Is doing good, good enough?

A study on the relationship between ESG and firm performance, financial risk, and capital structure decisions

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Abstract

This study investigates the relationship between ESG - as well as its individual components - and firm performance, which is measured by return on assets and return on equity, financial risk, which is measured by credit ratings, and capital structure decisions, which are measured by the total debt over total assets ratio. To do so, this research focused on S&P500 firms during the timeframe 2006-2022. The main statistical method used was OLS but in the robustness tests section such relationships were tested using other statistical methods – OLS with lagged independent variables, SUREG and 2SLS. By doing so, an inconclusive relationship is found between ESG (as well as the social and governance components) and firm performance. However, a positive and significant relationship is identified between the environmental pillar and ROA and ROE. Regarding the relationship between ESG and higher credit ratings, a positive and significant relationship is observed across the four statistical methods considered. The results also indicate that the social and governance pillars contribute to this. Finally, when it comes to the relationship between ESG and capital structure decisions, results are again inconclusive as different methods yield different conclusions.

Keywords: ESG, ESG pillars, firm performance, financial risk, capital structure decisions

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Resumo

Este estudo investiga a relação entre ESG - bem como os seus componentes individuais - e o desempenho das empresas, que é medido pelo retorno sobre ativos e retorno sobre capital próprio, o risco financeiro, que é medido pelos ratings de crédito, e as decisões de estrutura de capital, que são medidas pelo rácio da dívida total sobre o ativo total. Para o efeito, este estudo centrou-se nas empresas do S&P500 durante o período 2006-2022. O principal método estatístico utilizado foi o OLS, mas na secção de testes de robustez as relações de interesse foram testadas utilizando outros métodos estatísticos - OLS com variáveis independentes desfasadas, SUREG e 2SLS. Ao fazê-lo, é encontrada uma relação inconclusiva entre ESG (bem como as componentes social e de governação) e o desempenho das empresas. No entanto, é identificada uma relação positiva e significativa entre o pilar ambiental e o ROA e o ROE. No que diz respeito à relação entre ESG e ratings de crédito mais elevadas, observa-se uma relação positiva e significativa nos quatro métodos estatísticos considerados. Os resultados indicam que os pilares social e de governação contribuem para esta relação. Por último, no que respeita à relação entre ESG e as decisões de estrutura de capital, os resultados são novamente inconclusivos, uma vez que diferentes métodos apresentam resultados diferentes.

Palavras-chave: ESG, pilares de ESG, performance das empresas, risco financeiro, decisões de estrutura de capital

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List of abbreviations

2SLS – Two-Stage Least Squares

CCR – Changes in Credit Ratings Regulation

CFP – Corporate Financial Performance

CG – Corporate Governance

CR – Credit Ratings

CRA – Credit Ratings Agencies

CSR – Corporate Social Responsibility

EBIT – Earning Before Interest and Taxes

EBT – Earnings Before Taxes

EN – Environmental

ESG – Environmental, Social and Governance

GLS – Generalized Least Squares

H - Hypothesis

H_ESG – High Environmental, Social and Governance

ICR – Interest Coverage Ratio

IV – Instrumental Variable

L_ESG – Low Environmental, Social and Governance

LNTA – Logarithm of Total Assets

N – Number of observations

OLS – Ordinary Least Squares

OPM – Operating Profit Margin

P – P-value

P25 – 25th Percentile

P75 – 75th Percentile

PPE – Property, Plant and Equipment

PPETA - Property, Plant and Equipment to Total Assets ratio

ROA – Return on Assets

ROE – Return on Equity

S&P500 – Standard & Poor's 500

SD – Standard Deviation

SO – Social

SUREG – Seemingly Unrelated Regression

TDTA – Total Debt to Total Assets Ratio

TR – Tax Rate

U.S. – United States

1 Introduction

ESG importance has been growing for the last two decades following the Principles for Responsible Investment launched in 2006 by the United Nations and the signature of the Paris Agreement in 2015, which set several goals to promote a sustainable future and reduce global warming. With this increasing awareness, investors also started to take more and more ESG metrics into account not only for ethical purposes, but also to understand how such measures can influence financial performance, risk management and overall stakeholder engagement.

ESG, which stands for Environmental, Social and Governance, is a framework used to assess firms' overall sustainable practices and ethical standards. It comprises three metrics, Environmental, Social and Governance. The Environmental one considers the firm's impact on the environment by assessing how its operations affect several indicators such as resources depletion, waste and pollution, climate change, deforestation, and greenhouse gas emissions. The Social component evaluates firms' relationships with its stakeholders – costumers, suppliers, employees, and the communities where they operate. Some aspects considered for this matter are human rights, working conditions, diversity and safety in the workspace and consumer protection policies. The Governance pillar analyzes how firms are governed through several factors such as leadership practices, bribery and corruption, executive remuneration, board composition, and transparency/quality reporting.

Since ESG nowadays has a critical role in the investment and business world, it is important to understand the relationship between ESG and firm metrics so that managers can make informed corporate decisions on sustainable investments considering its short- and long-term implications. As contradicting results have been found in the past regarding the relationship between ESG scores and firm performance, financial risk and capital structure decisions, the aim of this research is to shed some further light on the topic and understand what theories such results support.

Bearing this in mind, this study first assesses if firms with higher ESG scores are more profitable – which would support the stakeholder theory – or less profitable – which would be in favor of the shareholder theory. Afterwards, it is tested if firms with better ESG measures are attributed higher credit ratings - if so, it could make sense that such firms use more leverage to finance their activities since they would have access to cheaper debt.

To do so, this research starts by conducting OLS regressions. However, to understand the validity of the results, two types of robustness tests are performed: the first set of tests uses the OLS statistical method, but the sample is either divided in sub-samples or some variables

are taken out. The second set of tests runs the initial regressions but using different statistical techniques (OLS with lagged independent variables, SUREG and 2SLS).

