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Green Economy and Credit Quality in the European Banking Industry: What are the Opportunities for Sustainability?

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1 Introduction

In recent years, the increase in demand for "green" products by investors and borrowers as well as pressure from the community regulator have pushed banks towards a necessary consideration of Environmental, social and governance (ESG) risks in their credit risk management policies (Schultz et al., 2013; Bryant et al., 2020; Stiroh, 2020). The inclusion of ESGr in business models influences prudential requirements; ESG practices are therefore to be considered a strategic variable for both banks and authorities (EBA, 2020; ECB, 2020). ESGr should be meaningful for all stakeholders, although the imperative of achieving profitability and solvency objectives does not always guarantee the adoption of better ESG

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policies. The latter requires banks to achieve, among other things, higher qualitative standards of Corporate Social Responsibility (CSR) in order to be able to act with a view to containing environmental impacts and with greater commitment to implementing programmes of social responsibility (see for all, Bătae et al., 2020; Miralles-Quirós et al., 2019).

The relationship between ESGr and Credit Risk (CR) in banks has been investigated in previous literature (Bouslah et al., 2018; Gangi et al., 2019 and others for all); however, there is a lack of empirical data on whether such a relationship can mitigate the effect of the Non Performing Loans (NPL) index on solvency levels (Albertini, 2013; Birindelli et al., 2022).

Some authors have analyzed the impact of ESG activity on the value of the bank (Finger et al., 2018; Azmi et al., 2021; Ren et al., 2022), others have focused on the analyses of the correlation between ESG and bank stability (Di Tommaso & Thornton, 2020; Chiaramonte et al., 2022); still, other studies investigate the impact of ESG policies on the reduction of systemic risk (Berger et al., 2016; Anginer et al., 2018). There is still sparse literature regarding the possible effects of the ESGr on the NPL ratio and the solvency ratio (SLV ratio). If the focus shifts to the empirical results, it can be noted that these are even more limited and often conflicting, especially if the observation perimeter is extended to the European zone.

Based on current knowledge, although research has addressed the relationship between ESG and CR, our study is one of the first to consider the European banking sector and use a market-based measure of the Credit Default Swaps (CDS) spread (Drago et al., 2019) on a sample of European banks.

The innovative contribution is to have linked the solvency of the banks and the financial performance (FP) to the metrics of the CR, measured by the spread of the CDS and by the ESGr.

In the non-financial sector, ESGr appears to reduce losses and CDS spread levels, thereby improving credit ratings (Attig et al., 2013; Bouslah et al., 2018); the quality of the GCA and FP could be significantly improved. This result is achieved using the regression technique, by testing whether the green credit asset increase can reduce the NPL ratio and improve the SLV ratio.

The analysis was conducted on a panel of European banks, in both the Member States of the European Union and non-member countries, listed on the stock exchange in the period 2012–2021, on data extracted from various sources, although most refer to the Refinitiv Datastream.

Initially, the sample included 810 bank-year observations. After eliminating all the bank-year observations with at least one missing value among regression model variables, the number was reduced to 310 to create a balanced panel. Based on the total sample statistics, for the ESG combined score (ESG_{comb}), the average of the selected banks is less than 80%.

We postulate that the ESGr, NPLs and bank solvency linkage may give higher scores. The expectation is tested using a framework built around the analysis of three different regression models: the first to analyze the relationship between the CDS and ESG_{comb} score; the second to study the relationship between NPL and ESG scores; and the third to study the relationship between SLV ratio (Total Equity/Total Assets) and NPL.

The results of Zhang et al. (2016) support the hypothesis of moral hazard, that an increase in the NPL ratio will increase lending risk, which may lead to instability of the financial system. Moreover, the moral hazard issue will be accentuated due to the low solvency ratio and will then lead to a higher NPL ratio.

Ultimately, the models developed are a useful contribution to the existing literature as few previous studies have used more than one statistical model that correlates the indicators of ESG policies with those of the FP and banks' solvency. According to Buallay (2019), the study of the relationship between ESG dimensions, the performance, and banks'solvency are much more complex than a "simple cause-effect link". Therefore, each dimension of financial metrics relative to ESGr needs to be analyzed, as one might expect significant relationships between ESGr, financial performance, and SLV ratio. We analyze these relationships, in a disaggregated way, to support our findings more effectively than previous studies.

The chapter is organized as follows. Section 2 presents the literature review and development of hypotheses. In Sect. 3, we provide the research design and the methodological approach for empirical remarks. In Sect. 4,

we discuss the empirical findings and, finally, in Sect. 5, we provide the conclusions, the main implication, and the future developments of our research.

