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GHG Emissions of Italian Unlisted Firms and Bank Debt

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In this paper I investigate the effect of the greenhouse gas emissions of a sample of 478 Italian unlisted firms on their bank debt, in the context of the growing attention and awareness for climate change issue. My findings show that unlisted firms generating low levels of greenhouse gas emissions borrow less long-term, short term, and total bank debt than unlisted firms generating high levels of greenhouse gas emissions, to finance their growth opportunities. Being the first work analyzing this topic, to the best of my knowledge, further empirical research could also investigate the impact of greenhouse gas emissions on the bank financing of unlisted firms of different countries, representing specific cultural and political approaches towards climate change problems.

Keywords: greenhouse gas emissions, greenhouse gas footprint, Italian unlisted firms, bank debt

Introduction

Climate change has become a major issue in the last decades because of increased attention and awareness of consumers, investors, media, and institutions towards environmental problems and related risks for people and businesses. This caused important international meetings to be organized, such as the first World Climate Conference (UNFCCC, 2023), or international agreements to be adopted (UNFCCC, 2023; 2016), to take action to fight against climate change.

As a result, financial institutions and specifically EU banks have shifted their credit supply towards firms with a better greenhouse gas (GHG) footprint (Reghezza, Altunbas, Marques-Ibanez, d'Acri, & Spaggiari, 2022; Chen, Calabrese, & Cowling, 2024), so that businesses with a low amount of GHG emissions can easily access bank debt (Wellalage & Kumar, 2021; Chava, 2014; Chen, Hasan, Lin, & Ngoc Vy, 2018), relative to their counterparts producing a high amount of GHG emissions (Chava, 2014; Chen et al., 2018).

At the same time, firms producing a low amount of GHG emissions tend to borrow less from banks to maintain a reduced level of perceived financial risk and a considerable financial flexibility to be able to finance their future growth opportunities that they have as greener businesses (P. Asimakopoulos, S. Asimakopoulos, & Li, 2023; Hsu, Wu, Wang, & Chang, 2023). The findings of this study support this view.

The aim of this work is to appraise the impact of the transition to a greener economy on the use of bank capital by unlisted firms, by analyzing a sample of Italian businesses. In doing so, my paper sheds light on the relationship between the GHG emissions of unlisted firms and their bank debt and, to the best of my knowledge, no research has dealt with this specific topic so far.

The rest of the work is developed as follows. Section 2 reviews the related literature and provides my hypothesis concerning the relationship between the GHG emissions of the sampled firms and their bank debt.

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Section 3 describes these firms and the empirical model characteristics. Section 4 offers the results and interprets them. Section 5 concludes.

Literature Review and Hypothesis

Since 1979, when the first World Climate Conference took place (UNFCCC, 2023), climate change has generated much attention all over the world. Specifically, the international concern about global warming led the international community to adopt, in 1992, the United Nations Framework Convention on Climate Change. This is a text for international cooperation to fight against climate change by limiting average global temperature increase. Later, negotiations were launched to strengthen the worldwide response to climate problem, and, in 1997 the Kyoto Protocol was adopted (UNFCCC, 2023). The Kyoto Protocol represents legal binding carbon emission targets for industrialized countries which had to be achieved during 2008-2012 (Böhringer, 2003). In 2015, a further major step was taken to limit global warming to below 2 °C above pre-industrial level by 195 countries which signed the Paris Agreement (UNFCCC, 2016).

In this context, financial regulations oblige or incentivize EU banks to introduce sustainability factors into their lending decision-making process, to improve the comprehension of the potential effects of environmental risk and favor the transition to a more sustainable economy (D'Apolito, Galletta, Iannuzzi, & Sylos Labini, 2024). After the Paris Agreement, European banks have thus decreased the amount of credit allowed to firms generating high levels of GHG emissions and reallocated credit to greener firms in the EU (Reghezza et al., 2022; Chen et al., 2024). Therefore, businesses with a better environmental footprint can obtain more bank debt (Wellalage & Kumar, 2021), whereas firms with a lower environmental profile pay significantly higher interest rates on bank loans (Chava, 2014; Chen et al., 2018).

This issue is likely to be particularly critical for unlisted firms generating high levels of GHG emissions. In fact, unlisted companies are usually smaller, thus having difficult access to bank lending (Harrison, Youwei, Samuel, & Yuliang, 2022) because they are perceived as riskier by banks owing to their lack of transparent information (Chen et al., 2024), and tend to be discouraged when they could apply for a bank loan (Freel, Carter, Tagg, & Mason, 2012). Hence, unlisted businesses with a poor environmental profile face major problems when they seek to raise capital from banks. At the same time, as unlisted companies, they cannot rely on financial markets.