The findings are the following: there is an inconclusive relationship between ESG (as well as the Social and Governance pillars) and firm performance. However, a positive and significant relationship is found between the Environmental pillar and ROA and ROE. Regarding the relationship between ESG and higher credit ratings, a positive and significant relationship is found across the four statistical methods considered. The results also support that the Social and Governance pillars contribute to this. Finally, when it comes to the relationship between ESG and capital structure decisions, results are again inconclusive since different methods yield different conclusions.

This research proceeds as follows. In the next section, the relevant literature will be addressed [2]. Following the literature review, the research hypotheses tested in this paper will be presented [3]. The data is discussed afterwards [4]. This part contains an overview of the sample selected [4.1], a description of the variables used [4.2] and the descriptive statistics of those variables [4.3]. The next section covers the regression models ran [5] and it is followed by the OLS empirical results [6]. The next section [7] displays some robustness tests, which are divided in two categories: alternative OLS specifications [7.1] and different statistical methods [7.2]. After that, the key findings are summarized [8] and the limitations and ideas for further research are approached [9]. The last chapter concludes this dissertation [10].

2 Literature review

The aim of this chapter is to shed some light on previous findings regarding the relationship between ESG and firm performance, financial risk, and capital structure choices. This section is divided in three sub-sections, one for each of the studied relationships of interest [2.1] [2.2] [2.3].

2.1 Relationship between ESG and firm performance

There is an ongoing debate on whether ESG has a positive or negative impact on firm performance since contradicting results have been found in the past. Those results are either supported by the Shareholder (if a negative relationship is found) or by the Stakeholder theory (if the relationship is positive).

The Shareholder Theory states that the main goal of a firm is to maximize profits for the shareholders and, therefore, all activities that do not contribute to this are considered a waste of resources (Friedman, 2007). According to this theory, ESG investments may negatively impact firm performance and should not be pursued since companies need to incur significant upfront expenses to implement sustainable practices without clear short-term returns (Cappucci, 2018). Further, by investing in ESG firms are diverting resources that could be allocated to their core activity (Di Tommaso & Thornton, 2020).

This theory is backed by some studies on the field that indicate that corporate ESG practices have a significant negative impact on firm performance (Grisales & Aguilera-Caracuel, 2019) specially when the firms analyzed are non-state-owned and non-environmentally sensitive (Ruan & Liu, 2021). Another research shows that this negative relationship holds when information asymmetries are low and argues that ESG practices represent costs unrelated to the operations of the firm which reduce wealth and profits (Farooq, 2015).

On the other hand, the Stakeholder Theory defends that companies should be managed taking into consideration the interests of all the stakeholders affected by its operations such as customers, suppliers, employees, communities, regulators, and the environment, and not only the interests of the shareholders (Freeman & McVea, 2017). This theory supports investment in ESG since it considers such practices beneficial for firm performance. This may happen through the following mechanisms: better reputation that leads to talent attraction (Montgomery & Ramus, 2003) and customer loyalty (Creyer, 1997), efficiency gains as the

implementation of sustainable practices can reduce operational costs (Schoenherr, 2012), risk mitigation by allowing firms to not incur in lawsuits, regulatory fines and reputational damages related to ESG issues (Karpoff, Lott & Wehrly, 2005), improving access to capital markets since firms with high ESG scores are attractive to several investors (Kurtz, 2020) and growth in the long run as it aligns the firm with market sustainability trends (Bonini & Bové, 2014).

This view is supported by a broad part of the literature on this topic where the following studies and respective findings can be highlighted: an analysis of 2200 empirical studies on the relationship between CFP and ESG that revealed that not only the majority of the studies present positive relationships but also that such relationships are stable over time (Friede, Bush, & Bassen, 2015), a research that concluded that businesses that present a strong performance on material sustainable issues significantly outperform firms with poor ratings in both stock and accounting dimensions (Khan et al., 2016) and a study on S&P500 firms that showed that the ones with higher disclosures of ESG practices experience higher levels of financial and operational performance measured by ROE and ROA (Alareeni & Hamdan, 2020). It was also found that corporate governance is the ESG component that displays the most significant impact on corporate profitability (Kim & Li, 2021).

2.2 Relationship between ESG and financial risk

Firms with lower probabilities of default are attributed higher credit ratings which allow them to have access to lower costs of debt. Considering this, it is relevant to understand the relationship between ESG and credit scores specially since it is a variable that is taken into account by the main credit agencies firms Moody's ("ESG Risk Solutions & Management – Moody's"), S&P ("ESG Evaluation | S&P Global Ratings") and Fitch ("ESG & Credit Ratings: Fitch Ratings").

Most studies find a positive relationship: an analysis with 3331 firms from different geographies and industries concluded that companies with a high level of ESG awareness present better levels of creditworthiness, which is measured by the Altman Z-score (Brogi, Lagasio, & Porretta, 2022). It is also worth mentioning that the social and governance metrics are the ones that appear to affect credit ratings the most. The arguments presented to support this are that ESG practices have a risk mitigation role that reduces the overall risk of firms and, therefore, their default probabilities (Devalle, Fiandrino & Cantino, 2017) and the fact that such companies usually have a high degree of transparency in their operations (Agnese & Giacomini, 2023).

2.3 Relationship between ESG and capital structure decisions

Once again, the literature presents conflicting findings when it comes to the relationship between ESG scores and capital structure decisions.

The previous literature section mentioned that firms with higher ESG scores are attributed more favorable credit ratings and, therefore, have access to cheaper debt. This makes debt financing more attractive which, in turn and according to some authors, may incentivize the use of more leverage in the capital structure (Apergis, Poufinas & Αντωνόπουλος, 2022).

