *et al.* (2021), using a panel data set of 2,785 companies over the period 2004–2018 from 42 countries, document a significant and negative impact of emissions on firms' distance-to-default. Return on assets (ROA) and cash flow volatility are potential channels through which emissions affect the DR. Investigating the determinants of DR of rural banks in Indonesia during the period 2009–2018 allows the conclusion that net interest margin, operation efficiency and ROA significantly influence DR (Puspitasari *et al.*, 2021). According to Xu *et al.* (2019), who analysed 431 traded banks from 2004 to 2017, bank profitability is negatively associated with its contribution to systemic and idiosyncratic risks. Gulati *et al.* (2019) prove that lower profitability results in the growth of the risk of banks in India. This is confirmed by Kotiso (2018), who finds a negative relation between operational efficiency and DR, and by Parrado-Martínez *et al.* (2019), who prove the negative relation between bank profitability and bankruptcy risk. Also, Liang *et al.* (2016) show that profitability is an important bankruptcy predictor. The conclusions of the research presented above entitle us to formulate the following hypothesis:

H3. Banks with higher profitability are less likely to be in default.

The impact of a bank's size on its DR is not apparent, which can be linked on the one hand to the too-big-to-fail and moral hazard theories and, on the other hand, to the increased intensity of supervision and greater transparency of large banks. Garcia *et al.* (2022) and Drago *et al.* (2017) suggest that the larger size of a bank (proxied by total assets) reduces DR. Gulati *et al.* (2019) found the opposite results, demonstrating that large banks increase the likelihood of defaults. Given that large and systemically important banks are subject to more intensive supervision and have to comply with stricter quantitative standards, we formulate the following hypothesis:

H4. The size of the bank is negatively correlated with its default risk.

In addition to the research strands on the impact of bank-specific variables on DR outlined above, other relationships should be highlighted. For instance, Kotiso (2018) proves that a negative relationship with DR characterizes a bank's liquidity. Parrado-Martínez *et al.* (2019) and Benbouzid *et al.* (2017) also determine liquidity indicators as determinants of a bank's DR. Switzer *et al.* (2018) and Chodnicka-Jaworska and Jaworski (2017) suggest that strong regulatory capital contributes to the reduction of DR. This is confirmed by Kotiso (2018), Soenen and Vennet (2022), Parrado-Martínez *et al.* (2019) and Paries *et al.* (2022). Mendicino *et al.* (2020) demonstrate that when the banking system faces a higher DR, an increase in capital requirements initiated by bank supervision authorities is less expensive in the short term and more advantageous in the long term. Benbouzid *et al.* (2017) and Drago *et al.* (2017) also identify leverage as a significant determinant of DR. Xu *et al.* (2019) pay attention to over-reliance on non-interest income, wholesale funding and leverage as factors contributing to a bank's risk increase. In addition, greater diversification in the banking sector and a greater concentration of banks in lending, according to Gulati *et al.* (2019), reduce banks' stability. Garcia *et al.* (2022) prove that the size of the board has a positive association with DR, while Kinateder *et al.* (2021) focus on the impact of board gender diversity on financial institutions' risk. Liang *et al.* (2016) also indicate the board structure as a factor associated with DR. They also identify a relationship between ownership structure and a company's bankruptcy risk. Haque and Shahid (2016) conclude that government ownership and foreign ownership in the case of listed banks are positively associated with DR.

2.3 Sustainability and non-financial performance as bank default risk factors

The strand of research dedicated to the relationship of ESG ratings or their components (E, S, G) with DR is relatively new. The literature review by Friede *et al.* (2015) concludes that approx. 90% of studies show a nonnegative ESG – corporate financial performance relation. The majority of them prove a positive association. According to Tarmuji *et al.* (2016), who analyse non-financial entities from Malaysia and Singapore, ESG practices positively impact a company's performance. Atif and Ali (2021), based on data referring to US nonfinancial institutions, concluded that ESG disclosure is positively related to Merton's distance to default and is negatively related to the CDS spread. Caiazza *et al.* (2023), using a sample of companies that make up the S&P500 index, provide evidence that ESG scores are negatively associated with firm credit risk. Meles *et al.* (2023) examine the relationship between green innovation and DR using a sample of companies from 35 European countries from 2003 to 2019. They proxy DR using Altman's Z-score and Zmijewski's ZM-score, which prove a negative relation between green innovation and the company's DR. The results of Capasso *et al.* (2020) indicate that DR is negatively associated with a company's carbon emissions and carbon intensity. However, these results could have some limitations given what Saha *et al.* (2019) suggest regarding the quality of carbon disclosures.

Bouslah *et al.* (2018) explain the relationship between corporate social responsibility and a company's risk through three basic theories:

(1) the risk mitigation approach;

(2) theoretical models relating social performance to expected returns; and

(3) the view of overinvestment.

Although the concept of corporate social responsibility (CSR) is not the same as ESG, it is often equated with it (see, e.g. Gillan *et al.*, 2021).

Referring to the first stream, Bouslah *et al.* (2018) state that CSR expenditures can generate moral capital or goodwill among stakeholders, which provides insurance-like protection that reduces an entity's risk exposure. The second one presumes the existence of price differences because traditional investors make investment decisions focusing on financial criteria, while socially responsible investors base both on financial and ESG measures. The third theory treats spending on CSR as capital expenditures that do not reinforce the company's value thus only increasing its leverage. Lee *et al.* (2022) confirm the "risk-mitigation view", in which banks with higher ESG scores are more prudent in lending, reducing the probability of bank default. The findings of Galletta and Mazzù (2022) show that banks with fewer ESG controversies take less risk. Di Tomasso and Thornton (2020) note that high ESG scores are associated with a modest reduction in risk-taking for high or low-risk-takers banks and that the impact is conditional on executive board characteristics. Their findings are consistent with the "stakeholder" view of ESG activities.