2 Literature Review and Development of Hypotheses

In the last two decades, the attention of the regulator, economic operators, and academic scholars has mainly been directed to the understanding of the virtuous relationship between ESGr and FP. However, most of the published empirical studies have focused on the relationship between the level of NPLs and CR in banks with contrasting findings. Much research demonstrates a positive correlation between ESG and FP (Wu & Shen, 2013; Widyawati, 2020; Cornett et al., 2016; Buallay et al., 2021); indeed, other studies provide non-significant results on this relationship (Matuszak & Różańska, 2017; Mate et al., 2021).

In most empirical studies there is a greater interest in the use of proxies concentrated on a single pillar of ESG (for example Dowell et al., 2000; Konar & Cohen, 2001); corporate investments and activities voluntarily undertake to manage responsibly and account for its impact on society (Masulis & Reza, 2015; Liang & Renneboog, 2017); satisfaction of bank's employees and customers (Luo & Bhattacharya, 2006; Servaes & Tamayo, 2013). It is only recently that research has begun to take advantage of the increased availability and breadth of cross-company and industry data afforded by ESG disclosure scores (Liang & Renneboog, 2017; Trigo et al., 2022). From a regulatory point of view, the attention of authorities towards ESG issues has been interesting. In the first step, the European Union (EU) was keen to improve disclosure by banks on non-financial information by preparing specific reports on sustainability. In 2014, in fact, the first EU directive (2014/95/EU) also required banks to carry out the necessary non-financial reporting in order to disclose information on ESG activity strategies. By virtue of the completion of the Banking Union (BU) process, the European Banking Authority (EBA, 2020), in October 2020, published an ESG risk oversight

document for banks and investment firms, succeeded by a consultation document, published at the end of November by the European Central Banking (ECB, 2020), which also made it mandatory for banks to include the ESG risk component in stress testing activity and to be completed by the end of 2022.

There have also been regulatory interventions in countries outside the EU zone. This is the document on the "Principles for Responsible Banking", the aim of which is to align the ESG strategy of the banks both with the Paris Climate Agreement and with the United Nations Sustainable Development Goals, of the "Climate Biennial Exploratory Scenario" (CBES) issued in the United Kingdom, for the assessment of the resilience of the financial system to environmental risks (Bank of England, 2021).

If we then consider the scientific production on the issues that have been highlighted, it is important to point out that, if there is substantial literature on the positive impacts of sustainability practices on the levels of corporate profitability (Gangi et al., 2019), there are, however, few studies on the analysis of the impact of ESG activities on credit risk, measured both by the ESGr and by the spread on CDS, and on the existing correlation between CR, FP, and bank solvency.

Our work fits precisely into this line of study and aims to contribute to bridging the gap in the literature through an empirical analysis of the correlation between financial performance and solvency indicator, referred to as $ESG_{\text{-comb}}$ scores. The intent is to seek solid evidence to identify a possible channel for CR reduction. In fact, if market operators tend to associate a satisfactory ESGr with lower CR, this would have a positive impact both on provisioning policies and on the agency costs component and the presence of asymmetric information (El Ghoul et al., 2011). This would lead to a virtuous process: the containment of capital constraints would guarantee better access to the financing channel (Cheng et al., 2014) with undisputed positive effects on the bank performance (García-Sánchez & García-Meca, 2017). Furthermore, in the non-financial sector, ESGr appears to reduce market share losses and CDS spread levels, which would then improve the CR (Attig et al., 2013).

Based on the above, we can formulate our first research hypothesis:

Hp 1: As ESG ratings improve, there is a positive effect on banks' credit risk (inverse relationship between ESGr and CR).

Using ESGr issued by Refinitiv and using CDS spread (the values as a proxy for creditworthiness), the relationship between ESGr and CR in the sample banks is analyzed. The analysis is referenced to the time range 2012–2021 (Sustainable Development Goals—SDGs—and Paris Agreement—COP 21) to identify the effects of exposure to ESG risk, discounting any distortions in CDS prices in earlier periods resulting from the succession of financial crises in 2008 and 2012.

The literature is more extensive; some scholars link credit quality to financial and economic variables (Naili & Lahrichi, 2020); other authors (Wu & Shen, 2013; Shen et al., 2016) indeed highlight a direct correlation between credit quality and CSR strategic choices, in terms of ESG activities, on reduction NPL levels. Compliant with the constraints of "green finance", they can reduce the riskiness of their loan portfolio through a reduction in the NPL level (Cui et al., 2018; Nizam et al., 2019) with positive effects on the SLV ratio.