There is also literature which supports that, once firms become ESG rated, their optimal market and book leverage ratios decrease to prevent debt-overhang. Such effect is proven to be stronger when companies receive an above average ESG score (Asimakopoulos et al., 2023). Another study conducted by the same authors concludes that ESG scores are negatively associated with leverage. They also find that the three ESG pillars contribute to this. The main reason presented for this is that companies want to avoid having underinvestment problems (Asimakopoulos et al., 2023). Those studies are therefore in line with firms using less leverage on their capital structure.

Besides that, there is literature that shows that capital structure decisions are not affected by ESG performance and, therefore, consider that ESG is not relevant for efficient capital structure choices and for firms' ability to raise funds (Kounduri, Pittis & Plataniotis, 2021).

3 Research hypotheses

This research tested six hypotheses in total, the first two regarding the relationship between ESG and firm performance [3.1], the following two regarding ESG and financial risk [3.2] and the last two regarding ESG and capital structure decisions [3.3]. This section therefore presents and explains the hypotheses considered.

3.1 Relationship between ESG and firm performance

Regarding the relationship between ESG and firm performance, a broad part of the existing literature found positive and stable relationships over time (Friede et al., 2015), but there are also studies that found significant negative relationships (Grisales et al., 2019). Considering this, this research aims to shed light on the significance and sign of the relationship between ESG and firm performance, which led to the first hypothesis:

H1: There is a positive relationship between ESG and firm performance.

Since ESG comprises three components, Environmental, Social and Governance, it is relevant to understand which of those factors presents a stronger relationship with performance measures. According to Kim & Li (2021), from the three ESG pillars, Governance is the one that displays the most significant relationship with firm performance measures. To understand if this research goes in line with their finding, the second hypothesis was defined:

H2: From the ESG components, Governance is the one that influences the most the relationship with firm performance.

3.2 Relationship between ESG and financial risk

Regarding the relationship between ESG and financial risk, most studies find that firms with higher ESG metrics present better levels of creditworthiness (Brogi et al., 2022). To understand if this study goes in line with such previous findings, the third hypothesis was defined in the following way:

H3: There is a positive relationship between ESG and better credit ratings.

Once again, as ESG is composed by three elements, it is important to understand what are the pillars that present a stronger relationship with credit ratings. According to Brogi et al. (2022), the social and governance metrics are the ones that appear to affect credit ratings the most. This led to the definition of the following fourth hypothesis:

H4: From the ESG components, Social and Governance are the ones that influence the most the relationship with credit ratings.

3.3 Relationship between ESG and capital structure decisions

Regarding the relationship between ESG and capital structure choices, there are conflicting findings in the literature. Some studies support that firms with higher ESG scores use more leverage on their capital structure (Apergis et al., 2022), others find that they use less leverage (Asimakopoulos et al., 2023) and there is also literature that shows that capital structure decisions are not affected by ESG (Kounduri et al., 2021). Bearing this in mind, this research wants to understand if there is indeed a significant relationship between ESG and capital structure choices and, if so, if it is negative or not, which led to the fifth hypothesis:

H5: There is a negative relationship between ESG and using more debt on the capital structure.

Finally, as ESG is composed by three elements, it is important to shed light on what are the pillars that influence the potential relationship with capital structure decisions. According to Asimakopoulos et al. (2023), the three ESG pillars contribute to this. Based on this, the sixth hypothesis was set in the following way:

H6: ***From the ESG components, all of them (Environmental, Social and Governance) present a significant relationship with capital structure choices.***

4 Data

This section will start by briefly presenting the type of firms chosen as well as the timeframe selected [4.1], then it will go over the variables considered [4.2] and then it will introduce the descriptive statistics of those variables [4.3].

4.1 Sample selection

To study the hypothesis proposed, this research will focus on S&P 500 firms. The S&P 500 is a stock market index which comprises the five hundred largest public companies in the U.S. across all industries. This subset of firms was chosen for several reasons: firstly, large firms usually have a high degree of disclosure of their practices which means that they have wider ESG data availability; also, by representing a significant portion of the U.S. equity market, this index is considered to be a good representation of the country's economy; finally, since those are the largest firms in the U.S., they are the ones that have more resources available to allocate to the implementation of ESG practices if managers decide to do so.

Regarding the timespan used, this study considers the interval between 2006 and 2022. The first year considered was 2006 since this was the year in which the United Nations launched the Principles for Responsible Investment, that were crucial in the promotion of ESG investment practices. The last year considered is 2022 because, since ESG scores are only attributed on a yearly basis, the 2023 ESG data is still not available. Bearing this in mind, all the variables presented on this section were extracted in a yearly frequency for further analysis. This research therefore uses panel data as several firms were considered across time.

4.2 Variables

This section will discuss in detail the variables that were used to conduct this study. Firstly, the dependent variables ROA, ROE, Credit Ratings and Total Debt over Total Assets will be presented. Subsequently, the independent variables will be addressed. Finally, the relevant control variables will be mentioned. All the data needed to compute the variables presented below was extracted from "Refinitiv Eikon Datastream" using "LS&PCOMP" as series except for the Credit Ratings, which were taken from the North America "Ratings" section in "Compustat".

4.2.1 Dependent variables

The variables chosen to measure firm performance were Return on Assets (ROA) and Return on Equity (ROE). ROA, which is computed as Net Income divided by Total Assets, is a measure of operational profitability and indicates how efficiently firms are using their assets to generate profits (Bhagat & Bolton, 2008; Hatem, 2014). ROE, which is calculated as Net Income divided by Equity, is a measure of firm efficiency and assesses firms' ability to earn profits from their shareholders investments (Hatem, 2014; Azeez, 2015).