However, high ESG scores are also associated with a reduction in bank value, consistent with the "overinvestment" view of ESG, whereby scarce resources are diverted from investment. Furthermore, Aevoae *et al.* (2022) conclude that stakeholder theory and the theory relating social performance to expected returns, in which increased investments in ESG mitigate bank-specific risks, explain our findings. They show the negative and statistically significant impact of increased ESG scores on banks' contribution to systemic risk. Neitzert and Petras (2022) provide empirical evidence that the environmental pillar significantly determines risk reduction. Analysing the effect of the environmental pillar in more detail yields that all subcomponents of the environmental pillar (environmental innovation, emissions and resource use) reduce bank risk. On the contrary, the findings for the social and governance pillars are equivocal. Finally, they state that integrating ESG factors into daily business and lending activities reduces default and portfolio risk. Gholami *et al.* (2022), using a sample of Australian financial and non-financial companies, investigate the impact of ESG performance disclosure on profitability. These authors find that higher ESG performance disclosure is associated with higher profitability; however, the industry comparison analysis shows significant differences between financial and non-financial sectors. Lööf and Stephan (2019), based on a sample of 887 stocks listed in five European countries during the period 2005–2017, proved that higher ESG scores are associated with a reduced downside risk in the stock market. Gangi *et al.* (2018), using a sample of 142 banks from 35 countries covering the period 2011–2015, suggest that bank risk decreases with increasing environmental engagement. They concluded that stakeholder theory and the conflict resolution hypothesis are useful frameworks to overcome the trade-off between economy and ecology. Chiaramonte *et al.* (2022), analysing data from European banks operating in 21 countries from 2005 to 2017, found that the total ESG score reduces bank fragility during periods of financial distress. In times of financial turmoil, environmental activism reduces bank risk-taking. Scholtens and van Klooster (2019) show that banks' higher sustainability scores are significantly associated with lower DR.

Citterio and King (2023) emphasize a different aspect. Constructing a model dedicated to forecasting bank financial distress on a sample of 362 commercial banks headquartered in the US and EU-28, they notice that ESG indicators improve the predictive capability of their model to identify distress correctly. They believe ESG practice strongly reduces the likelihood of misclassifying distressed or defaulted banks as healthy. Switzer *et al.* (2018) analyse the relationship between corporate governance and default on sample financial institutions in 28 countries outside of North America in the post-global financial crisis (GFC) period. They use both CDS spreads and a Merton-type model to measure DR, and their results show that both internal governance variables and external regulatory determinants have a big effect on DR. The influence of various governance variables is continent-specific. The results of Drago *et al.* (2019) prove that a CSR rating upgrade leads to an immediate and significant decrease in CDS spreads, while CSR rating downgrades do not significantly impact CDSs. High CSR scores are associated with low CDS spreads. Lundqvist and Vilhelmsson (2016) construct enterprise risk management (ERM) as a framework for the quality of the risk management system, mainly in terms of governance. Based on the sample of 78 of the world's largest banks, a higher degree of ERM implementation is associated with a lower CDS spread.

Most of the analysed research results indicate that a high ESG performance reduces the risk of bank default. Therefore, we propose the following hypothesis:

H5. The increase in ESG scores leads to a decrease in the bank's probability of default risk.

The hypothesis formulated above is consistent with the findings of stakeholder theory, which indicates that shareholders' objectives (good financial performance) cannot be achieved without also meeting the needs and goals of other stakeholders, in particular employees, local communities, customers and the environment. The hypothesis also refers to the signalling theory, according to which a high ESG score can be regarded as a positive signal to stakeholders, reassuring them that the bank's standing is good (as indicated by its financial performance) and the bank's value is not threatened by the materialization of risks that cannot be identified from reading the financial statements. The credibility of the signals sent is ensured by the fact that the scoring is assigned by a reputable entity based on a standardized methodology that is in line with the signalling theory. The alignment of ESG and financial performance also provides a basis for the legitimacy of the bank among a broad spectrum of stakeholders. In contrast, the hypothesis under examination is at odds with agency theory for two reasons. First, insofar as it is assumed that ESG inputs translate into ESG performance, an improvement in ESG performance should result in a deterioration of financial performance. Second, if agents try to mask poor financial performance with ESG performance, then good ESG scores should be accompanied by good financial performance.

2.4 Impact of COVID-19 on default risk

Altman (2020), using the Z-score and the sample of BBB-rated companies over 2007–2019, analyses the potential impact of a downturn in the real economy determined by the COVID-19 pandemic on expected default rates. Li *et al.* (2022), based on 244 commercial banks from 52 countries from 2002 to 2020, provide evidence that during the COVID-19 crisis, banks with better ESG performance operated with lower credit and liquidity risks. ESG practices reduce the constraints of excessive and aggressive bank risk-taking. In the sample of commercial banks in Vietnam, Le *et al.* (2022) show that the higher the level of income diversification, the lower the risk of default. At the same time, they find that in response to the COVID-19 outbreak, the bank's DR decreased; however, the impact of COVID-19 on the relationship between income diversification and DR is not confirmed. These authors also demonstrate the positive impact of GDP growth on the bank stability index. Arias *et al.* (2022), based on a sample of 161 US bank holding companies and the years 2016–2020, concluded that bank culture helps mitigate the impact of COVID-19 on bank DR. Analysing 30 developed countries, Augustin *et al.* (2022) find a positive and significant sensitivity of sovereign DR to the intensity of the spread of the COVID-19 pandemic. This relationship refers to fiscally constrained governments.

Based on data on loans to companies from 10 EU countries, Nigmonov and Shams (2021) suggest that the COVID-19 pandemic has a significant negative impact on DR during May and June 2020. The impact is stronger for companies with lower credit ratings. Lu *et al.* (2022), using a sample of G7 firms from 2004 to 2020, found a positive bidirectional relationship between sustainability performance and profitability. Researchers suggest that companies with better ESG performance are hit harder on their financial standing, but the benefits of financial performance on sustainability are strengthened during the GFC. During COVID-19, companies with strong sustainability performance were more resilient, and their financial performance worsened relatively less, but the benefits of profitability resulting from ESG practices were weakened.