Based on these remarks, we formulate our second and third hypotheses. Starting from the verification of geographic and size biases, statistical models could be developed with the aim of assessing whether the following assumptions are verified:

Hp 2: If there is an inverse relationship between ESGr and CR, there is also an inverse relationship between ESGr and NPL value (increasing the rating reduces the value of Npl);

Hp 3: The inverse relationship between ESGr and the value of NPls does not always generate a positive impact on the SLV.

We expect that an increase in ESG score has a positive effect on banks' CR, but a correlation between the ESG score and NPL is negative for all dimensions with a positive impact on SLV.

3 Methodology and Research Design

For the analysis, three different regression models were built: the first to analyze the relationship between CDS and ESG score, the second to study the relationship between NPL and ESG score, and the third to study the connection between SLV ratio and NPL. In Table 6.1, we present the description of the variables that we use for our analysis.

The dependent variable of the first model will therefore be the natural logarithm of annual 5-year senior unsecured CDS spread levels.

The dependent variable of the second model will be the natural logarithm of NPL.

The dependent variable of the third regression model is the solvency ratio, autonomously calculated based on Refinitiv Datastream data as ratio between total equity and total assets:

$$\text{SOLVRatio}_{it} = \frac{\text{Total Equity}_{it}}{\text{Total Asset}_{it}} \tag{6.1}$$

The model that analyzes the relationship between CDS and ESG score is:

$$\begin{aligned} \ln(\text{CDS})_{i,t} = {} & \beta_0 + \beta_1 \text{ESG}_{i,t} + \beta_2 \text{ENV}_{i,t} + \beta_3 \text{CG}_{i,t} + \beta_4 \text{SOC}_{i,t} \\ & + \beta_5 \text{ROENorm}_{i,t} + \beta_6 \text{CapAde}_{i,t} + \beta_7 \text{CostRatio}_{i,t} \\ & + \beta_8 \text{Size}_{i,t} + \beta_9 \text{NPLRatio}_{i,t} + \epsilon_{i,t} \end{aligned} \tag{6.2}$$

The main variables of the above model are all ESG scores. The control variables of the model are: ROENorm, normalized Return on Equity (ROE); CapAde, the capital adequacy ratio; CostRatio, the cost-to-income ratio; Size, the size of the company measured by logarithm of total assets; NPLRatio.

The model that analyzes the relationship between NPL and ESG is given below:

Table 6.1 Variables description

Variables	Role	Description	Calculation method	Source
Ln(CDS)	Dependent variable	Natural logarithm of CDS spreads	Ln(CDS Spread)	Autonomous calculations based on the data provided by Refinitiv Datastream
Ln(NPL)	Dependent variable	Natural logarithm of non performing loans	Ln(NPL)	Calculations based on the data provided by Refinitiv Datastream
Solvency Ratio	Dependent variable	Ratio of total equity to total assets	$\frac{Total\ Equity}{Total\ Asset}$	Calculations based on the data provided by Refinitiv Datastream
ESG	Independent variable	Combined ESG score	Refinitiv's ESG score is an overall company score based on the self-reported information in the environmental, social and corporate governance pillars.	Refinitiv Datastream
ENV_Score	Independent variable	Environmental ESG score	Refinitiv's Environment Pillar Score is the weighted average relative rating of a company based on the reported environmental information and the resulting three environmental category scores.	Refinitiv Datastream
GOV_Score	Independent variable	Corporate Governance ESG score	Refinitiv's Governance Pillar Score is the weighted average relative rating of a company based on the reported governance information and the resulting three governance category scores.	Refinitiv Datastream

SO_Score	Independent variable	Social ESG score	Refinitiv's Social Pillar Score is the weighted average relative rating of a company based on the reported social information and the resulting four social category scores.	Refinitiv Datastream
Cost to Income Ratio	Control variable	Cost-effectiveness Ratio: Ratio of operating expenses to net interest and other banking income	$\frac{Operating\ Expenses\ Total}{Net\ Interest\ Income}$	Autonomous calculations based on the data provided by Refinitiv Datastream
Capital Adequacy	Control variable	Adequacy Ratio: Ratio of TIER 1 capital to total Risk Weighted Assets (RWA).	$\frac{TIER\ 1 Capital}{RWA}$	Autonomous calculations based on the data provided by Refinitiv Datastream
NPL Ratio	Control variable	Ratio of non performing loans to total amount of loans disbursed	$\frac{Non\ performng\ Loans}{Total\ loans}$	Autonomous calculations based on the data provided by Refinitiv Datastream
ROE_ Normalized	Control variable	Performance Index. Profitability of total operations net of the impact of extraordinary operations		Autonomous calculations based on the data provided by Refinitiv Datastream
Size	Control variable	Natural logarithm of the total asset	Ln(Total asset)	Autonomous calculations based on the data provided by Refinitiv Datastream
CDS SPread	–	*Credit Default Swap* spread with *maturity* 5 years express in basis point.		Refinitiv Datastream