The metric selected to measure financial risk was credit ratings (CR) (Kim & Li, 2021). Credit ratings are opinions issued by rating agencies regarding firms' overall level of creditworthiness. Companies with higher levels of creditworthiness are attributed higher credit ratings. The ones extracted for this thesis were the "S&P Domestic Long-Term Issuer Credit Ratings". Since Credit Ratings are presented with letters – AAA is the best one and D is the worst – but they will be included in the regressions conducted, each credit rating was attributed a number. A D rating was given a 1 (minimum) and a AAA rating was given a 21 (maximum). Here the logic is that every time the firm improves its credit rating by one position, for instance from AA+ to AAA, the number attributed increases by one unit, in this case from 20 to 21. We have 21 numbers because there are 21 possible credit ratings that can be given to a firm. Below it is a table with the credit ratings and their respective attributed scores. In here it's important to consider that this variable will be used as a control variable for the capital structure regressions.

Table 1 - Credit ratings and attributed scores

Rating	Score
AAA	21
AA+	20
AA	19
AA-	18
A+	17
A	16
A-	15
BBB+	14
BBB	13
BBB-	12
BB+	11
BB	10
BB-	9
B+	8
B	7
B-	6
CCC+	5
CCC	4
CCC-	3
CC	2
D	1

The metric used to assess capital structure choices was the total debt to total assets ratio (TDTA) (Gordon & Lee, 2001; Akinleye & Dadepo, 2019). This measure indicates what is the percentage of the firm's assets that is being financed through short- and long-term debt. In here it is important to consider that this variable will be used as a control variable for the firm performance and financial risk regressions.

4.2.2 Independent variables

To understand the impact of ESG on firm performance, financial risk and capital structure decisions, the main independent variable used is the ESG score. This study uses the Refinitiv ESG score (ESG) which is an overall score based on the firms' self-reported information on the Sustainable, Social and Governance dimensions (Gregory, 2022). By reflecting the performance of companies in those dimensions, this score allows investors and stakeholders to have an overview of firms' sustainable practices. This score can take values between 0 and 100 and, the higher the score, the better are the ESG practices of the company.

Besides the ESG score, this study also uses the Environmental, Social and Governance scores individually to understand which of those components' present stronger relationships with the dependent variables. The Refinitiv Environment Pillar Score (EN) is a weighted average rating of the three environmental category scores reported by firms on emissions, resource use and innovation. The Social Pillar Score (SO) is a weighted average rating of the four social category scores reported by firms on human rights, product responsibility, community, and workforce. The Governance Pillar Score (CG) is a weighted average rating of the three governance category scores reported by firms on management, shareholders, and CSR strategy.

4.2.3 Control variables

This sub-section presents the control variables considered in this study. This research controls for size, liquidity, tangibility, and operating performance.

To capture size, the variable chosen was the logarithm of total assets (LNTA) (Dang et al., 2018). Total assets, which is the sum of current and non-current assets, measures everything that a firm controls and owns that has an economic value. Their logarithm is used to address potential skewness issues and to reduce the variation scale since firms' sizes vary a lot. Larger companies can benefit from economies of scale and have a higher degree of market power. Also, by being able to diversify their product portfolio and geographical locations, they are less risky and can secure funds at lower costs which can influence their capital structure decisions.

To control for liquidity, the interest coverage ratio (ICR) was considered (Kim & Li, 2021). This ratio, which is computed as EBIT divided by interest expenses, indicates how easily a firm can cover its interest expenses on debt with its operating income. Firms with more liquidity have a higher degree of financial flexibility to take advantage of good investment opportunities and, since they can meet their short-term obligations easily, they have lower probabilities of default, which leads to higher credit ratings and lower costs of debt that, again, can influence capital structure choices.

To account for tangibility, PPE as a portion of total assets (PPETA) was included (Hall, 2012). Firms with more PPE will have higher depreciations that will impact expenses and the amount to be taxed. Also, those firms can use the PPE as collateral on their loans to have easier access to debt financing and reduce borrowing costs since lenders can liquidate them if they default, which makes debt an attractive financing option. Regarding financial risk, it's important to consider that firms with more tangible assets are more resilient during economic downturns as they have assets that can be sold.

Finally, to assess operational performance, the operating profit margin (OPM), which is given by EBIT divided by revenues, was added (Borodin et al., 2020). This ratio indicates the percentage of revenues that is turned into operating profit and sheds light on firms' operational efficiency. Firstly, firms with high OPMs tend to have good financial performance as they are generating more EBIT in comparison to their revenues. Also, since companies have a stable income stream, this may incentivize the use of debt since they can meet debt obligations easily. They are also better positioned to endure market fluctuations as they have bigger margins to account for increases in costs and decreases in revenues while remaining profitable.

To sum up, the table below presents the dependent, independent and control variables that were used in this thesis as well as their acronym used in the regressions, their type, the formula used to compute them and where they were extracted from.

Table 2 - Variables description

Category	Type	Variables	Formula	Source
Dependent	Firm performance	ROA	Net income / Total assets	Refinitiv Eikon Datastream
		ROE	Net income / Equity	Refinitiv Eikon Datastream
	Financial risk	CR	Attributed according to table 1	Compustat - North America Ratings
	Capital structure	TDTA	Total debt / Total assets	Refinitiv Eikon Datastream
Independent	ESG scores	ESG	Extracted directly from the source	Refinitiv Eikon Datastream
		EN		Refinitiv Eikon Datastream
		SO		Refinitiv Eikon Datastream
		CG		Refinitiv Eikon Datastream
Control	Size	LNTA	Ln(Total assets)	Refinitiv Eikon Datastream
	Liquidity	ICR	EBIT / Interest expense	Refinitiv Eikon Datastream
	Tangibility	PPETA	PPE / Total assets	Refinitiv Eikon Datastream
	Operational performance	OPM	EBIT / Revenues	Refinitiv Eikon Datastream

4.3 Descriptive statistics

To clean the initial extracted dataset, all the observations that had at least one variable missing value were excluded. Considering this, the final sample included 6621 observations and, since not all the firms have the same number of observations, this study handles imbalanced data. The summary statistics of the final sample considered are displayed in the following table.