Given that COVID-19 has not caused a significant deterioration in credit portfolio quality and contributed to banks' lending and investment policies becoming more prudent, we formulate the following hypothesis:

H6. The COVID-19 pandemic is negatively associated with the probability of bank default risk.

3. Data and methodology

3.1 Methodology

The two-stage generalized method of moments (GMM) estimator (Blundell and Bond, 1998) was used to test the research questions. The GMM model takes into account the dynamic nature of the bank's decisions regarding income-generating operations and uses lagged explanatory variables [1]. Furthermore, this approach is used to control unobserved heterogeneity and simultaneous bias. In particular, in the GMM system, the level variables are instrumented with differences in delays and the difference variables are instrumented with lags. The regress and time dummy are treated as endogenous, whereas the remaining regressors are treated as weakly exogenous. To control for the determinants of DR in the banking sector, we developed the model of Meles *et al.* (2023) and the model of Palmieri *et al.* (2023b). Finally, the equation below expresses the general form of the following model:

$$Y_{n,i,t} = \beta_0 + \beta_1 Y_{n,i,t-q} + \beta_2 \mathrm{ESG}_{n,i,t} + \beta_3 \mathrm{Bank}_{\mathrm{Control}_{n,i,t}} + \beta_4 \mathrm{Macro}_{i,t} + \beta_5 \mathrm{NPL}_{n,i,t} {*} \mathrm{COVID19} + \beta_6 \mathrm{LLP}_{n,i,t} {*} \mathrm{COVID19} + \varepsilon_{i,t} \tag{1}$$

where the subscripts of n, i and t denote the bank, country and year, respectively; $Y_{n,i,t}$ is the bank's DR measured by ZSCORE. The model uses a vector of $ESG_{n,i,t}$ variables [ESG_SCORE, ESG_SCORE_SQ, SOCIAL, GOVERNANCE, ENVIR] corresponding, respectively, to the bank's sustainable policies in terms of comprehensive ESG approach, including social, corporate governance and environmental factors. ESG_SCORE is the aggregate score for the bank, and ESG_SQ is the square of the ESG score. $Bank\_Control_{n,i,t}$ are independent variables, we used the vector of individual bank control variables [SIZE, ROA, LLP, NPL], where SIZE is the logarithm of the bank's total assets; ROA is the return-on-assets ratio; LLP – loan loss provisions; NPL – non-performing loans. $Macro_{i,t}$ We used GDP as gross domestic product growth and INFLATION as the consumer price index. The estimation run for the comparison of pre- and post-pandemic COVID-19 periods was unsuccessful, as the post-pandemic period was not included in the study sample (2012–2021). Additionally, the test estimates for the pandemic period only covered the two years 2020–2021 and did not meet the model estimation conditions. Therefore, we decided to introduce interactions for COVID-19 and the variables NPL and LLP. A COVID-19 time dummy is added to account for the COVID-19 outbreak in 2020. Taking into account the problems of collinearity due to banking control variables, we made a selection of variables and considered only the variables whose correlation was the lowest. Lee *et al.* (2022) used a similar model. Finally, a random component is ε.

To ensure the consistency of GMM estimates, two specification tests – the Sargan test and the Hansen test – examine the overidentification of all instruments. The presence of autocorrelation of first- and second-order residuals was verified using the Arellano–Bond tests, AR(1) and AR(2), respectively. The null hypothesis of no autocorrelation was verified. Thus, the null hypothesis is true if the random component of the model does not show autocorrelation over time.

3.2 Sample and variables

Using a panel regression method and data from the Refinitiv Eikon database of 303 commercial banks from 61 countries from 2012 to 2021, it is shown that ESG activities have an effect on the risk of a bank default.

Table 1 shows the distribution of the total number of banks in each country participating in this study. With shares above 20%, banks from the USA and Japan dominate the data sets. However, the sample appears geographically balanced, including considerable shares of banks from Europe and other Asian countries. The proportion of samples distributed

Country	# Banks
Argentina	4
Austria	2
Belgium	1
Brazil	6
Canada	9
Chile	4
China	12
Colombia	3
Cyprus	1
Czech Republic	1
Denmark	3
Egypt	2
Finland	1
France	3
Germany	3
Greece	5
Hong Kong	3
Hungary	1
India	12
Indonesia	5
Ireland	3
Israel	4
Italy	9
Japan	23
Jordan	1
Korea	6
Kuwait	3
Malaysia	8
Morocco	1
Netherlands	1
New Zealand	1
Norway	1
Oman	4
Philippines	10
Poland	10
Portugal	2
Puerto Rico	1
Qatar	5
Russia	2
Saudi Arabia	1
Singapore	3
South Africa	5
Spain	5
Sweden	3
Switzerland	5
Taiwan	10
Thailand	6
Turkey	6
United Arab Emirates	3
UK	8
USA	70

Source: Authors' own creation

Table 1. Distribution of banks in the research sample

between developed and developing countries is balanced, with no clear dominant positions in either group, confirming the previous hypothesis that the source of the crisis may be emerging markets and mature market economies. The study uses the most up-to-date banking data, including the ESG variables. The variables are defined according to the ESG score methodology published in May 2022 by Refinitiv (2022). Three dimensions of ESG performance were analysed: environmental (environment_score), social (social_score) and governance (governance_score). The assessment of the Environment pillar is based on three points: resource use, emission reduction and innovation. The social pillar ranking considers four categories: workforce score, maintaining job satisfaction, human rights, community score and product responsibility. Ultimately, evaluating the corporate COVID-19 governance pillar combines the effectiveness of best corporate governance practices, the equal treatment of shareholders and the assessment of the social responsibility strategy in day-to-day operations. However, we are aware of some shortcomings in ESG scoring. More specifically, although the disclosure of irrelevant data points does not affect the score, the lack of information on relevant aspects hurts the bank's risk assessment. However, being comparable between industries and companies of different sizes, the Refinitiv scores serve as a sufficient approximation of the ESG scores for our sample.

