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# Unlocking finance through sustainability: Evidence from Italian-listed companies

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## ABSTRACT

The aim of the paper is to analyze the impact of sustainable practices on the accessibility to bank debt. Many studies have shown that companies prioritizing sustainability can benefit from more favorable financing conditions; therefore, being sustainable, publicly traded companies can help reduce risks related to sustainability and encourage long-term sustainable development.

To test this hypothesis, this study answers the research question through a quantitative method. The research is structured into two main steps. First, it identifies an environmental index and measures of banking debt. Second, a regression analysis is carried out on these two metrics to evaluate their relationship. The sample is selected from the Orbis database and is composed of 68 firms operating in industries more sensitive to environmental issues.

Results show that there is no statistically significant relationship between the sustainability index and access to short-term bank debt.

The evidence contributes to extending the existing literature by offering new insights into the effect of sustainability on credit access. Findings are a useful baseline for academics, practitioners, and decision-makers in understanding how these business models affect credit evaluation by the financial system—especially in light of the ESG guidelines issued by the EBA (2020).

This study addresses a gap in the literature by exploring whether banks are already reacting to regulatory changes (CSRD, ESG Pillar III) in their credit rating practices, even during the transitional and pre-mandatory phase. It uniquely combines a sustainability index with firm-level debt measures for a highly representative sample of Italian listed firms.

## 1. Introduction

In the last few years, the increasing normative and stakeholders' pressure led companies to integrate sustainability into the business models, also in response to Agenda 2030 and European directives 2014/95/EU e 2022/2464/EU, the so called Corporate Sustainability Reporting Directive (CSRD) (Formentini & Taticchi, 2016; Lombardi & Schimperna, 2025; Rodriguez-Anton et al., 2019). In this

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context, the evolution towards sustainable business models has proven central (Boons & Lüdeke-Freund, 2013; Schaltegger et al., 2016; Trequattrini et al., 2021). These models are based on creating economic value in synergy with environmental and social objectives and require the combination of institutional logic, stakeholder involvement and shared value (Schaltegger et al., 2012; Acquier et al., 2019).

As key players in the credit allocation process, the banking system has also been involved in this change (Diamond, 1984; Fama, 1985), given their privileged access to both financial and non-financial information, which is increasingly relevant for assessing creditworthiness (Goss & Roberts, 2011; Raimo et al., 2021; Zhang, 2021). In line with the new Corporate Sustainability Reporting Directive and the European Banking Authority (EBA) Environmental Social and Governance (ESG) Pillar III package, banks have started to consider sustainability practices and reporting in their credit granting decisions.

Several recent studies have highlighted a positive relationship between environmental performance and access to credit, particularly in the context of Italian SMEs and developing countries (Wellalage & Kumar, 2021; Zhang, 2021; D'Apollito et al., 2024). However, while evidence is accumulating on the role of Corporate Social Responsibility (CSR) in access to credit, only a few studies have focused on the other side of the banking process, namely the cost of debt, which represents an equally important dimension of the credit relationship.

Studies on the cost of debt have produced mixed results (Goss & Roberts, 2011; La Rosa et al., 2018; Raimo et al., 2021): some researches show a negative relationship between Corporate Social Responsibility (CSR) performance and interest rate (La Rosa et al., 2018); others researches a non-linear relationship (Ye & Zhang, 2011; Huang et al., 2017). However, overall, it has been found that greater Environmental, Social and Governance (ESG) transparency can improve creditworthiness and reduce the cost of financing (Attig et al., 2013; Jiraporn et al., 2014).

Although existing evidence mostly refers to pre-CSR and pre-EBA ESG periods, it has not yet been explored whether and how banks have already started to adopt ESG/CSR criteria in their credit ratings, voluntarily or preparatory, even when not yet required by the regulations. Therefore, an empirical assessment of the effect of these regulations on the relationship between CSR and access/cost of credit in the transitional implementation phase is lacking. In particular, there is a need to understand how these new regulations are influencing – possibly in an anticipatory manner – banks' practices in granting credit in relation to CSR, especially in terms of access. This represents a significant gap in the current literature and provides the motivation for the present study.

Accordingly, the aim of the research is to determine whether companies with sustainable models can attract greater short-term bank debt, a measure chosen for its relevance (Magri, 2010; Bank of; Fattouh et al., 2024; Intrinsic, 2012; Banca of Italy, 2020).

This study answers the research question through a quantitative method (Anderson et al., 2012; Bell et al., 2018), and investigates listed Italian companies belonging to industries more sensitive to sustainability issues, especially environmental matters. The sample is selected from the Orbis database, and is composed of 68 firms.

The representativeness of the final sample is high: the companies analyzed represent approximately 84 % of the revenues and 85 % of the capitalization of the initial sample, based on data for the year 2022. The data were collected mainly from the Orbis database, FRED (Federal Reserve Economic Data) database, and Our World in Data statistic website.

Briefly, this paper is structured into two steps: first, the research identifies an environmental index and measures of banking debt. In the second step, analyzing the Italian listed companies, we use a regression analysis between these two metrics to determine relationship. By using regression analysis with fixed effects, the study finds that there is no relation between our sustainability index and access to short-term bank debt.

The evidence contributes to extending existing literature by drafting the state of the art of the effect of sustainability on credit access. Our findings are a useful baseline for academics, practitioners, and decision-makers in understanding the effect of the green business on the credit evaluation made by the financial system, also in light of the guidelines issued by the EBA (2020).

The remainder of the paper is organized as follows: Section 2 examines relevant literature. Section 3 presents the research methodology. Section 4 presents the findings and discussion. Section 5 presents conclusions with theoretical and practical contributions, limitations, and future research agenda.