Table 3 - Initial summary statistics

Category	Variables	N	Mean	p25	Median	p75	SD	Min	Max
Dependent	ROA	6621	.073	.035	.065	.106	.077	-.701	.771
	ROE	6621	.364	.088	.153	.25	6.681	-248.5	315.6
	CR	6621	13.868	12	14	16	2.617	2	21
	TDTA	6621	.281	.155	.267	.385	.187	0	3.916
Independent	ESG	6621	54.84	40.13	57.07	70.72	19.663	0	95.16
	EN	6621	47.747	23.63	52.09	72.17	28.451	0	98.55
	SO	6621	56.998	40.37	58.47	74.29	21.472	0	98.12
	CG	6621	58.155	42.77	60.72	75.19	21.511	0	99.44
Control	LNTA	6621	16.763	15.782	16.691	17.581	1.404	12.446	22.042
	ICR	6621	65.055	3.426	7.723	15.953	810.915	-5904.163	34931.2
	PPETA	6621	.282	.066	.167	.47	.272	0	1.395
	OPM	6621	.165	.102	.16	.231	.218	-9.064	.72

By looking at it, outliers can be identified in some variables since the mean and median values are quite apart and the minimum and maximum values are very different from the percentile 1 and percentile 99 values. To account for this, ROA, TDTA, PPETA and OPM were winsorized at the 1st and 99th percentile. What this means is that all the values below the 1st percentile were replaced with the value of the 1st percentile and all the values above the 99th percentile were replaced with the value of the 99th percentile. ROE was winsorized at the 5th and 95th percentile and ICR at the 10th and 90th percentile. By using this technique, the influence of outliers was reduced while maintaining all the observations in the dataset. The descriptive statistics with such adjustments are displayed below.

Table 4 - Winsorized summary statistics

Category	Variables	N	Mean	p25	Median	p75	SD	Min	Max
Dependent	ROA	6621	.073	.035	.065	.106	.067	-.158	.293
	ROE	6621	.189	.088	.153	.25	.165	-.064	.636
	CR	6621	13.868	12	14	16	2.617	2	21
	TDTA	6621	.278	.155	.267	.385	.162	0	.727
Independent	ESG	6621	54.84	40.13	57.07	70.72	19.663	0	95.16
	EN	6621	47.747	23.63	52.09	72.17	28.451	0	98.55
	SO	6621	56.998	40.37	58.47	74.29	21.472	0	98.12
	CG	6621	58.155	42.77	60.72	75.19	21.511	0	99.44
Control	LNTA	6621	16.763	15.782	16.691	17.581	1.404	12.446	22.042
	ICR	6621	12.253	3.426	7.723	15.953	11.999	1.564	40.608
	PPETA	6621	.281	.066	.167	.47	.271	.003	.929
	OPM	6621	.172	.102	.16	.231	.113	-.174	.515

On average, the firms in this sample have a 7% ROA, a 19% ROE, a BBB+ credit rating and they finance 28% of their assets with debt. Also, on average, the overall ESG score of this dataset is 55 on a scale from 0 to 100 in which, the better the ESG practices, the higher the ESG score. From the ESG components, Governance is the one that presents the higher mean value (58). Social follows with a mean score value of 57 and Environmental comes last with a mean value of 48.

Table 5, which is presented below, displays the correlation matrix - with the respective p-values below between parenthesis - for the variables used in this research. The matrix displays positive correlations between the dependent variables ROA, ROE, CR and TDTA and the ESG score and its individual components EN, SO, CG. Despite being considered week - as the highest value is 0.29 – those correlations are all significant at the 1% significance level except for ROA with ESG, EN and CG.

There may be some multicollinearity problems as there are seven correlation values above or equal to |0.30| between independent/control variables used in the same regression which are significant at the 1% significance level – LNTA with CR, ESG, EN and SO, PPETA with TDTA and ICR with CR and TDTA. To account for this and ensure that the results are valid, a robustness test will be performed in [7.1.3].

Table 5 - Correlation matrix

This matrix displays the correlation values between variables used in this study with the respective p-values below between parenthesis

Variables	1	2	3	4	5	6	7	8	9	10	11	12
(1) ROA	1.000											
(2) ROE	0.750	1.000										
	(0.000)											
(3) CR	0.197	0.152	1.000									
	(0.000)	(0.000)										
(4) TDTA	-0.084	0.087	-0.334	1.000								
	(0.000)	(0.000)	(0.000)									
(5) ESG	0.029	0.127	0.274	0.057	1.000							
	(0.018)	(0.000)	(0.000)	(0.000)								
(6) EN	0.004	0.094	0.265	0.060	0.869	1.000						
	(0.763)	(0.000)	(0.000)	(0.000)	(0.000)							
(7) SO	0.043	0.121	0.291	0.052	0.891	0.741	1.000					
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)						
(8) CG	0.002	0.069	0.124	0.050	0.704	0.441	0.417	1.000				
	(0.868)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)					
(9) LNTA	-0.275	-0.141	0.349	-0.073	0.428	0.466	0.392	0.248	1.000			
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)				
(10) ICR	0.589	0.366	0.334	-0.540	-0.026	-0.069	0.007	-0.042	-0.193	1.000		
	(0.000)	(0.000)	(0.000)	(0.000)	(0.031)	(0.000)	(0.554)	(0.001)	(0.000)			
(11) PPETA	-0.096	-0.139	-0.109	0.345	0.057	0.101	0.004	0.112	-0.026	-0.243	1.000	
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.738)	(0.000)	(0.036)	(0.000)		
(12) OPM	0.395	0.287	0.207	-0.036	0.033	0.008	0.064	0.007	0.111	0.267	-0.051	1.000
	(0.000)	(0.000)	(0.000)	(0.003)	(0.007)	(0.498)	(0.000)	(0.554)	(0.000)	(0.000)	(0.000)	

5 Methodology

This section will present the regression models that were used to test the hypotheses presented in section [3]. Again, this section is sub-divided according to the relationships of interest [5.1] [5.2] [5.3]. To perform the regressions, the statistical software "Stata" was used. Also, this study conducted panel data regressions, which allowed to capture variations within firms and across time.