The risk of bank default or its stability can be estimated using a Merton-type bank default measure calculated as the distance to default (Saeed and Izzeldin, 2016). Its advantage consists of being a forward-looking measure, while the disadvantage boils down to the fact that it can be applied only in the case of listed banks. Also, Jo *et al.* (2022) suggest that the Merton model is not a sufficient measure of bank DR. An alternative can be the CDS spread (e.g. Ötker-Robe and Podpiera, 2010; Samaniego-Medina *et al.*, 2016). The approximation of DR by CDS relates to the limitation that CDS premiums are relatively volatile and affected not only by firm-specific determinants. Also, market variables like stock return, the change in stock return volatility and the change in the median CDS spread in the rating class have explanatory power (Galil *et al.*, 2014). The market valuation seems to be the crucial merit of using the CDS premium as a DR estimation measure.

In contrast, Doumpos *et al.* (2016) propose the overall financial strength indicator. The advantage of this approach is the inclusion of income diversification as a new factor affecting the bank's standing. The conclusions refer mainly to a group of banks active in emerging markets and must be verified in the broader sample. In turn, Parrado-Martínez *et al.* (2019) quantify the probability of default by use of the systemic model of bank originated losses (SYMBOL). The outcome of SYMBOL depends inter alia on the Basel regulatory framework and assumptions referring to the scope of the deposit insurance scheme, and the model is tested on the sample of only European banks. Considering the broad scope of bank-specific, regulatory and macroeconomic variables, the possibility of carrying out simulations seems to be the vital advantage of SYMBOL.

Despite the drawback consisting of the assumption that features are normally distributed, the widely used approach to quantifying DR is the Z-score index (e.g. Mercieca *et al.*, 2007; Duffie, 2011), referring to the mean and standard deviation. These statistics are robust, limiting the effect of outliers and skewness. Additionally, Z-scores can improve the performance and accuracy of some algorithms, e.g. linear regression and logistic regression, and make data more interpretable and comparable. This approach allows for the identification of trends and anomalies. Therefore, we use a Z-score to assess the bank's probability of default. In other words, the Z-score compares bank stability buffers (capitalization and return) with return volatility. In general, the measurement is calculated as follows:

$$Z_{it} = \frac{car_{it} + \mu_{roa,it}}{\sigma_{roa,it}} \quad (2)$$

where the *car* is the bank's capital-asset ratio, while $\mu_{roa,it}$ and $\sigma_{roa,it}$ represent estimates of the expected value and the standard deviation of the bank's return on assets, respectively. Thus, the Z-score is the number of standard deviations by which a bank's return on assets has to fall for the bank to become insolvent (Lepetit and Strobel, 2013). The Z-score is an expression of the number of standard deviations by which the ROA must decrease relative to the expected value for capital to be considered depleted and the bank to be at risk of insolvency. Thus, the higher the Z-score, the more stable the bank.

The description of variables applied in the study is presented in Table 2.

4. Results

The descriptive statistics of the variables used in the model are presented in Table 3, Panel A. The average ZSCORE of the sample banks is 55.16, and the standard deviation is 34.9. The range of the ESG score is large, with minimum and maximum values equal to 4.56 and 87.75, respectively. The ESG statistic presents a mean value of 43.20% and a standard deviation of 17.32, which means that, on average, the banks analysed met the ESG assumptions by more than 40%. On average, the banks demonstrated a compliance rate of 51.85% in corporate governance standards, indicating a moderate level of adherence. Social

Variable name	Symbol	Definition	Source	Expected sign
Z-SCORE	Y	Number of standard deviations by which the ROA must decrease relative to the expected value for capital to be considered depleted and the bank to be at risk of insolvency	Refinitiv Eikon database	Dependent variable
SIZE OF THE BANK	SIZE	The logarithm of the bank's total assets		+
BANK's ROA	ROA	Return-on-assets ratio		+
BANK's LLP	LLP	Loan loss provisions ratio		–
BANK' NPL	NPL	Non-performing loans ratio		–
ANNUAL GDP GROWTH	MACRO	GDP growth in the country of the bank's origin		+
INFLATION	INFLATION	Consumer price index in the country of the bank's origin		+
ESG SCORE	ESG	Refinitiv ESG scoring assigned according to Refinitiv methodology (2022)		+
ESG_SCORE_SQ	ESG_SCORE_SQ	The square of the ESG score		+
S PILLAR	SOCIAL	S (social) component of the Refinitiv ESG score (S score)		+
G PILLAR	GOVERNANCE	G (governance) component of the Refinitiv ESG score (G score)		+
E PILLAR	ENVIR	E (environmental) component of the Refinitiv ESG score (S score)		+
COVID-19	COVID-19	Time dummy to account for the COVID–19 outbreak in 2020	–	+

Source: Authors' own creation

Table 2. Description of variables

	Obs	Mean	Median	SD	Min	Max	Skew
Panel A							
ZSCORE	1,065	55.16	46.00	34.96	3.08	206.90	1.16
SIZE	1,065	24.14	24.29	0.83	21.62	25.33	−0.49
ROA	1,065	0.01	0.01	0.01	−0.04	0.06	1.02
LLP	1,065	0.01	0.00	0.02	0.00	0.37	8.99
NPL	1,065	0.09	0.02	0.86	0.00	16.30	18.33
GDPgrowth	1,065	2.54	2.29	3.08	−10.95	25.18	−0.52
INFLATION	1,065	2.32	1.81	2.80	−2.54	19.60	2.89
ESG	1,065	43.20	41.34	17.32	4.56	87.75	0.21
SOCIAL	1,065	43.13	40.52	21.51	0.96	96.73	0.28
GOVERNANCE	1,065	51.85	53.41	20.49	4.75	94.00	−0.20
ENVIR	1,065	31.26	21.14	26.02	0.00	97.25	0.66
Panel B							
ZSCORE	698	44.43	36.44	29.12	3.08	148.44	1.36
SIZE	698	24.42	24.64	0.75	21.62	25.33	−1.12
ROA	698	0.01	0.01	0.01	−0.04	0.06	0.88
LLP	698	0.01	0.01	0.02	0.00	0.37	7.77
NPL	698	0.13	0.03	1.06	0.00	16.30	14.82
GDPgrowth	698	2.61	2.78	3.56	−10.95	25.18	−0.48
INFLATION	698	2.48	1.80	3.33	−2.54	19.60	2.47
ESG	698	47.10	48.10	18.45	4.56	87.75	−0.16
SOCIAL	698	47.33	47.62	23.71	0.96	96.73	−0.06
GOVERNANCE	698	53.55	55.87	21.12	4.75	94.00	−0.23
ENVIR	698	40.31	34.85	25.93	0.00	97.25	0.27