There is literature documenting that firms safeguarding environmental as well as social and governance issues obtain more and cheaper bank capital so that they can tend to borrow more from banks (Wellalage & Kumar, 2021; Chava, 2014; Chen et al., 2018). However, businesses with better environmental footprint have more growth opportunities, in terms of long-term green investments and sales development, and these lead them to adopt a more conservative leverage policy, suggesting a moderate use of bank debt. A careful debt policy also means a lowering in the perceived financial risk, and this helps attract and retain stakeholders who can support growth processes (Asimakopoulos et al., 2023; Hsu et al., 2023). Therefore, businesses with a better GHG footprint need to keep a low level of bank debt as they will employ it afterwards to finance their development.

Therefore, the hypothesis to be tested is the following:

H1: Unlisted firms generating low levels of GHG emissions borrow less long-term, short term, and total bank debt than unlisted firms generating high levels of GHG emissions, to finance their growth opportunities.

Sample Definition and Model Characteristics

The sample consists of Italian active unlisted non-financial and non-insurance firms for the period 2013-

2022, with a turnover of at least 1 million euros, so as to guarantee greater comparability with other studies dealing with relatively large companies. The sample includes 478 firms whose accounting data are drawn from Aida. Aida is a database collected by Bureau van Dijk, which delivers detailed information from balance sheets and income statements for public and private Italian companies, covering all sectors of activity.

Table 1 displays the emissions of GHGs according to the EU Technical Expert Group (TEG) on Sustainable Finance (2020) and the composition of the sample firms, grouped by NACE Macro-sector code. The table shows the amount of GHG emissions by sector and in tonnes of CO_{2e} in 2018 (columns 1 and 2). CO_{2e} means "carbon dioxide equivalent", which is a measure to express GHGs in the same unit. In fact, even if CO_2 is the most common GHG emitted by human activities in terms of quantity and environmental impact, there are other GHGs, such as methane, nitrous oxide, and so on. Therefore, CO_{2e} is a more accurate way of calculating the amount of GHGs as a whole, because it measures different GHGs in a common unit (Brander & Davis, 2012). The sectors with the highest levels of GHG emissions are: D—Electricity, gas, steam, and air conditioning supply (29.23%) and C—Manufacturing (23.93%) (column 3). Most of the firms being studied belongs to the C—Manufacturing (n = 202; 42.26%) and G—Wholesale and retail trade; repair of motor vehicles and motorcycles (n = 180; 37.66%) sectors (columns 4 and 5).

An ordinary least square (OLS) regression analysis is used to test the hypothesis. The definition and explanation of each variable are reported in Table 2, and further described below.

The dependent variables are three measures of leverage. In line with previous research (Michaelas, Chittenden, & Poutziouris, 1999; Sogorb-Mira, 2005; Bonfim & Antão, 2012; D'Apolito et al., 2024), the following variables are used to calculate the incidence of bank debt: LTDR, STDR, and TDR meaning, respectively, long-term bank debt, short-term bank debt, and total bank debt over total assets.

The independent variable is represented by GHGEs. It is a dummy variable that takes value 1 if a firm generates low GHG emissions and 0 otherwise. The sample firms are categorized as firms emitting low or high levels of GHGs according to the EU TEG on Sustainable Finance (2020) sector classification. Specifically, in this work businesses are selected as businesses emitting low levels of GHGs if they belong to sectors with the lowest emission profile, that is whose emissions in tonnes of CO_{2e} in 2018 were lower than 1%. Therefore, firms emitting low levels of GHGs are firms of the following sectors: I—Accommodation and food service activities; J—Information and communication; K—Financial and insurance activities (not included in the sample firms); L—Real estate activities; M—Professional, scientific, and technical activities; N—Administrative and support service activities; O—Public administration and defense; compulsory social security; P—Education; Q—Human health and social work activities; R—Arts, entertainment, and recreation; S—Other service activities; T—Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use; U—Activities of extraterritorial organizations and bodies. These sectors represent approximately 5% of total GHG emissions and 15.27% of the businesses in the sample (n = 73). On the contrary, businesses emitting high levels of GHGs are businesses of the remaining sectors that had emissions in tonnes of CO_{2e} in 2018 greater than 1%: A—Agriculture, forestry, and fishing; B—Mining and quarrying; C—Manufacturing; D—Electricity, gas, steam, and air conditioning supply; E—Water supply; sewerage, waste management, and remediation activities; F—Construction; G—Wholesale and retail trade; repair of motor vehicles and motorcycles; H—Transportation and storage. These sectors account for almost 95% of total GHG emissions and include 84.73% of the sample firms (n = 405) (see Table 1).