$$\begin{aligned}\ln\left(\mathrm{NPL}\right)_{i,t} &= \beta_0 + \beta_1 \mathrm{ESG}_{i,t} + \beta_2 \mathrm{ENV}_{i,t} + \beta_3 \mathrm{CG}_{i,t} \\ &+ \beta_4 \mathrm{SOC}_{i,t} + \beta_5 \mathrm{ROENorm}_{i,t} + \beta_6 \mathrm{CapAde}_{i,t} \\ &+ \beta_7 \mathrm{CostRatio}_{i,t} + \beta_8 \mathrm{Size}_{i,t} + \epsilon_{i,t}\end{aligned} \tag{6.3}$$

Again, the main variables are represented by all ESG score. The control variables of the model are: ROENorm, normalized ROE; CapAde, the capital adeguacy ratio; CostRatio, the cost-to-income ratio; Size, the size of the company measured by logarithm of total assets.

Finally, the models that analyze the relationship between SLV ratio have two different points of view. On the one hand, with respect to ESG score, while on the other, with respect to the value of NPL.

The equations are the following:

$$\begin{aligned}\mathrm{SolvRatio}_{i,t} &= \beta_0 + \beta_1 \mathrm{ESG}_{i,t} + \beta_2 \mathrm{ENV}_{i,t} + \beta_3 \mathrm{CG}_{i,t} + \beta_4 \mathrm{SOC}_{i,t} \\ &+ \beta_5 \mathrm{ROENorm}_{i,t} + \beta_6 \mathrm{CapAde}_{i,t} + \beta_7 \mathrm{CostRatio}_{i,t} \\ &+ \beta_8 \mathrm{Size}_{i,t} + \beta_9 \mathrm{NPLRatio}_{i,t} + \epsilon_{i,t}\end{aligned} \tag{6.4}$$

$$\begin{aligned}\mathrm{SolvRatio}_{i,t} &= \beta_0 + \beta_1 \ln\left(\mathrm{NPL}\right)_{i,t} + \beta_2 \mathrm{ESG}_{i,t} + \beta_3 \mathrm{ENV}_{i,t} \\ &+ \beta_4 \mathrm{CG}_{i,t} + \beta_5 \mathrm{SOC}_{i,t} + \beta_6 \mathrm{CapAde}_{i,t} + \beta_7 \mathrm{CostRatio}_{i,t} \\ &+ \beta_8 \mathrm{Size}_{i,t} + \beta_9 \mathrm{NPLRatio}_{i,t} + \beta_{10} \mathrm{ROENorm}_{i,t} + \epsilon_{i,t}\end{aligned} \tag{6.5}$$

The main variables of this model are all ESG scores and NPLs.

The control variables of the systematic risk model are: ROENorm, normalized (ROE); CapAde, the capital adeguacy ratio; CostRatio, the cost-to-income ratio, Size, the size of the company measured by logarithm of total assets; NPLRatio.

The estimators used to perform the panel regression analysis on the models mentioned above are the Fixed model and the Random estimator. The Pooled estimator was discarded a priori, since this regression is most often unlikely to be adequate to implement a regression on panel data, since it has some serious limitations. As for the choice between the Fixed and Random models, Hausman" test (1978) was performed to check which of the two was the most appropriate, and the test indicated that the most suitable model was the Fixed model for all models exept the

Table 6.2 The Hausman Test

Dependent variable	*Independent variable*	*Models*	*Result of Hausman Test*	*Chosen model*
Ln(CDS)	***ESG***	Random vs Fixed Effects	chisq = 30.009, df = 10, p-value = 0.0008536 alternative hypothesis: one model is inconsistent	**Fixed Effects**
Ln(NPL)	***ESG***	Random vs Fixed Effects	chisq = 46.088, df = 8, p-value = 2.287e-07 alternative hypothesis: one model is inconsistent	**Fixed Effects**
Solvency Ratio	***ESG***	Random vs Fixed Effects	chisq = 43.803, df = 10, p-value = 3.572e-06 alternative hypothesis: one model is inconsistent	**Fixed Effects**
Solvency Ratio	***ESG & NPL***	Random vs Fixed Effects	chisq = 21.345, df = 10, p-value = 0.01881 alternative hypothesis: one model is inconsistent	**Random Effects**

model that shows the relationship between solvency ratio and NPL (see Table 6.2).