Table 3.
Descriptive statistics

Note: Panel A for full sample and Panel B without banks from the USA
Source: Authors' own creation

performance criteria were met to a slightly lower extent, with an average score of 43.13%, suggesting areas for improvement in social responsibility initiatives. Environmental performance, however, lagged behind, with companies achieving only 31.26% compliance on average, signalling a pressing need for heightened focus and investment in environmental sustainability measures. On the other hand, during the period under review, the average ROA was 1%, while the NPL reached 0.09. Panel B in Table 3 presents statistics for a sample excluding banks from the USA. The average ZSCORE of the sample without banks from the USA is 44.43, and the standard deviation is 29.12. The ESG statistic presents a mean value of 47.10% and a standard deviation of 18.45, which means that, on average, banks outside the USA are implementing ESG policies to a greater extent.

The following Tables 4 and 5 present the average results for the panel regression estimation, verifying factors that influence the bank's probability of default. However, in the first step (Table 4), we focus on the estimation of Model (1) to verify changes in the probability of default under the influence of ESG activity compared to bank-specific control and macroeconomic factors. Meanwhile, as a second step, individual ESG pillars were added to the study based on Model (1), but its independent variables were limited to ESG ratings only (Table 5). Overall, the Sargan and Hansen tests confirm the validity of the instruments used in the regression. Furthermore, the Arellano–Bond serial correlation test does not suggest second-order autocorrelation (AR2), indicating the adaptability of the instruments used in the model. Instruments collapse to overcome the proliferation problem of instruments.

	Dependent variable: ZSCORE	Model (1)	Model (2)	Model (3)
	L(−1)ZSCORE	0.946*** (0.024)	0.950*** (0.025)	0.953*** (0.023)
H4	SIZE	−0.895* (0.508)	−1.528** (0.772)	−1.832*** (0.669)
H3	ROA	22.824 (43.549)	71.741 (45.741)	72.098* (41.888)
H2	NPL	−0.073** (0.033)	−0.693 (0.568)	−0.419** (0.191)
H2	LLP	−73.660*** (22.036)	−71.321** (34.191)	−85.727** (36.082)
H5	ESG_SCORE	0.139 (0.112)	0.316** (0.135)	0.241** (0.120)
H5	ESG_SCORE_SQ	−0.001 (0.001)	−0.003** (0.001)	−0.002 (0.001)
H1	GDPgrowth		−1.294** (0.539)	−1.317** (0.589)
H1	INFLATION		0.783** (0.353)	0.516 (0.329)
H6	COVID19 * NPL			0.255*** (0.070)
H6	COVID19 * LLP			14.734 (29.962)
	CONS	21.782* (12.845)	33.058* (19.429)	41.690** (16.929)
	Observations	1052	792	792
	N groups	174	155	155
	Wald test Chi^2	22,676.788	3,759.691	5,884.030
	p-value	0.000	0.000	0.000
	AR(1)	−4.45	−3.54	−3.54
	p-value	0.000	0.000	0.000
	AR(2)	0.49	0.84	0.83
	p-value	0.622	0.401	0.407

Notes: Standard errors are in parentheses; $***p < 0.01$; $** p < 0.05$; $* p < 0.1$
Source: Authors' own creation

Table 4. Determinants of bank default risk based on the two-step system GMM estimator

The country's macroeconomic situation is a general factor driving the risk of bank insolvency. Therefore, in the first hypothesis (*H1*) we assumed that economic growth is negatively associated with bank DR (GDPgrowth –1.294). In most of the estimated models, economic growth measured by GDP had an unexpected negative impact on ZSCORE, causing it to decrease. This result is not in line with business cycle theory (Boyd and De Nicoló, 2005; Gontarek, 2016) and our *H1* hypothesis may suggest that, nevertheless, a good economy may encourage banks to increase lending and take higher risks, leading to an increase in solvency risk. This result is partially supported by the Washington (2014) study, which demonstrated that Kenyan banks identify a significant negative impact of GDP per capita on the risk of bank default, but only in the short term. However, the inflation rate had a positive impact, confirming our assumption that higher inflation may be attributable to the higher interest rate charged on the lending fund due to inflationary pressures. The verification of the second hypothesis (*H2*) showed that the higher risk of credit taken by banks in the form of NPLs (NPL –0.073) or loan losses (–73.66) can increase the probability of bank insolvency. The impact of NPLs on bank stability is well-known in the financial literature. The financial accelerator models developed by Anil *et al.*, 2019; Bernanke *et al.*, 1996; Park and Shin, 2021 show that banks burdened by NPLs reduce lending, reduce profitability and tie up their capital as reserves increase, resulting in the weakening of their condition and growing DRs. A possible explanation is that banks are less cautious in lending and have taken excessive advantage of risk limits. When banks grant credit to the riskier sectors, they take a more significant impairment loss, increasing the probability of defaults. Increasing losses of impairment of loans affect a bank's income and worsen its credit health. However, this has not undermined the earning potential of banks. The regression coefficients for ROA are positive in all cases (ROA +22.824), but only in the case of Model 3 was the relationship found to be statistically significant at the 0.1 level. Therefore, we cannot