## 2. Literature review

### 2.1. Corporate social responsibility and access to debt's capital

Over the last years, researchers and policymakers have shown growing interest in ESG issues (Di Martino et al., 2024). According to the increasing normative and stakeholders' pressure, several conceptual approaches debate the interface between environment, development, and society (Drago et al., 2025; Formentini & Taticchi, 2016; Rudyanto & Veronica Siregar, 2018; Schimperna & Loizzo, 2022; Vitolla et al., 2019). Particularly, companies are facing the challenges of the 2030 Agenda, 2014/95/EU, 2022/2464/EU aims (Belmonte-Ureña et al., 2021; Lombardi et al., 2020; Lombardi & Schimperna, 2025; Rodriguez-Anton et al., 2019; Saviano et al., 2024). To achieve this, companies developed sustainable business models (Boons & Lüdeke-Freund, 2013; Lüdeke-Freund & Dembek, 2017; Schaltegger et al., 2016; Trequattrini et al., 2021; Ferlito & Faraci, 2022). They are "characterized by creating economic success through (and not just along with) a certain ecological or social activity" (Schaltegger et al., 2012, p. 98). However, their management requires the combination of several factors, including the institutional logics, the consideration of different stakeholders and the integration of varying value dimensions (Acquier et al., 2019; dos Santos et al., 2022). Banks and credit institutions have also had to adapt their business models by integrating sustainability.

As the principal theory behind the study, we have institutional theory (DiMaggio & Powell, 1983; Scott, 1995/2001/2008/2013). Central to the theory is the notion of legitimate organizations conforming to external expectations for stability and access to resources.

Accordingly, institutionalized organizations tend to adopt some practices-sustainability practices, for instance-not only for the sake of efficiency but also to meet external pressures coming from coercive (regulatory), normative (professional) and mimetic (from competitive uncertainty) bases of the institutional environment.

Under pressure from regulators (for example, in the wake of the Corporate Sustainability Reporting Directive), stakeholders and other industry peers, companies have entered into an increasing alignment with sustainability standards, thereby being regarded as more legitimate by financial institutions. From the institutional perspective, we hypothesize: that companies with a sustainable model may enjoy better access to bank credit since their practices help reduce long-term risk and correspond to ratifying social and regulatory expectations.

Banks are delegated controllers in the lending phase and therefore have access to information about the company that may not be available to outsiders (Diamond, 1984; Fama, 1985). This information is both financial and non-financial and useful in the whole credit allocation process (accessibility and cost) and in order to analyze market reaction (Di Martino et al., 2024). In particular, several studies have begun to investigate the role of non-financial information in the process of credit (Goss & Roberts, 2011; Raimo et al., 2021; Wellalage & Kumar, 2021; Zhang, 2021). In this perspective, banks have also started to verify corporate sustainability reporting or practises for credit granting, facing new challenges (Saviano et al., 2024). This appears to align with the latest CSRD and the EBA ESG Pillar III package (2022).

In this sense, the project of a common taxonomy becomes relevant. The EU Taxonomy Regulation, enacted in 2020, represents a significant step in legally defining environmentally sustainable economic activities (Gortsos & Kyriazis, 2024), and it is topic of discussion in recent literature (Tettamanzi et al., 2024), also focusing on Small and Medium Enterprises (O'Reilly et al., 2024). One of the topics of discussion is the alignment with the taxonomy and the effects: the uncertainty of the regulatory context causes difficulties in the assessment made by banks (Garcia-Torea et al., 2024); firms disclosing alignment with the Taxonomy exhibit higher economic-financial (Tonarello et al., 2025) and environmental (Tettamanzi et al., 2024) performances. However, the implications for all stakeholders remain to be explored (Tettamanzi et al., 2024), as financial market operators, investors, and national regulators (Lucarelli et al., 2020). Indeed, some challenges exist, such as the risk of aligning with the taxonomy only when required (O'Reilly et al., 2024).

However, only few studies have focused on CSR and access to debt's capital and only recently. Early studies showed a positive relationship between environmental performance and access to credit (Wellalage & Kumar, 2021; Zhang, 2021). In particular, it has been demonstrated on countries that recently joined Europe and Italy, using measures of access to credit and environmental performance derived from surveys (Zhang, 2021). Even focusing on unlisted companies in developing countries, which are not as closely monitored as listed companies, shows that companies with a better environmental performance received about 6.4 per cent more loans (as a ratio of total turnover) and that this effect is more pronounced in small and medium-sized enterprises (Wellalage & Kumar, 2021). Huang et al. (2023) show evidence that Chinese firms with better CSR performance tend to have greater access to bank credit, particularly for long-term loans, where the positive relationship is more pronounced compared to short-term loans. Furthermore, studies on the Italian SME environment show that SMEs with a more sustainable orientation have not only greater access to bank credit, but also a better ability to pay the cost of bank debt. The analysis was carried out on panel data of 125 listed Italian SMEs in 14 regions over the period 2017–2021. The level of implementation of sustainable practices was calculated as a quantitative score composed of 20 items grouped in three areas: disclosure, processes and governance. The dependent variables are Long Term Debt Ratio, Short Term Debt Ratio, Total Debt Ratio, and interest coverage ratio between EBITDA margin and interest expense (D'Apolito et al., 2024).

## 2.2. Corporate social responsibility and cost of debt

Scholars have also investigated the other aspect of the bank lending process, namely the cost of bank debt for businesses (Goss & Roberts, 2011; La Rosa et al., 2018; Raimo et al., 2021). In particular, Goss and Roberts (2011) investigated 3996 loans to US companies from 1991 to 2006. The proxy for CSR is the Kinder, Lydenberg and Domini (KLD) relationship for US firms. The financial performance parameter used was the interest charged on corporate loans, measured as the initial versus London Inter-Bank Offered Rate (LIBOR), adopting a spread approach like in Potì and Wang (2023). The result showed modest premiums associated with CSR. Thus, the authors found that banks do not consider CSR as a significant value or risk-reducing factor.