The total sample analyzed included 31 European banks listed with 310 bank-year obsevations from 31 December 2012 to 31 December 2021 (included). The Refinitiv Datastream database was used for data extraction.

Initially, the sample included 810 bank-year observations. After eliminating all the bank-year observations with at least one missing value among regression model variables, the number was reduced to 310 to create a balanced panel. The time horizon of analysis was the ten-year period from 2012 to 2021, with the intentional inclusion of the years 2020–2021, despite the COVID-19 pandemic.

As regards the geographical area considered in the selection of banks, it covered the whole European continent, both the Member States of the European Union and non-member countries.

Regarding total sample statistics, for ESG combined, the average of the selected banks is less than 80%.

Looking at the two tails of the distribution, on the left side we have the minimal value (19.23%) and the first percentile (23.71%). On the right side of the distribution range, we have the maximum value and the ninety-ninth percentile equal to 97.56% and 97.34%, respectively.

Environment, Corporate Governance and Social Score have a similar distribution, with averages of 62%, 73% and 58%, respectively.

The ROE is, on average 4.55%. Thus, we can conclude that the sample's banks are generally functioning at a profit.

On the left side of the distribution range, we find the banks that had the worst performance, with first percentile at −40%; on the other side, we find the intermendiate that had the best performance, with the ninety-ninth percentile being 26.3%.

As regards size descriptive statistics, the total asset is slightly lower than the 3 billion euros, on an average (see Table 6.3).

On a preliminary basis, we analyzed Pearson' correlation coefficients over the total sample with the purpose of observing the degree of correlation between the ESG score and the three dependent variables (CDS spread, NPL, and solvency ratio). The results are reported in Table 6.4.

We can see a negative correlation, both between the ESG score and CDS spread, and between ESG score and the solvency ratio, with the coefficients in question being −0.349 and −0.374, respectively.

In summary, this result is also in line with our assumptions, as it indicates that the increase in ESG score has a positive effect on banks' credit risk (RQ 1).

However, the correlation between the ESG score and NPL is negative for all scores, apart from the Social ESG score that has a positive coefficient, precisely 0.005. This confirms the initial assumption about the negative relationship between ESG score and NPL (RQ 2).

Pearson's correlation matrix is also useful for the determination of multi-collinearity among selected variables. According to Lind et al. (2017), the regression model analyzed should not show the problem of multi-collinearity because the coefficients of correlation between regressors are below 0.7.

Table 6.3 Descriptive statistics

Variables	Obs	Mean	Std. Dev.	Min	Max	p1	p99	Skew.	Kurt.
Total assets	310	2.720e+09	5.980e+09	54,753,000	4.113e+10	65,239,000	2.994e+10	3.705	17.475
Common Equity	310	2.420e+08	7.020e+08	-2,823,969	5.484e+09	4,041,361	3.848e+09	4.657	27.156
NPL	310	1.070e+08	3.150e+08	904,374	2.112e+09	1,157,604	1.711e+09	4.323	22.865
EBIT	310	50,600,000	1.780e+08	-1.259e+08	1.566e+09	-6,134,899	1.051e+09	5.433	35.975
EBITDA	310	55,300,000	1.910e+08	-1.048e+08	1.667e+09	-6,027,604	1.125e+09	5.351	35.022
Tier1 capital	310	2.380e+08	6.910e+08	3,685,426	5.412e+09	4,874,035	3.767e+09	4.614	27.021
Total liabilities	310	2.470e+09	5.280e+09	49,020,000	3.564e+10	60,126,000	2.546e+10	3.633	16.782
Deposits	310	1.630e+09	4.230e+09	15,362,572	2.727e+10	15,647,506	2.106e+10	3.79	17.483
RWA	310	1.850e+09	5.480e+09	32,207,000	3.772e+10	39,137,113	3.179e+10	4.229	21.899
ROE	310	4.555	14.117	-88.27	98.14	-40.46	26.34	0.077	21.793
ENVSCORE	310	79.001	16.713	19.23	97.56	23.71	97.34	-1.312	4.229
CGSCORE	310	62.33	21.425	12.86	97	14.48	94.33	-0.477	2.194
SOSCORE	310	73.448	14.85	14.83	98.61	25.92	97.03	-0.953	4.317
ESG	310	58.418	14.163	22.67	91.68	27	87.41	0.083	2.396
Size	310	20.489	1.525	17.818	24.44	17.994	24.123	0.305	2.765
Capital Adequacy	310	0.144	0.029	0.082	0.279	0.089	0.221	0.976	4.502
Cost to Income Ratio	310	2.667	1.334	0.807	9.246	0.906	7.197	1.849	7.538
Solvency Ratio	310	0.069	0.029	-0.041	0.156	0.028	0.149	0.853	3.916
NPL Ratio	310	0.052	0.081	0.002	0.533	0.003	0.46	3.459	16.428
ROE Normalized	310	0.595	0.327	0	1	0	1	-0.487	2.029
Ln(NPL)	310	16.842	1.484	13.715	21.471	13.962	21.26	1.16	4.654
CDS Spread	310	178.911	203.77	19.45	1312	23.46	975	2.42	9.69
Ln(CDS)	310	4.732	0.915	2.968	7.179	3.155	6.882	0.484	2.545