Dependent variable: ZSCORE Full sample:	ESG model	Social model	Gov model	Envir model
L(−1)ZSCORE	0.958*** (0.023)	0.958*** (0.022)	0.961*** (0.021)	0.903*** (0.045)
ESG_SCORE	−0.048** (0.024)			
SOCIAL		−0.039** (0.020)		
GOVERNANCE			0.008 (0.050)	
ENVIR				−0.105*** (0.040)
CONS	3.851** (1.605)	3.430** (1.444)	1.216 (2.486)	8.292** (3.425)
Observations	1316	1316	1316	1316
N groups	190	190	190	190
Wald test Chi^2	1814.211	1889.691	2230.574	833.287
p-value	0.000	0.000	0.000	0.000
Panel A ESG above mean	ESG model	Social model	Gov model	Envir model
L(−1)ZSCORE	1.020*** (0.021)	1.015*** (0.021)	1.015*** (0.021)	1.006*** (0.024)
ESG_SCORE	−0.082** (0.033)			
SOCIAL		−0.060** (0.024)		
GOVERNANCE			−0.011 (0.031)	
ENVIR				−0.026 (0.029)
CONS	3.944** (1.983)	3.031* (1.676)	0.022 (1.766)	1.004 (2.041)
Observations	616	616	616	616
Wald test Chi^2	2354.756	2291.675	2700.745	2148.976
p-value	0.000	0.000	0.000	0.000
Panel B ESG below mean	ESG model	Social model	Gov model	Envir model
L(−1)ZSCORE	0.913*** (0.041)	0.918*** (0.038)	0.900*** (0.043)	0.875*** (0.046)
ESG_SCORE	0.155 (0.134)			
SOCIAL		0.024 (0.077)		
GOVERNANCE			0.218** (0.102)	
ENVIR				−0.100** (0.042)
CONS	−0.202 (3.887)	3.459 (2.557)	−3.976 (3.985)	8.305*** (3.144)
Observations	700	700	700	700
Wald test Chi^2	584.928	644.310	534.830	643.987
p-value	0.000	0.000	0.000	0.000

Notes: Panel A for banks with an ESG above average; Panel B for banks with an ESG below average; Standard errors are in parentheses; $***p < 0.01$; $**p < 0.05$; $*p < 0.1$
Source: Authors' own creation

Table 5.
The impact of ESG scores and their individual pillars (social, government and environmental) on bank default risk

confidently confirm hypothesis *H3*. While it's tempting to draw a straightforward correlation between higher profitability and a lower likelihood of default among banks, it's important to recognize that financial dynamics are often complex and multifaceted. The significance of a single model result may not provide a comprehensive view of the relationship between bank profitability and DR. Financial systems are influenced by numerous factors, including regulatory environments, market conditions and macroeconomic trends.

Our study does not allow us to confirm *H4*, stating that the size of the bank is negatively correlated with its DR, which corresponds to the somewhat inconclusive results of previous studies. It simultaneously sets the direction for further analyses by dividing the sample into systemically important banks and other institutions and thus checking whether intensified supervision has an impact on DR.

The verification of hypothesis (*H5*) results show that the bank's ESG scores positively impact the ZSCORE index (+0.316). Compared to the other factors, ESG activities increase bank ZSCORE. In Model (3) in Table 4, ESG indicates that a typical bank increases its ZSCORE ratio by approximately 0.241%. The findings are congruent with Palmieri *et al.* (2023b), who reveal that improving ESG scores has a mitigation effect on firms' DR, especially for selected industries. From a banking perspective, they encourage a holistic approach to integrating ESG scores into lending practices. Similar results were obtained in the research by Meles *et al.* (2023), who analysed the relationship between green innovation and insolvency risk in 35 European countries between 2003 and 2019 and found that green innovation is negatively associated with firms' insolvency risk. The research most similar to ours is the work of Safiullah *et al.* (2022), which reports that firms with higher eco-innovation experience lower DR, as determined by distance to default. However, it should be noted that an increase in the ESG scores expressed by the variable ESG_SCORE_SQ results (ESG_SCORE_SQ –0.003) in a decrease in the ZSCORE and, consequently, an increase in the probability of banks default. The negative relationship can be interpreted as the challenges of applying sustainable ESG policies causing an increase in banks' DR in our banks' sample and over the period analysed. These results may suggest that an inadequate assessment of ESG risks, such as the impact of climate change, regulatory changes or social issues, can expose banks to unexpected losses and increase the risk of default.

Undoubtedly, changes in banks' activities were mainly caused by the outbreak of the COVID-19 pandemic, so this factor was also included in our study (*H6*). Furthermore, bank defaults interact with the COVID-19 time dummy to test the exact effects of the time effect on NPLs and loan loss provisions. Our study shows that during the COVID-19 pandemic, the effect of the increase in loan loss provisions on the ZSCORE index was not statistically significant. Our study reveals that amidst the tumult of the COVID-19 pandemic, the impact of heightened loan loss provisions on the ZSCORE index did not demonstrate statistical significance. This finding suggests that the conventional relationship between increased provisioning and the ZSCORE index may have been disrupted or obscured by the unprecedented economic conditions and regulatory responses during the pandemic era. Such insights underscore the need for nuanced understanding and adaptive approaches in financial analysis, particularly in times of crisis. In turn the iteration of the NPL ratio with COVID-19 showed a positive effect on the ZSCORE (COVID19*NPL +0.255), confirming the earlier findings of Li *et al.* (2022), who provided evidence that during the COVID-19 crisis, banks represented by lower risks of credit and liquidity. Also, Quang Trinh *et al.* (2023) find that socially responsible banks with higher social capital and trust experience lower idiosyncratic and systematic tail risk, even in the context of the COVID-19 pandemic in 2020. ESG practices reduce the constraints of excessive and aggressive bank risk-taking. These results differ slightly from those reported by Nigmonov and Shams (2021), who showed that the COVID-19 pandemic significantly negatively impacts DR in 10 EU countries. The evidence is consistent with our prediction on the impact of COVID-19 on the resulting risk-taking behaviour and, particularly, the banks' risk.