Looking at all European companies listed on stock exchanges in the S&P Europe 350 for the period 2005–2012, a negative relationship was found between corporate social performance and interest rates. Consistent with this result, the authors found a positive relationship between corporate social performance and debt rating (La Rosa et al., 2018).

Additionally, an improvement in CSR reduces the cost of debt when firms' CSR investment is below an optimal level. According to Ye & Zhang (2011) and Huang et al. (2017), who conducted studies on the Chinese area, this relationship is U-shaped. Further studies on different areas confirm that companies with higher levels of transparency in ESG disclosure benefit from access to third-party financial resources on better terms (Raimo et al., 2021). It means that CSR performance conveys important non-financial information that rating agencies can use in assessing the creditworthiness of companies (Attig et al., 2013). Similar conclusions were reached by Jiraporn et al. (2014), on a sample of 2516 firm-year observations from 1995 to 2007 of US firms from KLD's database.

While scholars have studied the relationship between CSR and the credit-granting process, both in terms of credit access and cost, they have not focused on the period following the introduction of the CSRD and EBA amendments. These impose initial obligations on CSR ratings in credit access, staggered according to the size and complexity of the banks. The latter may have already started adopting policies in this regard following the introduction of the CSRD and EBA amendments, even though they are not yet obligated to do so, either to "prepare" themselves or voluntarily because they have realized that considering CSR in ratings is beneficial.

Therefore, the research question is as follows:

(RQ): Do companies with sustainable business line mix have greater access to bank debt?

### 3. Methodology

The research question is answered through a quantitative method (Anderson et al., 2012; Bell et al., 2018). Specifically, we have used regression analysis as valuable tool for investigating the relationship between corporate sustainability and the ability to secure bank debt. By modeling our sustainability indicator as independent variables and measures of bank debt as dependent variables, we have assessed whether companies with more sustainable business models receive more debt. Regression models also allow for controlling other variables, enhancing the robustness of findings. Thus, this instrument provides a rigorous framework for evaluating causality and directionality in this financial-sustainability linkage. In particular, the regression analysis with fixed effects is used in order to test the relationship between sustainability of companies and banking issues (D'Apolito et al., 2024; Raimo et al., 2021). Therefore, the current research uses an Ordinary Least Squares (OLS) regression analysis with fixed effect to test the relationship between the sustainability measured by an Emission Index elaborated by the authors and the access to short-term debt. In order to analyze the impact of the different variables, not all the control variables are used in the first processing, as described in results section. Regarding the data, they were collected mainly from the Orbis database, Federal Reserve Economic Data (FRED) database and Our World in Data statistic website for environmental information.

#### 3.1. Sample selection

The starting population is represented by Italian listed companies belonging to sectors more sensitive to sustainability issue and especially environmental matters, retrieved using environmental datasets. We have used the Nomenclature statistique des Activités économiques dans la Communauté européenne (NACE) classification to detect the most sensitive sectors. Therefore, we have considered sectors coded A to F, representing the industrial and manufacturing sectors. The excluded sectors mainly refer to trade, service, and consultancy activities. In fact, companies operating in the energy, mining, metals, construction, chemical, and pulp and paper sectors are considered environmentally sensitive due to the nature of their production processes, business activities, and resulting environmental impacts (Garcia et al., 2017). Thus, even financial companies are excluded considering also their structure and the objective of the research, i.e. analyzing the impact of corporate sustainability on the ability to raise finance from banks.

In view of these exclusions, we have a population of 174 listed companies, that belongs to sensitive industries. Companies for which not all variables are available in the years of analysis (2018–2022) are excluded. Therefore, the final sample, that is the result of a cross-analysis of data published on Orbis database, is composed by 68 firms. The representativeness of the final sample is high, in fact the companies analyzed represent approximately 84 % of the revenues and 85 % of the capitalization of the population, with reference to the data for the year 2022.

Concerning the period of analysis (2018–2022), the choice is related to the Italy's transposition of EU Directive 2014/95/EU through Legislative Decree 254/2016 about publication of Non-Financial Statements of firms. From a geographical perspective, this issue becomes even more important in countries like Italy, characterised by a bank-centric system (Panetta, 2014), where bank debt plays a central role for companies.

#### 3.2. Econometric model

The relation between sustainability index and the ability to raise bank debt is tested through a fixed effects analysis, as D'Apolito et al. (2024) and Raimo et al. (2021) if we consider cost of debt instead of the ability to collect bank debt. The model proposed by this research is represented in the following equation:

$$\text{Bank Debt}_{it} = \alpha + \beta \text{Sustainability index}_{it} + \text{Control Variables}_{it} + \tau_t + \varepsilon_{it}$$

where  $i$  represents firms and  $t$  years;  $\alpha$  is the constant term;  $\beta$  indicates the coefficient of our independent variable;  $\gamma$  includes the control variables detected;  $\tau$  represents fixed effects; and  $\varepsilon$  is the error term. Specifically, the dependent variable, as explained in the following paragraphs, is represented by the changement over the years of the ratio short-term debt to total assets.

#### 3.3. Variables and data collection

We identify the dependent variable following the literature (D'Apolito et al., 2024; Bonfim; Antao, 2012; Sogorb-Mira, 2005). Specifically, we adopt the short-term debt ratio, considering its annual change, in order to investigate the immediate impact of sustainability in the short-term, in light of the increasing pressure by the regulators and the stakeholders in general and the relevance of the short-term bank debt in Italian companies, both listed and unlisted (Magri, 2010; Bank of; Intrinsicano, 2012; Banca of Italy, 2020). This type of measure also considering of its impact on survival (Fattouh et al., 2024). Data about this variable are retrieved from Orbis database.