Table 6.4 Pearson correlation matrix

	ln(CDS)	ln(NPL)	SolvRatio	ESGScore	ESGENV	ESGCG	ESGSO	CapAde	CostRatio	Size	ROENor	NPLRatio
ln(CDS)	1	…	…	…	…	…	…	…	…	…	…	…
ln(NPL)	0.041	1	…	…	…	…	…	…	…	…	…	…
Solv Ratio	0.400	0.139	1	…	…	…	…	…	…	…	…	…
ESG Score	-0.349	-0.104	-0.374	1	…	…	…	…	…	…	…	…
ESGENV	-0.327	-0.081	-0.570	0.674	1	…	…	…	…	…	…	…
ESGCG	-0.276	-0.162	-0.262	0.847	0.445	1	…	…	…	…	…	…
ESGSO	-0.276	0.005	-0.282	0.859	0.533	0.489	1	…	…	…	…	…
Cap Ade	-0.392	-0.235	-0.013	0.178	0.148	0.157	0.118	1	…	…	…	…
Cos t Ratio	-0.006	0.028	-0.494	0.039	0.315	0.021	-0.048	-0.216	1	…	…	…
Size	-0.413	0.731	-0.099	0.128	0.124	0.056	0.163	0.143	-0.041	1	…	…
ROENor	-0.124	-0.046	0.051	0.054	-0.090	0.007	0.110	0.032	-0.176	-0.018	1	…
NPL Ratio	0.522	0.166	0.181	-0.268	-0.156	-0.225	-0.233	-0.234	0.137	-0.419	-0.110	1

4 Main Results and Discussion

As regards the first model, from the results using Fixed-effect model, we can observe that the coefficient associated with ESG score immediately appears to be statistically very significant based on the p-value (0.009561). The coefficient in question is very high and has a negative sign, precisely -9.086. This result further supports RQ 1 that the ESG score positively affects the decrease in credit risk of European banks (see Table 6.5).

For all other scores, the results show a significant and positive relation with CDS spread. We have a positive coefficient as 2.28(***), 3.50(**), and 4.29(*) for Environment, Corporate Governance, and Social.

The R2 coefficient of determination (0.2505) in regression indicates that the model can explain 25.05% of CDS spread.

The only control variable with statistically significant coefficients is the capital adequacy ratio (-8.416***).

The other control variables, which are not characterized by statistically significant coefficients, are instead the cost ratio, the size, the ROE normalized, and the NPL ratio.

Using the Fixed-effect model for the second model—relationship between ESG score and NPL—we can see that the coefficient associated

Table 6.5 Effects of ESG on CDS spread

Variables	Estimate	Std. error	t-value	Pr(>|t|)	Signif. code
ESG Score	-9.086112	3.4812413	-2.61	0.009561	**
ESGENV	2.2826742	0.5743096	3.9746	9.06E-05	***
ESGCG	3.5070435	1.2874548	2.724	0.006872	**
ESGSO	4.2972306	1.9080818	2.2521	0.025121	*
Cap Ade	-8.4166194	1.5951899	-5.2762	2.72E-07	***
Cost Ratio	-0.0037161	0.0329289	-0.1129	0.910232	
Size	-0.0711322	0.1557196	-0.4568	0.648186	
ROENor	-0.106756	0.1132707	-0.9425	0.34679	
NPL Ratio	0.9425164	0.6628946	1.4218	0.156237	