5.1 Relationship between ESG and firm performance

The OLS regression models used to test the first hypothesis look as following:

$$ROA_{it} = \beta_0 + \beta_1 ESG_{it} + \beta_2 TDTA_{it} + \beta_3 LNTA_{it} + \beta_4 ICR_{it} + \beta_5 PPETA_{it} + \beta_6 OPM_{it} + \gamma_i + \delta_t + \varepsilon_{it}$$

In which the dependent variable ROA, the independent variable ESG and the control variables TDTA (total debt as a portion of total assets), LNTA (logarithm of total assets), ICR (interest coverage ratio), PPETA (property, plant and equipment as a portion of total assets) and OPM (operating profit margin) are explained in detail in [4.2]. It is also important to mention that γ_i represent firm fixed effects and δ_t represent time fixed effects that were added when the regressions were ran. The same model was used but with ROE as a dependent variable. So, in total, two regressions were conducted to test the first hypothesis.

The OLS regression models that were used to test the second hypothesis look as following:

$$ROA_{it} = \beta_0 + \beta_1 EN_{it} + \beta_2 TDTA_{it} + \beta_3 LNTA_{it} + \beta_4 ICR_{it} + \beta_5 PPETA_{it} + \beta_6 OPM_{it} + \gamma_i + \delta_t + \varepsilon_{it}$$

In which the variables are the same as the ones used to test the previous hypothesis except for the independent variable of interest – in this regression the individual Environmental score is used instead of the ESG score. The same model was used but with the Social and Governance score as independent variables and with ROE as the dependent variable. So, in total, six regressions were run to test this hypothesis.

5.2 Relationship between ESG and financial risk

The OLS regression model used to test the third hypothesis looks as following:

$$CR_{it} = \beta_0 + \beta_1 ESG_{it} + \beta_2 TDTA_{it} + \beta_3 LNTA_{it} + \beta_4 ICR_{it} + \beta_5 PPETA_{it} + \beta_6 OPM_{it} + \gamma_i + \delta_t + \varepsilon_{it}$$

In which the dependent variable CR, the independent variable ESG and the control variables TDTA, LNTA, ICR, PPETA and OPM are explained in detail in [4.2]. In total, one regression was run to test this hypothesis.

The OLS regression models that were used to test the fourth hypothesis look as following:

$$CR_{it} = \beta_0 + \beta_1 EN_{it} + \beta_2 TDTA_{it} + \beta_3 LNTA_{it} + \beta_4 ICR_{it} + \beta_5 PPETA_{it} + \beta_6 OPM_{it} + \gamma_i + \delta_t + \varepsilon_{it}$$

In which the variables are the same as the ones used to test the previous hypothesis except for the independent variable of interest – in this regression the individual Environmental score is used instead of the ESG score. The same model is used but with the Social and Governance score as independent variables. So, in total, three regressions were run to test this hypothesis.

5.3 Relationship between ESG and capital structure decisions

The OLS regression model used to test the fifth hypothesis looks as following:

$$TDTA_{it} = \beta_0 + \beta_1 ESG_{it} + \beta_2 CR_{it} + \beta_3 LNTA_{it} + \beta_4 ICR_{it} + \beta_5 PPETA_{it} + \beta_6 OPM_{it} + \gamma_i + \delta_t + \varepsilon_{it}$$

In which the dependent variable TDTA, the independent variable ESG and the control variables CR, LNTA, ICR, PPETA and OPM are explained in detail in [4.2]. In total, one regression was run to test this hypothesis.

The OLS regression models that were used to test the sixth hypothesis look as following:

$$TDTA_{it} = \beta_0 + \beta_1 EN_{it} + \beta_2 CR_{it} + \beta_3 LNTA_{it} + \beta_4 ICR_{it} + \beta_5 PPETA_{it} + \beta_6 OPM_{it} + \gamma_i + \delta_t + \varepsilon_{it}$$

In which the variables used are the same as the ones used to test the previous hypothesis except for the independent variable of interest – in this regression the individual Environmental score is used instead of the ESG score. The same model is used but with the Social and Governance score as independent variables. So, in total, three regressions were run to test this hypothesis.

6 Empirical results

This section will present the results of the OLS regressions conducted and it is divided in three sub-sections. Each sub-section presents one of the three relationships of interest of this thesis [6.1] [6.2] [6.3].

6.1 Relationship between ESG and firm performance

Table 6 presents the coefficients and respective p-values – represented by stars after the coefficients - of the OLS regressions that were conducted to test the first two hypothesis regarding the relationship between ESG and its individual pillars and firm performance measures ROA and ROE.

The coefficients and p-values of (1) indicate that the independent variable ESG and the control variables LNTA, ICR and OPM are significant in explaining the variation in the dependent variable ROA since $p<0.1$ for all of them. The interpretation of the ESG coefficient is that when the ESG score increases by one unit, ROA increases by 0.0132 percentage points. Also, the F statistic, which tests the overall significance of the model, is significant at a 1% significance level. What this means is that at least one of the independent/control variables used is significant in explaining the variation in the dependent variable.

In (5), it can be observed that the independent variable ESG and the control variables TDTA, LNTA, ICR and OPM are significant in explaining the variation in the dependent variable ROE as $p<0.1$ for all of them. The interpretation of the ESG coefficient is that when the ESG score increases by one unit, ROE increases by 0.0332 percentage points. Again, the model seems to be good since the F statistic is significant for a 1% significance level.