Regarding the independent variable, we have calculated an indicator that represents the degree of sustainability of the company's business. In light of the relationship between company business lines and sustainability and the differences in terms of sustainability of the different business lines (Lubin & Esty, 2010; Li et al., 2011), we use the business line mix data present in the Orbis database as

starting data. Then, considering the importance of the environmental aspect in the context of bank debts (EBA, 2020), we have combined this data with the information relating to the CO2 emissions of the various industrial sectors. For this purpose, we have calculated an emissions coefficient for each individual sector, based on greenhouse gas emissions data for EU27 countries in 2020 (Ritchie et al., 2024). The sectors detected are: Agriculture; Land use change and forestry; Waste; Buildings; Industry; Manufacturing and construction; Transport; Electricity and heat; Fugitive emissions of greenhouse gases from energy production; Other fuel combustion; Bunker fuels. The final sustainability index of companies is given by the weighted average of the sector emission coefficients for the individual business lines. It was necessary to determine for each single business line (299 in total) the corresponding sector defined by Ritchie et al. (2024).

With the aim of improving the quality of the regression model, we consider a set of control variables following the prevailing literature. Firstly, we control for the size and profitability measured by Return On Asset (ROA) (Jiraporn et al., 2014; Goss & Roberts, 2011; D'Apolito et al., 2024; Raimo et al., 2021; Huang et al., 2017). Furthermore, we also take into account variables related to financial management such as the current ratio (La Rosa et al., 2018), and the interest coverage ratio, that is a very important variable in the credit granting processes (EBA, 2021; EBA, 2020).

In the following Table 1 you can find the explanation of each variable used.

#### 4. Results and discussion

First, we use descriptive statistics to describe the study variables. Thus, we have developed and reported the mean, maximum, minimum and standard deviation (Table 2).

Descriptive statistics show an average positive value of all the variables during the period analyzed, excluding the interest coverage ratio.

Adopting the multicollinearity analysis, we have examined the correlation matrix among the independent variables and calculate the variation inflation factors (VIF) as reported in Tables 3 and 4.

The correlations between the independent and control variables are all below 0.5, and the variance inflation factors are under 1.5, indicating that multicollinearity is unlikely to pose a significant issue in the analysis. According to Li et al. (2008), multicollinearity typically becomes problematic when correlations exceed 0.8 or VIFs surpass a threshold of 10.

Therefore, below, in Table 5, the regression results using all the control variables except the Interest coverage ratio.

The results of this elaboration, with particular attention to the R square, show a poor explanatory capacity of the model. For this reason, a new control variable, namely the lagged Debt change, is introduced.

The fixed effects panel data model analysis explained in Table 6, provides critical insights into the determinants of debt change. The study finds that approximately 33.77 % of the within-entity variance in debt change is explained by the independent variables included in the model, with significant contributions from lagged debt change ROA, in line with results of Huang et al. (2017) that shows a positive relationship between profitability and decrease of cost of debt. Despite the model's high overall significance, it exhibits limited explanatory power regarding between-entity variability and overall variance.

The parameter estimates yield several noteworthy findings. First of all, about Debt\_Change\_Lagged it emerges that the coefficient of  $-0.4594$  is highly significant (T-stat: 5.6711, P-value: 0.0000), indicating that a one-unit increase in lagged debt change results in a decrease of approximately 0.4594 units in current debt change. This suggests a trend-correcting behavior in debt changes over time.

Secondly, focusing in our sustainability measure, represented by the Emission Index, results show that with a coefficient of 3.4322, the variable is not statistically significant (T-stat: 0.5455, P-value: 0.5863), implying that it does not have a substantial effect on ratio debt change within the sample period (La Rosa et al., 2018), in line with the problems related to the challenges related to the incorporation of ESG issue in credit decision (Saviano et al., 2024). The coefficient of the Availability Index is  $-0.1506$  and not statistically significant (T-stat: 0.3814, P-value: 0.7036), indicating that the availability index does not significantly influence debt

**Table 1**

Variables description

This table reports information about the variables used in the analysis. They are divided into dependent, independent and control variable, as shown in the first column. The names used in the analysis are reported in the second column, while the third column highlights formulas of the variables. The fourth column shows the database used.

Variable Type	Name	Explanation	Literature	Source
Dependent variable	Debt Change	Annual change of the ratio short-term bank debt to total assets	D'Apolito et al. (2024)	Own elaboration on Orbis data
Independent variable	Emission index	Weighted average of the sector emission coefficients respect to business lines mix	Lubin & Esty, 2010; Li et al., 2011	Own elaboration on combination of Orbis data and Ourworldindata
Control variables	Availability index	Ratio of current assets to current liabilities	La Rosa et al. (2018)	Orbis
	ROA	Return on assets	D'Apolito et al. (2024)	Orbis
	Total assets	Size identified by total assets over GPD normalized through logarithmic function	Jiraporn et al., 2014; Goss & Roberts, 2011	Own elaboration on combination of Orbis data and Federal Reserve Economic Data
	Interest coverage ratio	Ratio of total interest expenses to EBITDA	D'Apolito et al., 2024; EBA, 2021; EBA, 2020	Own elaboration on Orbis data

Source: own elaboration

**Table 2**

Descriptive statistics

This table reports descriptive statistics for the variables used in the empirical analysis, The data refer to the final sample.