The observation of a shift towards a negative impact of ESG on the bank's DR with a more than proportional increase in ESG scores influenced us to deepen our analysis with a further step in which we verified the importance of individual ESG pillars. In Table 5, the study for the entire bank sample confirmed that an increase in ESG scores can contribute to an increase in bank DR (decrease ZSCORE index). The relationship is negative for all statistically significant models (ESG model –0.048, social model –0.039 and environmental model –0.105, respectively). These results may suggest that if banks do not perform a thorough risk assessment of their ESG activities, they may underestimate or overlook the potential risks associated with these activities. These results differ slightly from those reported by Palmieri *et al.* (2023a), who suggest that wholesale and retail banks can reduce DR by improving the performance of the environmental pillar.

Our unexpected observation was the reason for verifying its stability in a further test, dividing the sample into two panels. Panel A shows the results for a sample of banks with a higher-than-average ESG score, while panel B shows the results for banks with a lower-than-average ESG score. The sample split highlighted the importance of a bank's degree of involvement in sustainability activities in the probability of an increase in DR. The robustness check estimation confirmed that the bank's involvement in sustainability activities provides a "stronger" ESG influence on DR. Only the overall ESG measure and the social pillar remain statistically significant in Panel A. In contrast, the governance pillar (+0.218) and the environmental pillar (–0.100) remain statistically significant in the group of banks with lower ESG scores (panel B).

Specifically, we find evidence supporting hypothesis (*H5*) that a stronger ESG score increases bank DR. Our empirical evidence shows that a higher ESG score does not reduce the risk of bank default. These results partially support the theory (Karkowska and Acedański, 2019), which emphasizes that the effect of corporate governance on bank stability practically did not strengthen after the 2007–2009 financial crisis. However, the background and skills of board members would make significant changes in managing and reducing bank risk exposure. We suggest that our results could contribute to the current debate on ESG standards in the banking industry and banking regulation when creating tools to prevent bank insolvency.

As a robustness check for the primary model, we performed a separate calculation for the model without banks from the USA. The results of this estimation are presented in Table 6. The sample of banks from the US is significantly larger than the rest of the country; therefore, it may have distorted the results. Nonetheless, we compared the estimation and discovered that the results are consistent with the primary Model 2.

5. Conclusions

ESG issues are progressively taking centre stage in business practices, particularly within the framework of corporate strategies. This paper aims to empirically explore the effects of

Table 6. Determinants of bank default risk based on the two-step system GMM estimator

	Dependent variable: ZSCORE	Model (1)	Model (2)	Model (3)
	L(−1)ZSCORE	0.987*** (0.016)	1.004*** (0.022)	1.005*** (0.025)
H4	SIZE	−0.579 (0.508)	−0.277 (0.587)	−0.517 (0.492)
H3	ROA	56.723* (33.237)	23.785 (35.626)	13.356 (34.023)
H2	NPL	−0.114 (0.157)	−0.328** (0.133)	−0.457*** (0.143)
H2	LLP	−43.697*** (15.506)	−34.968 (21.592)	−27.851 (21.216)
H5	ESG_SCORE	−0.035 (0.085)	0.171** (0.087)	0.134 (0.088)
H5	ESG_SCORE_SQ	0.000 (0.001)	−0.001* (0.001)	−0.001 (0.001)
H1	GDPgrowth		−0.291 (0.404)	−0.323 (0.413)
H1	INFLATION		0.235 (0.289)	0.313 (0.260)
H6	COVID19 * NPL			0.416*** (0.114)
H6	COVID19 * LLP			−26.764 (26.359)
	CONS	14.841 (13.316)	2.893 (15.270)	9.689 (12.987)
	Observations	708	469	469
	N groups	119	100	100
	Wald test Chi^2	6262.622	3707.181	6923.086
	p-value	0.000	0.000	0.000
	AR(1)	−3.91	−3.07	−3.05
	p-value	0.000	0.002	0.002
	AR(2)	−0.65	−0.62	−0.63
	p-value	0.514	0.534	0.530

Notes: Sample without banks from the USA; Standard errors are in parentheses; ***$p < 0.01$; ** $p < 0.05$; * $p < 0.1$
Source: Authors' own creation

ESG scores on bank stability, specifically through the lens of bank DR, given the increased scrutiny banks face from stakeholders, especially regarding the incorporation of the ESG paradigm into their risk management practices.

According to Karkowska *et al.* (2023), ESG risk exhibits a bidirectional and significant relationship with other banking risks. This paper empirically investigates the combined and separate effects of ESG outcomes on bank DR. Leveraging a relatively extensive sample period (2012–2021) and a globally representative set of banks, our study encompasses post-GFC regulatory reforms, the European sovereign debt crisis and the COVID-19 crisis. This inclusivity allows us to examine whether the impact on bank DR is contingent on ESG-based activities while controlling for macroeconomic, bank-specific and COVID-19 variables. Our hypothesis posits that an increase in ESG scores corresponds to a decrease in the probability of banks facing DR.

Comparing different macroeconomic and bank-specific factors, our results highlight the positive impact of ESG measures on bank DR. However, this relationship varies according to the specific pillars (ESG) of bank sustainability and shifts into a negative one. The results of our study suggest that some ESG investments may have uncertain financial returns or require significant initial costs. If the expected financial benefits of ESG measures are not realized or the costs exceed the benefits, banks may experience financial stress, reduced profitability and an increased risk of default. Notably, ESG-related risks, encompassing physical risks associated with climate change and social risks tied to unrest or litigation, can significantly impact banks' DR.