Total Sum of Squares: 68.071
Residual Sum of Squares: 51.018
R-Squared: 0.25051
Adj. R-Squared: 0.13906
F-statistic: 8.9912 on 10 and 269 DF, p-value: 9.0553e-13
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Table 6.6 Effects of ESG on non performing loans

Variables	Estimate	Std. error	t-value	Pr(>|t|)	Signif. code
ESG Score	-4.714156	3.759643	-1.2539	0.21096	
ESGENV	1.37547	0.619031	2.222	0.02711	*
ESGCG	0.595103	1.396343	0.4262	0.67031	
ESGSO	2.305839	2.067776	1.1151	0.26578	
Cap Ade	-4.245735	1.729789	-2.4545	0.01474	*
Cost Ratio	0.076123	0.035419	2.1492	0.0325	*
Size	1.183918	0.167815	7.0549	1.44E-11	***
ROENor	-0.051076	0.098419	-0.519	0.60421	

Total Sum of Squares: 88.42
Residual Sum of Squares: 60.719
R-Squared: 0.31328
Adj. R-Squared: 0.21699
F-statistic: 15.4539 on 8 and 271 DF, p-value: < 2.22e-16
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

with ESG score (Environment score) appears to be statistically significant and its value is negative, with an accuracy of 1.375(*) (see Table 6.6).

The other score is not statistically significant. The R^2 coefficient of determination (0.3132) in regression indicates that the model can explain 31.32% of NPL. The control variables with statistically significant coefficients are capital adeguacy ratio (-4.24 *), cost ratio (0.076*), and size (1.18***).

Whereas for the third model, from the results obtained by the Fixed-effect model, we can observe that the coefficient associated with ESG score appears to be statistically very significant in explaining the variance of the solvency ratio based on t-statistics (2.9628) and p-value (0.0033209) (see Table 6.7).

The coefficient in question has a positive sign, precisely 0.22 (**).

We have the opposite result for the three distinct scores; the coefficients are negative and statistically significant: -0.041 (**) for environment, -0.082 (**) for corporate governance and -0.08(.) for social score.

The R^2 coefficient of determination (0.4781) in regression indicates that the model can explain 47.81% of the solvency ratio variance.

The other control variables to which statistically significant coefficients have been associated are capital adeguacy ratio (0.13 ***), cost ratio (-0.004***), size (1.18***), ROE normalized (0.005*) and NPL ratio (0.09***).

Table 6.7 Effects of ESG on solvency ratio

Variables	Estimate	Std. error	t-value	Pr(>|t|)	Signif. code
ESG Score	0.228050	7.70E-02	2.9628	0.0033209	**
ESGENV	-0.041021	1.27E-02	-3.2306	0.0013891	**
ESGCG	-0.082825	2.85E-02	-2.9097	0.0039205	**
ESGSO	-0.080443	4.22E-02	-1.9068	0.0576112	.
ROE	-0.000307	6.11E-05	-5.0199	9.42E-07	***
Cap Ade	0.139140	3.53E-02	3.945	0.0001019	***
Cost Ratio	-0.004209	7.28E-04	-5.7813	2.05E-08	***
Size	-0.029163	3.44E-03	-8.4703	1.62E-15	***
ROENor	0.005879	2.50E-03	2.3476	0.0196204	*
NPL Ratio	0.097825	1.47E-02	6.6746	1.41E-10	***

Total Sum of Squares: 0.04779
Residual Sum of Squares: 0.02494
R-Squared: 0.47814
Adj. R-Squared: 0.40054
F-statistic: 24.6466 on 10 and 269 DF, p-value: < 2.22e-16
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Finally, using the variation of the model that also has the NPL logarithm as independent variable, the Random-effect model is more performing. The result is very similar, and the coefficient associated with NPL appears to be statistically very significant in explaining the variance of the solvency ratio based on t-statistics (5.4202) and p-value (5.95E-08) (see Table 6.8).

The coefficient in question has a positive sign, precisely 0.006(***) (RQ3).

The R^2 coefficient of determination (0.4164) in regression indicates that the model can explain 41.64% of the solvency ratio variance.