	Debt change	Emission index	Availability index	ROA	Total assets (th. Euro)	Interest coverage ratio
<i>Min.</i>	-0.9780	0.0025	0.4050	-21,3740	20611	-3.9701
<i>Max.</i>	62.0268	0.2756	4.3320	34,9610	219618000	6.1636
<i>Mean</i>	0.7504	0.1331	1.4857	3,0426	8161669	-0.1428
<i>St.dev.</i>	4.9493	0.0690	0.7189	5,5991	28743419	0.8249

Source: own elaboration

**Table 3**

Correlation matrix

This table report the correlation values considering the independent variables.

<i>Emissionindex</i>	<i>Availabilityindex</i>	<i>ROA</i>	<i>TotalassetsthEuro</i>	<i>Interestcoverageratio</i>	
1.0000	-0.1425	0.0363	0.1605	-0.0026	<i>Emissionindex</i>
	1.0000	0.3555	-0.1518	-0.0983	<i>Availabilityindex</i>
		1.0000	-0.0537	0.3074	<i>ROA</i>
			1.0000	-0.0024	<i>TotalassetsthEuro</i>
				1.0000	<i>Interestcoverageratio</i>

Source: own elaboration

**Table 4**

Variation Inflation Factors (VIF)

This table report the values of VIF for each independent variable, in order to detect multicollinearity.

	VIF
<i>Emission index</i>	1.054
<i>Availability index</i>	1.266
<i>ROA</i>	1.340
<i>Total assets (th. Euro)</i>	1.045
<i>Interest coverage ratio</i>	1.172

Source: own elaboration

**Table 5**

Regression results without Interest coverage ratio

The table reports goodness of fit and coefficients for the regression with fixed effects with annual change of short-term debt ratio as dependent variable. The independent variables used are: Emission Index; Availability Index, ROA, Total Assets.

PanelOLS Estimation Summary						
Dependent variable: annual change of short-term debt ratio						
<i>R-squared:</i>	0.1247		<i>F-statistic:</i>	7.1224		
			<i>p-value</i>	0.0000		
			<i>Distribution:</i>	F (4,200)		
Parameter Estimation						
	<i>Parameter</i>	<i>Std. Err.</i>	<i>T-stat</i>	<i>P-value</i>	<i>Lower CI</i>	<i>Upper CI</i>
<i>Emission_Index</i>	1.6725	5.3986	0.3098	0.7570	-8.9729	12.318
<i>Availability_Index</i>	0.0336	0.3270	0.1026	0.9184	-0.6113	0.6784
<i>ROA</i>	0.1308	0.0252	5.1844	0.0000	0.0811	0.1806
<i>Total_Assets</i>	-0.9451	1.0705	-0.8829	0.3784	-3.0560	1.1658
<i>F-test for Poolability:</i>	1.0961					
<i>P-value:</i>	0.3102					

Source: own elaboration

change. The positive and significant coefficient of ROA, equal to 0.1348 (T-stat: 4.5953, P-value: 0.0000) suggests that an increase in ROA is associated with an increase in debt change. This indicates that more profitable entities tend to increase their debt levels, coherently with findings about profitability and cost of debt (Huang et al., 2017). Finally, the Total Assets variable: the coefficient of -1.1321 is not statistically significant (T-stat: 0.8895, P-value: 0.3754), suggesting that the size of total assets does not have a

**Table 6**

Regression results with debt change lagged and without Interest coverage ratio

The table reports goodness of fit and coefficients for the regression with fixed effects with lagged annual change of short-term debt ratio as dependent variable. The independent variables used are: Emission Index; Availability Index, ROA, Total Assets.

PanelOLS Estimation Summary						
Dependent variable: annual change of short-term debt ratio						
<i>R-squared:</i>	0.3377			<i>F-statistic:</i>	13.360	
				<i>p-value</i>	0.0000	
				<i>Distribution:</i>	F (5,131)	
Parameter Estimation						
	<i>Parameter</i>	<i>Std. Err.</i>	<i>T-stat</i>	<i>P-value</i>	<i>Lower CI</i>	<i>Upper CI</i>
<i>Debt_Change_Lagged</i>	-0.4594	0.0810	-5.6711	0.0000	-0.6197	0.2992
<i>Emission_Index</i>	3.4322	6.2913	0.5455	0.5863	-9.0136	15.878
<i>Availability_Index</i>	-0.1506	0.3948	-0.3814	0.7036	-0.9316	0.6305
<i>ROA</i>	0.1348	0.0293	4.5953	0.0000	0.0768	0.1928
<i>Total_Assets</i>	-1.1321	1.2727	-0.8895	0.3754	-3.6497	1.3856
<i>F-test for Poolability:</i>	1.8357					
<i>P-value:</i>	0.0016					

Source: own elaboration

significant impact on debt change in this model. The diagnostic tests, including the F-test for poolability (F-statistic: 1.8357, P-value: 0.0016), confirm that the fixed effects model is appropriate, indicating the presence of entity-specific effects.

Therefore, the fixed effects panel data analysis underscores the significance of lagged debt change and ROA as determinants of debt change. Lagged debt change exhibits a trend-correcting behavior, while higher profitability (ROA) is associated with increased debt levels. Other variables, such as the emission index, availability index, and total assets (over GDP and normalized using a logarithmic transformation), do not exhibit significant effects on debt change. These findings highlight the importance of past debt trends and profitability in understanding changes in debt levels.

The model which includes lagged variables, shows a higher within R-squared value (0.3377) compared to the model without lagged variables (0.1247) laid down in Table 6. This suggests that including lagged debt change significantly improves the explanatory power of the model regarding within-entity variance. Additionally, the lagged debt change variable itself was highly significant, indicating a trend-correcting behavior in debt changes over time. In contrast, the current model shows poor explanatory power for both within and between variances, as indicated by the negative R-squared values and the lower within R-squared value.