By looking at the results of the regressions (2), (3), (4), (6), (7) and (8), it can be concluded that only EN is significant in explaining the variation in ROA and ROE as $p<0.05$ in both scenarios. The EN coefficients interpretations are the following: when the environmental score increases by one unit, ROA increases by 0.0131 percentage points and ROE increases by 0.0366 percentage points. The F statistics indicate that the models are good since the p-values are zero in the 6 scenarios.

Table 6 - H1 and H2 OLS regression results

In which the dependent variables are return on assets (ROA) for (1), (2), (3) and (4) and return on equity (ROE) for (5), (6), (7) and (8). The independent variables are the ESG score (ESG), the environmental pillar score (EN), the social pillar score (SO) and the governance pillar score (CG). The control variables are total debt as a portion of total assets (TDTA), the logarithm of total assets (LNTA), the interest coverage ratio (ICR), property, plant, and equipment as a portion of total assets (PPETA) and the operating profit margin (OPM). Robust standard errors are presented below the coefficients between parenthesis; *** p<0.01, ** p<0.05, * p<0.1

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables			**ROA**				**ROE**	
ESG	0.000132*	-	-	-	0.000332*	-	-	-
	(7.15e-05)				(0.000184)			
EN	-	0.000131**	-	-	-	0.000366***	-	-
		(5.12e-05)				(0.000134)		
SO	-	-	8.26e-05	-	-	-	2.89e-05	-
			(6.65e-05)				(0.000153)	
CG	-	-	-	4.95e-05	-	-	-	0.000150
				(4.23e-05)				(0.000104)
TDTA	0.0140	0.0148	0.0136	0.0139	0.347***	0.349***	0.347***	0.346***
	(0.0145)	(0.0145)	(0.0145)	(0.0144)	(0.0349)	(0.0348)	(0.0349)	(0.0349)
LNTA	-0.00911***	-0.00955***	-0.00893***	-0.00864***	-0.0508***	-0.0522***	-0.0495***	-0.0497***
	(0.00306)	(0.00307)	(0.00305)	(0.00306)	(0.00706)	(0.00703)	(0.00708)	(0.00708)
ICR	0.00225***	0.00225***	0.00225***	0.00225***	0.00430***	0.00432***	0.00431***	0.00430***
	(0.000171)	(0.000170)	(0.000171)	(0.000170)	(0.000352)	(0.000351)	(0.000352)	(0.000351)
PPETA	-0.0197	-0.0206	-0.0199	-0.0194	-0.0360	-0.0384	-0.0360	-0.0352
	(0.0156)	(0.0155)	(0.0157)	(0.0157)	(0.0458)	(0.0454)	(0.0459)	(0.0459)
OPM	0.318***	0.317***	0.317***	0.318***	0.641***	0.639***	0.641***	0.642***
	(0.0250)	(0.0250)	(0.0249)	(0.0251)	(0.0395)	(0.0395)	(0.0395)	(0.0395)
Constant	0.144***	0.154***	0.143***	0.139***	0.766***	0.793***	0.756***	0.752***
	(0.0514)	(0.0516)	(0.0513)	(0.0514)	(0.113)	(0.113)	(0.114)	(0.114)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6621	6621	6621	6621	6621	6621	6621	6621
Number of firms	496	496	496	496	496	496	496	496
F statistic	40.30	40.54	40.18	40.24	46.70	46.86	46.91	46.79
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R-squared (overall)	0.4255	0.4303	0.4224	0.4200	0.2233	0.2274	0.2169	0.2182

6.2 Relationship between ESG and financial risk

Table 7 displays the coefficients and respective p-values of the OLS regressions that test the third and fourth hypothesis regarding the relationship between ESG and its individual pillars and the financial risk measure CR.

The coefficients and p-values of regression (1) display that the independent variable ESG and the control variables TDTA, LNTA, ICR, PPETA and OPM are significant in explaining the variation in the dependent variable CR since p<0.05 for all of them. The

interpretation of the ESG coefficient is that when the ESG score increases by one unit, the CR improves by 0.0131 units. Also, the F statistic, which tests the overall significance of the model, is significant at a 1% significance level.

The results of the regressions (2), (3) and (4) show that all the individual ESG pillars are significant in explaining the variation in CR since p<0.01 in the three scenarios. From the three pillars, EN is the pillar that presents the highest coefficient (0.00792 coefficient), and it is followed by the SO one (0.00764 coefficient). The F statistics indicate that the models are good since the p-values are zero in the three scenarios.

Table 7 – H3 and H4 OLS regression results

In which the dependent variable is credit ratings (CR). The independent variables are the ESG score (ESG), the environmental pillar score (EN), the social pillar score (SO) and the governance pillar score (CG). The control variables are total debt as a portion of total assets (TDTA), the logarithm of total assets (LNTA), the interest coverage ratio (ICR), property, plant, and equipment as a portion of total assets (PPETA) and the operating profit margin (OPM). Robust standard errors are presented below the coefficients between parenthesis; *** p<0.01, ** p<0.05, * p<0.1

	(1)	(2)	(3)	(4)
Variables		**CR**		
ESG	0.0131***	-	-	-
	(0.00301)			
EN	-	0.00792***	-	-
		(0.00196)		
SO	-	-	0.00764***	-
			(0.00243)	
CG	-	-	-	0.00591***
				(0.00149)
TDTA	-1.044**	-0.993*	-1.081**	-1.056**
	(0.505)	(0.511)	(0.504)	(0.509)
LNTA	0.709***	0.704***	0.730***	0.754***
	(0.110)	(0.111)	(0.110)	(0.112)
ICR	0.00947**	0.0102**	0.00979**	0.00954**
	(0.00410)	(0.00411)	(0.00411)	(0.00416)
PPETA	2.655***	2.605***	2.634***	2.687***
	(0.729)	(0.730)	(0.737)	(0.738)
OPM	1.975***	1.951***	1.952***	2.036***
	(0.427)	(0.429)	(0.427)	(0.431)
Constant	1.003	1.396	0.851	0.436
	(1.914)	(1.927)	(1.922)	(1.956)
Firm fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Observations	6621	6621	6621	6621
Number of firms	496	496	496	496
F statistic	12.07	12.28	11.50	11.65
Prob > F	0.0000	0.0000	0.0000	0.0000
R-squared (overall)	0.1354	0.1318	0.1356	0.1202

6.3 Relationship between ESG and capital structure choices

Table 8 shows the coefficients and respective p-values of the regressions that test the fifth and sixth hypothesis regarding the relationship between ESG and its individual pillars and the capital structure decisions measure TDTA.