5 Conclusion, Main Implication, and Future Developments

The study evaluates the relationship between the ESG variables of the Refinitiv database and the performance of the European banking sector for the period 2012–2021. Few previous studies have analyzed the

Table 6.8 Effects of NPL & ESG on solvency ratio

Variables	Estimate	Std. error	t-value	Pr(>|t|)	Signif. code
(Intercept)	0.491370	6.03E-02	8.1444	3.81E-16	***
NPL log	0.006707	1.24E-03	5.4202	5.95E-08	***
ESG Score	0.172410	7.71E-02	2.2363	0.025335	*
ESGENV	−0.038879	1.28E-02	−3.0363	0.002395	**
ESGCG	−0.064175	2.86E-02	−2.2456	0.024728	*
ESGSO	−0.065586	4.25E-02	−1.5433	0.122764	
ROE	−0.000313	6.17E-05	−5.073	3.92E-07	***
Cap Ade	0.188310	3.59E-02	5.2528	1.50E-07	***
Cost Ratio	−0.004446	7.35E-04	−6.0511	1.44E-09	***
Size	−0.027020	3.27E-03	−8.2648	2.20E-16	***
ROENor	0.005884	2.53E-03	2.3273	0.019951	*

Total Sum of Squares: 0.048614
Residual Sum of Squares: 0.028369
R-Squared: 0.41646
Adj. R-Squared: 0.39694
Chisq: 213.389 on 10 DF, p-value: < 2.22e-16
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

influence of ESG activities on financial performance and creditworthiness indicators (Xie et al., 2019; Gümüş et al., 2018; Naili & Lahrichi, 2020). In this regard, the work can make an innovative contribution to the existing literature as it analyzes the relationship between ESG factors and CR metrics, the latter measured by the CDS spread.

This relationship in turn is observed by relating it to NPL volume and solvency ratio, considered across all dimensions, such as capitalization, profitability, efficiency, and liquidity. The effects of this dual relationship were examined using a data panel built on a sample of listed European banks, which assigns an ESG score based on sustainable activities, resource intensity, share capital, and governance.

From the regression analysis, which answers the first research question, a positive relationship emerges between a better ESG performance and a solid credit risk profile that banks with better ESG performance are associated with better credit risk performance.

Regarding the second and third research questions, the models show a positive relationship between better ESG performance and the likelihood of higher profitability and creditworthiness metrics.

The results of the analyses support research questions RQ1, RQ2, and RQ3 by highlighting a positive relationship of ESG performance with a robust credit risk profile and increased profitability and creditworthiness of institutions. A possible explanation for this could be found in the greater prudence in carrying out banking activities due to the banks' commitment to environmental, social, and corporate governance practices; this virtuous attitude could in turn be a harbinger of more stable and profitable relationships.

These observations lead to several reflections: (i) attention to ESG issues is important in the banking sector and supports the EBA's proposal to include ESG activities in supervisory checks (EBA, 2020); (ii) the integration of sustainability practices into banks' internal processes should be a driving force for actions inspired by the principle of sound management (Faiella & Malvolti, 2020).

Despite the many implications just highlighted, the results suggest that the greatest benefits to the levels of profitability and solvency of banks, following the adoption of sustainability practices, can be felt more in the long term.

In other words, this study is needed now because it sheds light that the containment of CR can be achieved through a greater commitment by banks on sustainability issues. As emerges from the descriptive analysis, better overall loan portfolio quality corresponds to higher ESG_{comb} levels; this aspect should not be underestimated because the European banks still need to dispose a large amount of NPLs in the balance sheet. This is also an incentive for authorities, who must direct their regulatory policies towards greater attention to ESG issues. It is evident that a contraction of NPLs produces a positive impact on FP and SLV ratio levels and contributes to the stability of a bank. The latter aspect should not be understating, since greater bank stability leads to a strengthening of the conditions of financial resilience, in a context, such as the current one, characterized by the presence of negative contingent factors (e.g., the COVID-19 pandemic, the Russia–Ukraine war, and so on). These factors inevitably give rise to strong pressures deriving from systemic instability.

However, it is important to remember that throughout history, crises have been pivotal in developing societies (Vrontis et al., 2022; Thrassou et al., 2022).

This study has some limitations. One limitation could be the small number of banks in our sample; even if this (the sample) is in any case able to provide robust results for the analysis in question. Another limitation is linked to the possibility that other variables (typically those that are exogenous to the banking activity) may influence the relationships between the ESGr–NPL ratio–SLV ratio dimensions.

Possible future developments of the research could concern analyses of ESG policies on various dimensions of financial metrics, also extending the field of investigation to other contexts, such as that of emerging markets. For instance, if employees involved in the customer creditworthiness assessment process could affect overall portfolio CR, an analysis of their more advanced professional training could be conducted. This would limit the analysis to the rewarding aspects of the Social and Governance Pillars.

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