In terms of significant predictors, both models indicate that ROA is a significant determinant of debt change, consistently showing a positive relationship. This finding aligns with some sub-periods of the analysis of Huang et al. (2023). However, the emission index and availability index remain not significant in both models, suggesting that these factors do not significantly influence short-term debt change within the observed periods, despite the increasing interest on ESG (Lombardi et al., 2020; Rodriguez-Anton et al., 2019). The

**Table 7**

Regression results including Interest coverage ratio The table reports goodness of fit and coefficients for the regression with fixed effects with annual change of short-term debt ratio as dependent variable. The independent variables used are: Emission Index; Availability Index, ROA, Total Assets, Interest Coverage Ratio.

PanelOLS Estimation Summary						
Dependent variable: annual change of short-term debt ratio						
<i>R-squared:</i>	0.5535			<i>F-statistic:</i>	28.863	
				<i>p-value</i>	0.0000	
				<i>Distribution:</i>	F (6,130)	
Parameter Estimation						
	<i>Parameter</i>	<i>Std. Err.</i>	<i>T-stat</i>	<i>P-value</i>	<i>Lower CI</i>	<i>Upper CI</i>
<i>Debt_Change_Lagged</i>	-0.3119	0.0639	-4.8830	0.0000	-0.4382	-0.1855
<i>Emission_Index</i>	7.9112	13.202	0.5992	0.5501	-18.208	34.030
<i>Availability_Index</i>	-0.9549	0.8914	-1.0713	0.2860	-2.7185	0.8066
<i>ROA</i>	0.2712	0.0668	4.0600	0.0001	0.1391	0.4034
<i>Total_Assets</i>	2.4170	0.4067	5.9427	0.0000	1.6124	3.2216
<i>Interest_Coverage_ratio</i>	-2.2301	2.6638	-0.8372	0.4040	-7.5001	3.0399
<i>F-test for Poolability:</i>	1.8368					
<i>P-value:</i>	0.0016					

Source: own elaboration

results about emission index can be explained by considering some factors. The first is the regulatory one, in fact the push of the banking authorities to strongly consider the issue of environmental sustainability is quite recent (EBA, 2021). Therefore, the practical results are not yet clearly delineated, even considering our years of observation. Furthermore, this condition is also confirmed by the European Central Bank (ECB, 2024): an analysis of energy-intensive sectors in Euro Area shows a misalignment with the goals established in the Paris Agreement. Moreover, as literature suggests, nowadays the effect of sustainability is more pronounced in long-term debt (Huang et al., 2023). Furthermore, the theme of the EU taxonomy: there are several challenges in aligning with the taxonomy, including regulatory ones (O'Reilly et al., 2024), which could help different business stakeholders, including banks, to have more detailed information for credit assessment and financing choices. Indeed, an excessive simplification of the sustainability topic could have important practical implications for the stakeholders involved (Tettamanzi et al., 2024).

Overall, the inclusion of lagged variables in the previous model provided a more comprehensive understanding of debt dynamics, highlighting the importance of past debt changes in predicting current debt changes. The current model, without lagged variables, demonstrates weaker explanatory power and does not capture the trend-correcting behavior observed in the previous analysis.

In the last model we introduce the Interest coverage ratio variable. Results in Table 7 demonstrates a significant improvement in its ability to explain the variance in Debt\_Change within entities over time. The R-squared (Within) value increased notably compared to the previous model without the Interest Coverage ratio.

Focusing on the results, the variable Debt\_Change\_Lagged ( $-0.3119$  with p-value equal to 0) has a significant negative effect on Debt\_Change. A unit increase in the lagged debt change is associated with a decrease of 0.3119 units in the current period's debt change. Emission Index, Availability Index and also Interest coverage ratio are not significantly related to our dependent variable. ROA and Total assets have significant positive effect on Debt Change, in line with the results of Horrigan (1966) that found a positive relationship between size and credit rating, findings of Huang et al. (2017) that deal with cost of debt and conclusions of Huang et al. (2023) about size and access to debt. Instead, in Wellalage and Kumar (2021) we find the positive relationship only if we consider small and medium size enterprise.

In a comparison with the previous model emerges that R-squared (Within) value increased from 0.3377 in the previous model to 0.5535 in the updated model. This significant improvement suggests that the Interest coverage ratio adds explanatory power to the model. Both models are highly significant, but the updated model has a higher F-statistic (26.863 vs. 13.360), indicating a better overall fit. Finally, despite the improvement in the R-squared (Within), the Interest\_Coverage\_Ratio itself is not statistically significant. This suggests that while the variable contributes to the overall model, its individual effect is not distinguishable from zero when controlling for other variables.

Therefore, the inclusion of the Interest coverage ratio in the PanelOLS model has significantly improved the model's ability to explain the variance in Debt\_Change within entities over time, as evidenced by the higher R-squared (Within). However, the variable itself is not statistically significant, indicating that its effect on Debt\_Change is not robust. Other variables, such as Debt\_Change\_Lagged, ROA, and Total Assets, remain significant predictors while Emission Index remains not statistically significant, also in the light of the challenges faced by the banks in incorporating sustainability factors in credit decision (Saviano et al., 2024). Future models may consider exploring additional variables or transformations, also considering the recent relevant EU taxonomy (Gortsos & Kyriazis, 2024) to further enhance explanatory power.

Moreover, a preliminary analysis based on investigating a potential relationship between emission index and change in the long-term debt ratio, as in D'Apolito et al. (2024), Sogorb-Mira (2005) and Bonfim and Antão (2012), indicates a significant relationship between emission index and change in the long term debt while it does not show any significance in terms of relationship between the dependent variable with respects all other independent variables (Table 8).