The implications of our empirical results regarding ESG's impact on bank DR could have far-reaching effects on policymaking and regulation. Our findings demonstrate that a reflexive pursuit of enhancing ESG scores does not automatically mitigate the risk of bank insolvency. Our study shows that regulators should be particularly interested in clarifying significant improvements in ESG scoring and the reasons behind them. Notably, our findings reveal that a surge in ESG scoring is linked to an elevation in DR. This connection might be because ESG goals are given more weight than traditional business goals in banks. For example, assets with low credit risk but high ESG risk are quickly changed into assets with the opposite traits. The greening of banking portfolios may come at the expense of increased risk. In the end, our results show how important it is to include an analysis of the trade-off scale between ESG factors and other bank risks, especially credit risk, in supervisory practices like stress testing. The impact of ESG risk, particularly in pillar E, on credit risk is well documented. This connection arises from the fact that certain bank assets, such as loans financing fossil fuels, may become stranded.

Additionally, the costs associated with the energy transition resulting from climate policy can permanently exacerbate the standing of certain borrowers. The decline in the quality of loan portfolios, as demonstrated in our study, contributes to an escalation in DR. Notably, as our findings reveal, a substantial decline in ESG scoring correlates with an enhancement in the Z-score index. However, this paradoxical relationship suggests that the portfolio credit risk, negatively correlated with the Z-score index as we have illustrated, is influenced by ESG factors embedded in the scoring and might be underestimated.

This, in turn, provides a rationale for considering the implementation, along the lines of the practice used for credit ratings, of mandatory verification of ESG scoring methodologies by institutions responsible for the supervision of credit rating agencies. Such action should contribute to increased confidence in ESG scoring as a measure of ESG risk. Indeed, the real positive change in the ESG area is the reduction of ESG risks, not the extent of ESG disclosures shown so far to have a stronger positive impact on market performance than ESG scoring (Gawęda and Złoty, 2023). Policymakers might need to revisit or develop ESG and ESG scoring standards specific to the banking sector that incorporate risk evaluation metrics. This could involve encouraging banks to report their ESG scores and the risk assessments associated with their sustainability activities. Creating tools and guidelines for banks to evaluate and disclose potential risks linked to their ESG initiatives could be pivotal in preventing bank insolvency. Our results also demonstrate that ESG requirements, the fulfilment of which is reflected in ESG scoring, should be introduced gradually, taking into account the implications for other bank risks. Indeed, a spike in requirements contributes to the substitution of ESG risk with DR.

The correlations we have identified demonstrate that a policy of gradual improvement in ESG performance is effective in terms of its impact on reducing DR. However, a moderate pace of ESG risk reduction is insufficient to improve bank stability. The second requirement appears to be the harmonization of improvements across all three ESG pillars. Thus, the study could have an important impact on the sustainability strategies designed by banks.

The conclusions of our study regarding the informational value of ESG scoring are also crucial for bondholders and bank shareholders, as also pointed out by Apergis *et al.* (2022). This is especially true for investors using ESG criteria in their decisions. They need to be aware of the already-mentioned trade-off between high ESG scoring and issuer DR.

During the COVID-19 pandemic, the deterioration in the quality of loan portfolios did not harm bank DR, confirming the validity of the policy of direct and indirect state support for the banking sector. On the other hand, the study's findings regarding the negative effects of NPLs and GDP growth rates on the Z-Score index support a review of the pro-cyclicality of the design of quantitative supervisory and accounting regulations. This brings back the question of whether, and to what extent, additional provisions and tightening of capital requirements should already be made proactively when the economy flourishes, despite the lack of materialization of risk. Our findings are somewhat consistent with those of Shobhwani and Lodha (2023) regarding operating performance in that they do not support the impact of bank size on DR. The criteria for naming a global systemically important bank (G-SIB) need to be rethought so that they include a mix of things like size, cross-jurisdictional activity, complexity and substitutability. For instance, it suggests that the sheer scale of an institution does not inherently determine its risk to financial stability. In the case of a bank of a certain minimum size that does not meet the other conditions of a G-SIB, one may consider conditioning its recognition as a G-SIB only if certain risk indicators confirm this. Overall, these results may make policymakers rethink how they currently incorporate ESG factors into banking practices and regulatory frameworks. This highlights the need for a deeper and more thorough study of how ESG activities affect banks' DR.

Bank bankruptcies and bail-outs in 2023 (e.g. Silicon Valley Bank, Signature and First Republic in the USA and Credit Suisse) demonstrate that reforms aimed at strengthening the capital base, liquidity and expanding reporting and disclosure of incurred, implemented after the subprime crisis, not only failed to reduce the probability of such events to zero but also have not contributed to the improvement of their predictability. In this context, research that discloses new variables, their new combinations and the strength and direction of their impact on DR remains important for various stakeholder groups. These include shareholders, investors, depositors, supervisory institutions, deposit guarantee schemes and audit firms, which are responsible for reviewing financial statements, forming an opinion on them and prejudging whether a bank has a business continuity risk. Auditors' reputation, their most valuable asset, depends on how much this opinion is confirmed in the future. For these reasons, support for DR prediction models is very important.

We are referring to the shortcomings of ESG scorings, including their weak comparability and the low level of correlation of scorings given by different raters. Also while using the defined weighting the disclosure of 'immaterial' data does not affect the score. At the same time, the lack of information on relevant aspects hurts the bank's risk assessment. The decoupling of ESG reporting systems from ESG scoring providers' methodologies makes this possible.

The motivation for further studies is to verify the results obtained once a new definition of default is applied. Initiatives focusing on unifying reporting standards are executed while being convinced that their implementation is necessary from the point of view of strengthening the degree to which ESG scorings reflect these risks and the level of their management. It is also an interesting area for further research to broaden the spectrum of verified independent variables to include non-financial factors (e.g. related to the structure of the bank's governing bodies) and factors describing the bank's business model and shareholder structure. A further examination of this study seems reasonable over the next few years to verify the changes in the context of DR and ESG ratings following the COVID-19 pandemic.

Note

1. This estimator applies to relatively short study periods (T) and a large number of observations (N). This adjustment makes the two-stage estimator more efficient than single-stage estimators, even when the panel is relatively short (Roodman, 2009).

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Corresponding author

Zbigniew Korzeb can be contacted at: z.korzeb@pb.edu.pl