As in D'Apolito et al. (2024), I employed the following accounting control variables: SIZE (total assets) that is the natural logarithm of firm's total assets; EBITDA MARGIN (firm's operating margin) expressed as the ratio between EBITDA and revenues; LIQUIDITY (ability to repay outstanding short-term debt) measured by current assets over current liabilities; and ROA (firm's profitability) which is the return on assets.

Table 1

GHG Emissions and Sample Composition by NACE Macro-sector Code

NACE macro-sector code	Tonnes of CO_{2e} 2018	Tonnes of CO_{2e} 2018 (%)	Number of sample firms	Number of sample firms in %
A—Agriculture, forestry, and fishing	526,387,217.14	15.07	9	1.88
B—Mining and quarrying	81,201,552.02	2.32	0	0.00
C—Manufacturing	836,131,368.27	23.93	202	42.26
D—Electricity, gas, steam, and air conditioning supply	1,021,327,916.14	29.23	1	0.21
E—Water supply; sewerage, waste management, and remediation activities	161,962,114.37	4.64	0	0.00
F—Construction	64,791,686.40	1.85	4	0.84
G—Wholesale and retail trade; repair of motor vehicles and motorcycles	79,399,182.95	2.27	180	37.66
H—Transportation and storage	543,990,599,69	15,57	9	1.88
I—Accommodation and food service activities	17,333,105,86	0.50	2	0.42
J—Information and communication	8,780,514.69	0.26	37	7.74
K—Financial and insurance activities	10,837,435.09	0.31	0	0.00
L—Real estate activities	5,726,208.34	0.16	1	0.21
M—Professional, scientific, and technical activities	17,056,511.88	0.49	21	4,39
N—Administrative and support service activities	21,424,859.33	0.61	9	1.88
O—Public administration and defense; compulsory social security	29,297,099.74	0.84	0	0.00
P—Education	17,273,274.20	0.49	0	0.00
Q—Human health and social work activities	32,512,530.55	0.93	1	0.21
R—Arts, entertainment and recreation	8,298,587.66	0.24	0	0.00
S—Other service activities	9,816,300.62	0.28	0	0.00
T—Activities of households as employers; undifferentiated goods- and services- producing activities of households for own use	234,573.70	0.01	2	0.42
U—Activities of extraterritorial organizations and bodies	26.68	0.00	0	0.00
Total	3,493,782,665.32	100.00	478	100.00

Source: the first two columns from the left are from Table 2, page 13 of the EU TEG on Sustainable Finance (2020), whereas the remaining columns are the result of author's elaborations.

Table 2

Description of the Variables

Variables	Definition	Explanation
Dependent variables		
LTDR	Long-term debt ratio	Long-term bank debt/total assets
STDR	Short-term debt ratio	Short-term bank debt/total assets
TDR	Total debt ratio	Total bank debt/total assets
Independent variable		
GHGEs	Dummy equal to 1 if a firm generates low GHG emissions; 0 otherwise	Firms generating low- (high)- GHG emissions are those with emissions in tonnes of CO_{2e} in 2018 lower (higher) than 1%, according to the EU TEG (2020) sector classification

Control variables		
SIZE	Total assets	Natural logarithm of firm's total assets
EBITDA MARGIN	Firm's operating margin	EBITDA/revenues
LIQUIDITY	Ability to repay outstanding debt	Current assets/current liabilities
ROA	Firm's profitability	Return on assets

Source: author's elaborations.

Results and Discussion

Descriptive Statistics

Descriptive statistics on the sample of unlisted firms being studied are reported in Table 3 and the main results are commented upon below. The sample firms scarcely rely on bank debt as the mean total debt ratio (TDR) is less than 10%. This is due to the difficulty in accessing bank loans for unlisted firms which, as a consequence, need to use other sources of financing, such as trade debt, external equity, and retained earnings. More specifically, the unlisted firms employ more short-term bank debt (STDR) than long-term bank debt (LTDR). In fact, the average short-term bank debt is around 5.8%, whereas the average long-term bank debt is around 3.7%. However, it is worth noting that often short-term debt is renewed by banks to their trustworthy borrowers, so that for these borrowers the short-term bank debt actually becomes long-term bank debt. The average natural logarithm of the total assets (SIZE) is 10.23. The mean LIQUIDITY ratio is considerably greater than 1, i.e., 1.896, showing that generally the unlisted firms being studied have a strong ability to repay their short-term debt by employing cash related to their current investments, that is either cash itself or that generated by their more liquid assets. On average the firms I analyzed demonstrate that they are profitable as the mean return on assets (ROA) represents 4.9% of the total assets.