**Table 8**

Regression results using long-term debt instead short-term debt

The table reports goodness of fit and coefficients for the regression with fixed effects with annual change of long-term debt ratio as dependent variable. The independent variables used are: Emission Index; Availability Index, ROA, Total Assets.

PanelOLS Estimation Summary						
Dependent variable: annual change of long-term debt ratio						
<i>R-squared:</i>	0.0638			<i>F-statistic:</i>	1.7863	
				<i>p-value</i>	0.1200	
				<i>Distribution:</i>	F (5,131)	
Parameter Estimation						
	<i>Parameter</i>	<i>Std. Err.</i>	<i>T-stat</i>	<i>P-value</i>	<i>Lower CI</i>	<i>Upper CI</i>
<i>Debt_Change_Lagged</i>	-0.0024	0.0150	-0.1576	0.8750	-0.0320	0.0272
<i>Emission_Index</i>	-1083.3	402.65	-2.6904	0.0081	-1879.8	-286.75
<i>Availability_Index</i>	13.266	25.224	0.5259	0.5998	-36.633	63.164
<i>ROA</i>	2.0338	1.8722	1.0863	0.2793	-1.6698	5.7373
<i>Total_Assets</i>	0.7726	84.763	0.0091	0.9927	-166.91	168.45
<i>F-test for Poolability:</i>	1.0747					
<i>P-value:</i>	0.3585					

Source: own elaboration

## 5. Conclusions, implications and future research agenda

The aim of integrating ESG into the strategies of both financial and non-financial companies is an important factor for improving sustainability (D'Apollito et al., 2024; Karwowski & Raulinajtys-Grzybek, 2021; Karwowski & Raulinajtys-Grzybek, 2021). This issue is also very relevant when focusing on the financial context in Italy (Bank of Italy, 2022). Financial institutions have started to incorporate ESG criteria into their credit decisions (Ahmed et al., 2018; Goss & Roberts, 2011; Saviano et al., 2024), although the relationship between sustainability and access to credit is not simple, considering that it can be influenced by different factors (Abdul Razak et al., 2020). Furthermore, assessing sustainability and its impact on credit decisions can present challenges (Saviano et al., 2024), also taking into account that the ESG metrics are highly variable and subjective (Avramov et al., 2022; Dorfleitner et al., 2015; Dimson et al., 2020; Drago et al., 2024).

### 5.1. Discussion of theoretical and practical implications

In light of this, financial intermediaries that are quicker to correctly integrate ESG factors into their lending decisions will be able to accumulate a competitive advantage, considering that the risks stemming from the sustainability transition can have a significant effect on the credit portfolio of a financial institution (ECB, 2024). In the current context, we note the progressive introduction of greater regulatory requirements that will push banks to evaluate financing operations also on the basis of sustainability, and an ever-increasing non-financial disclosure by companies (Bank of Italy, 2022).

Focusing on the cost of debt, the results of the literature show how more sustainable firms can benefit from lower interest rates (Wellalage & Kumar, 2021; Raimo et al., 2021; La Rosa et al., 2018; Attig et al., 2013).

In view of this context and the existing literature, this research provides results that verify the relationship between the degree of sustainability (considering CO<sub>2</sub> emissions) of corporate businesses and access to credit. In consideration of the results emerging from the empirical analysis carried out on the sample of listed Italian companies belonging to sectors sensitive to sustainability in the period 2018–2022, there is no significant impact on the degree of environmental sustainability - measured through an Emission Index linked to the company's business mix - on the ability to obtain short-term bank debt. Therefore, a more sustainable mix of business lines, as defined by the study, does not seem to significantly improve access to short-term bank credit (RQ). These findings align with the results of La Rosa et al. (2018) if we consider periods of crisis. A greater significance of the accounting variables is highlighted. Specifically, the fixed effects panel data analysis underscores the significance of lagged debt change and ROA as determinants of debt change. Lagged debt change exhibits a trend-correcting behavior, while higher profitability (ROA) is associated with increased debt levels. Also considering the size we can find positive relationship, in line with previous studies (Huang et al., 2023; Wellalage & Kumar, 2021). These results also align with other research focused more on cost of bank debt, rather to access to debt (Huang et al., 2017). Other variables, such as the emission index, availability index, do not exhibit significant effects on debt change. These findings highlight the importance of past debt trends and profitability in understanding changes in debt levels.

### 5.2. Recommendations for managers and policymakers

Focusing on managerial implications, the results showed provide relevant information to companies' managers. At present and considering the assumptions underlying our analysis, business managers could give greater importance to economic-financial variables, such as profitability, and/or past debt management, in order to improve the possibility of accessing short-term debt. Today, information on the sustainability of business lines does not seem to be a determining factor in granting credit. However, it is important to consider also the future evolution and the limitations of the study. The managerial implications are also closely related to the evolution of the regulations, and in particular the recent issuance of the European sustainability taxonomy, considered a significative step (Gortsos & Kyriazis, 2024). Indeed, our empirical findings show that business line sustainability seems to be not a critical factor in credit assessment, and this may also be linked to disclosure challenges and taxonomy alignment, which may require more stringent requirements (O'Reilly et al., 2024). Moreover, the impact of regulatory uncertainty is also represented on the banks' side (Garcia-Torea et al., 2024). Therefore, this opens up a discussion regarding the activities of policy-makers, which could be fundamental in helping to adopt ESG parameters, both on the corporate side (and so also on disclosure) and on the banking side, also in light of the interest in ESG issues (Di Martino et al., 2024). Moreover, over-simplifying the topic of sustainability could have significant real-world consequences for all the stakeholders involved (Tettamanzi et al., 2024).

With regard to the non-significance of the Emission index, it is necessary to contextualize the results. In fact, the various regulations of the European banking authorities on sustainability risk management are quite recent and do not yet provide a clear framework for the loans providing process (for instance EBA, 2021). For this reason, the results of the application of sustainability criteria may not yet be clear, also in light of our analysis period (2018–2022). Furthermore, even the ECB data (2024) show a misalignment with the Paris agenda goals. Therefore, our results show that banks do not take into account the emission index, with a prevalence of accounting values and previous debts, given the non-mandatory nature of integrating sustainability criteria and the potential lack of disclosure by companies.

In addition to this implication, there are others. In the future, sustainability measures should become increasingly relevant in lending process, also in view of the evolution of banking regulations and the increased non-financial disclosure required of companies in Europe, like CSRD. Therefore, the consideration of sustainability measures based on corporate businesses should represent key driver to improve the relationship with the banking system, considering a decreased risk (Nirino et al., 2022). However, for this to happen, a change in behavior on the part of banks is necessary, solving the various sustainability integration challenges (Saviano et al.,

2024). In fact, in order to steer the economy towards sustainable development, it is essential that banks guarantee correct conditions of access to bank credit, by progressively integrating creditworthiness assessment criteria with sustainability indicators (Bank of Italy, 2022).

Regarding the academic implications, our research contributes to the literature on sustainability and access to credit, a less discussed topic than the cost of debt or rating (see for instance Raimo et al., 2021; Attig et al., 2013; Jiraporn et al., 2014; Goss & Roberts, 2011). Compared to Wellalage and Kumar (2021) our work uses different variables and analyses a different context, since the authors focus on unlisted firms in developing countries. The other contributions, however, focus on the European area, albeit with important differences. One of the researches focuses on countries that have recently joined Europe, although Italy is also present in the sample, highlighting an attention for our country in relation to this issue. Furthermore, the measures of access to credit and environmental are different from those we use and derive from a different methodology, i.e. survey (Zhang, 2021). Instead, La Rosa et al. (2018) analyze the whole of Europe, using a different sustainability measure that come from Thomson Reuters. The only contribution that focuses solely on Italy is D'Apolito et al. (2024). Unlike our paper, the authors focus on listed SMEs, without taking into account large companies. Another important difference is in the sustainability measure: the configurations of the variables vary considerably. Our measure, i.e. the Emission Index, takes into account the company's business mix and relates more to the environmental aspect.

With the exception of La Rosa et al. (2018) who does not find a relationship between access to debt and sustainability in times of crisis, the other contributions highlight a positive relationship. However, focusing on the contribution of D'Apolito et al. (2024) we note some important differences: the work analyses SMEs, which have different characteristics compared to large companies, so the results are not generalised to all listed Italian companies. Furthermore, we underline how our analysis time horizon is particular, as it is influenced by the pandemic period.

The findings of the study reveal that banks granting short-term credit do not currently meaningfully consider environmental sustainability, despite some regulatory efforts in that respect (e.g., CSRD, EU Taxonomy, EBA ESG guidelines). This lack of synchronization calls thus for the design and implementation of clear and enforceable regulatory frameworks that would incentivize or enforce credit risk assessment integration of ESG metrics.

The policymakers would enhance the effectiveness of these regulations by:

- Moving much faster with the implementation of rules for mandatory integration of ESG criteria in risk models used by banks;
- Strengthening requirements for non-financial reporting so as to enhance the comparability and credibility of corporate sustainability data;
- Providing clear guidelines or taxonomies that can easily be operationalized by financial institutions;
- Support capacity building actions for credit institutions, notably for smaller banks, to integrate ESG tools efficiently;
- Create transition incentives or grants of public guarantees mopping up underinvestment in sustainable firms viability arising from asymmetric information or distorted perceptions of risk.
- By filling these gaps, regulators would close in on ensuring credit allocation more properly serves the EU sustainable finance agenda.

### 5.3. Limitations and future researchers

Starting from this last consideration, following the limitations section. In fact, this paper, like other research, face several limitations. The first concerns the temporal aspect, chosen in the light of the evolution of the regulatory framework. The analysis is in periods influenced by Covid which had an impact on the economic system, so future research could repeat the analysis in different periods. Moreover, the analysis of only Italian-listed companies does not allow the results to be extended to unlisted companies and other geographical contexts characterized by different banking systems. Moreover, the sample is heterogeneous, considering SMEs and large companies without distinction. Finally, issues about the variables used. Our sustainability measure is developed on the basis of two information sources: data on sector emissions in Europe; corporate business lines. With regard to the latter data, extracted from Orbis, its quality should be considered, as it is not a mandatory data in the disclosure. Furthermore, a subjective connection with the sectors identified by Ritchie et al. (2024) was necessary. For this reason, future research could use different sustainability measures, such as Scope 1, 2, 3 emissions. In this sense, it is important to emphasize that the sustainability measure used in our analysis is somewhat independent of the taxonomy. Given the growing attention to the taxonomy (Tettamanzi et al., 2024), and studies highlighting a positive link with economic and financial performance (Tonnarello et al., 2025) for firms that align with the taxonomy, future research could evaluate these aspects in relation to the ability to raise bank debt. Regarding the aims of the work, it focuses primarily on the effect of sustainability on the ability to raise short-term bank debt. For this reason, future works could focus more on long-term debt measures, also due to the different explanatory potential of sustainability measures, and figure important perspectives of analysis on the onerousness of such instruments (Poti & Wang, 2023; Goss & Roberts, 2011), a topic not covered in this research, but that is central in the dynamic of the relationships between companies and banking system in light of the sustainability.

### Author statement

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## Data availability

Data will be made available on request.

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