Table 3

Descriptive Statistics

	Observations	Mean	Std. dev.	Min.	Max.
LTDR	478	0.0372	0.0652	0.00	0.498
STDR	478	0.0585	0.0921	0.00	0.494
TDR	478	0.0957	0.136	0.00	0.570
GHGEs	478	0.527	0.5	0.00	1.00
SIZE	478	10.23	1.35	7.23	15.0
EBITDA MARGIN	478	0.0705	0.0862	-0.545	0.579
LIQUIDITY	478	1.896	1.00	0.170	7.39
ROA	478	0.0490	0.0850	-0.714	0.451

Source: author's elaborations on accounting data from AIDA.

Estimation Results

The findings of the regressions are shown in Table 4. It displays the estimation results concerning the relationship between GHGEs, as the independent variable, and three measures of dependent variables, namely LTDR in Model 1, STDR in Model 2, and TDR in Model 3. The variable GHGEs are negatively related to all the three measures of leverage, LTDR, STDR, and TDR and these relationships are statistically significant at 1%. This confirms my hypothesis. Therefore, unlisted firms generating low levels of GHG emissions borrow less long-term, short-term, and total bank debt than unlisted firms generating high levels of GHG emissions, to finance their growth opportunities, in terms of long-term green investments and sales development. Therefore, the fact

that their counterparts use more bank capital, that is long-term, short-term, and total bank debt, can imply that unlisted firms, belonging to sectors producing high levels of GHG emissions, use this bank capital to finance projects of industrial and technical reconversion to become more climate-oriented businesses. And banks, as discussed above, are nowadays willing to lend money to firms engaged in the green transition.

SIZE, EBITDA MARGIN, and LIQUIDITY are the control variables whose coefficients are generally statistically significant. SIZE is negatively and significantly related to all the leverage measures. These results are in line with those of Titman and Wessels (1988), Cooley and Quandrini (2001), and D. A. Bhat, Chanda, and A. K. Bhat (2020), among others, and show that larger firms can have more accumulated internal finance than smaller ones and hence can rely less on debt. These findings also highlight a pecking order behavior for the sampled firms (Myers, 1984; Myers & Majluf, 1984). The relationship between EBITDA MARGIN and LTDR is positive and significant, while that with STDR is still significant but negative. The interpretation of such findings is that a higher ability to create firm value implies better access to bank credit for businesses (D'Apolito et al., 2024) and allows these firms with better prospects, in terms of profitability, to substitute short-term bank debt with long-term bank debt, as they are perceived as less risky by banks. The negative and statistically significant relationships between LIQUIDITY and LTDR, STDR, and TDR imply that firms with high liquidity, as proxied by the ratio between current assets and current liabilities, will borrow less, as they can count on more internally generated funds to finance their investments. This result is again in line with the pecking order predictions (Myers, 1984; Myers & Majluf, 1984).

Table 4

Estimation Results

Variables	Model 1 LTDR	Model 2 STDR	Model 3 TDR
Constant	0.1333*** [0.0238]	0.2124*** [0.0323]	0.3457*** [0.0479]
GHGEs	-0.0173*** [0.0058]	-0.0376*** [0.0079]	-0.0549*** [0.0116]
SIZE	-0.0060*** [0.0021]	-0.0075** [0.0029]	-0.0136*** [0.0043]
EBITDA MARGIN	0.1033** [0.0437]	-0.1177** [0.0594]	-0.0144 [0.0879]
LIQUIDITY	-0.0159*** [0.0031]	-0.0251*** [0.0041]	-0.0410*** [0.0062]
ROA	-0.0491 [0.0459]	0.0228 [0.0624]	-0.0719 [0.0923]
Observations	478	478	478
Number of firms	478	478	478
R^2	0.0930	0.1226	0.1591
R^2-adj.	0.0834	0.1133	0.1502

Note. ***, **, and * indicate significance at the levels of 1%, 5%, and 10%.

Source: author's elaborations on accounting data from AIDA.

Conclusions and Suggested Future Work

My study on the relationship between GHG emissions and bank debt of Italian unlisted firms documents that unlisted firms generating low levels of GHG emissions borrow less long-term, short-term, and total bank debt than unlisted firms generating high levels of GHG emissions, to finance their future development.

This work has limitations that can provide future lines of research. Specifically, as I dealt with a sample of Italian unlisted firms, the above-mentioned relationship could be further explored, by considering unlisted businesses belonging to several countries. This extension would allow the consideration, in an econometric model, of country-level differences in terms of cultural approaches towards environmental issues and government effectiveness in tackling and solving environmental problems.

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