The coefficients and p-values of regression (1), reveal that CR and ICR are significant in explaining the variation in TDTA as $p<0.05$ for both. However, the independent variable, the ESG score, is not significant in explaining the variation in TDTA. The F statistic, which tests the overall significance of the model, is significant at a 1% significance level.

The results of the regressions (2), (3) and (4), show that none of the individual ESG pillars is significant in explaining the variation in TDTA. Again, the F statistics indicate that the models are good since the p-values are zero in the three scenarios.

Table 8 - H5 and H6 OLS regression results

In which the dependent variable is total debt as a portion of total assets (TDTA). The independent variables are the ESG score (ESG), the environmental pillar score (EN), the social pillar score (SO) and the governance pillar score (CG). The control variables added are credit ratings (CR), the logarithm of total assets (LNTA), the interest coverage ratio (ICR), property, plant, and equipment as a portion of total assets (PPETA) and the operating profit margin (OPM). Robust standard errors are presented below the coefficients between parenthesis; *** p<0.01, ** p<0.05, * p<0.1

	(1)	(2)	(3)	(4)
Variables		**TDTA**		
ESG	7.72e-05	-	-	-
	(0.000198)			
EN	-	-0.000123	-	-
		(0.000129)		
SO	-	-	0.000273	-
			(0.000174)	
CG	-	-	-	8.84e-05
				(0.000109)
CR	-0.00513**	-0.00487**	-0.00526**	-0.00515**
	(0.00238)	(0.00241)	(0.00236)	(0.00239)
LNTA	-0.00379	-0.00274	-0.00456	-0.00359
	(0.00834)	(0.00840)	(0.00836)	(0.00834)
ICR	-0.00464***	-0.00463***	-0.00464***	-0.00464***
	(0.000291)	(0.000290)	(0.000291)	(0.000290)
PPETA	-0.0666	-0.0664	-0.0670	-0.0661
	(0.0481)	(0.0479)	(0.0478)	(0.0480)
OPM	0.0338	0.0340	0.0326	0.0346
	(0.0357)	(0.0357)	(0.0355)	(0.0357)
Constant	0.443***	0.427***	0.451***	0.439***
	(0.138)	(0.139)	(0.138)	(0.139)
Firm fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Observations	6621	6621	6621	6621
Number of firms	496	496	496	496
F statistic	20.74	20.89	20.67	20.78
Prob > F	0.0000	0.0000	0.0000	0.0000
R-squared (overall)	0.2541	0.2459	0.2585	0.2546

7 Robustness tests

This section presents some robustness tests that were performed to assess the validity of the results under several conditions. In here it is important to highlight that two different types of tests were conducted.

The first set of tests [7.1] used the same statistical method of the empirical results – OLS – and the initial sample either was sub-divided in smaller sub-samples (high vs low ESG scores and recession vs expansion years) or some variables were taken out of the model (due to potential multicollinearity problems identified before).

The second set of tests [7.2] focused on running the same regressions presented before in the methodology – and, therefore, the sample used is the same - but using different statistical methods from OLS (OLS with lagged independent variables, seemingly unrelated regression models and two-stage least squares regressions).

7.1 Alternative OLS specifications: sample subdivision and variables adjustment

As mentioned before, the robustness checks conducted in this sub-section use the OLS statistical method. In the first test [7.1.1] two sub-samples were created by dividing the ESG scores into High and Low; in the second one [7.1.2] two new sub-samples were created by dividing the years considered into recession and expansion ones; finally in [7.1.3] the same regressions as the one presented on the empirical results are performed but without the potential multicollinear control variables LNTA, ICR and PPETA.

7.1.1 High and low ESG scores

The first robustness test aimed to assess if the conclusions hold if ESG and its individual pillar scores are divided into High and Low and, if so, if the results are stronger for one of the sub-samples. To divide the observations in two groups (high and low), the following criteria was used: the median of the ESG score was computed – which can be found in [4.3] - and the observations above the median were considered as High and the ones below the median as Low. The same approach was followed for the individual pillar scores. Variables wise, it is important to mention that H_ESG refers to high ESG scores and L_ESG to low ESG scores. The same logic applies to the individual ESG pillars.

7.1.1.1 Relationship between ESG and firm performance

By looking at the results presented in Table 9, it can be concluded that a one unit increase in the ESG and in the individual EN pillar score is only significant in explaining the variation in ROA and ROE when the scores are considered low (below the median). When the ESG and EN scores are classified as high, both independent variables are no longer significant. The Social and Governance pillar scores are not significant in explaining the variation in ROA and ROE in both scenarios, which goes in line with the previous findings.

Table 9 - H1 and H2 OLS regression results with High and Low ESG scores

Robust standard errors are presented below the coefficients between parenthesis; *** p<0.01, ** p<0.05, * p<0.1

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Variables					**ROA**								**ROE**			
H_ESG	-0.000103	-	-	-	-	-	-	-	1.68e-05	-	-	-	-	-	-	-
	(0.000148)								(0.000410)							
L_ESG	-	0.000157*	-	-	-	-	-	-	-	0.000421*	-	-	-	-	-	-
		(0.000112)								(0.000291)						
H_EN	-	-	8.97e-05	-	-	-	-	-	-	-	0.000414	-	-	-	-	-
			(0.000122)								(0.000316)					
L_EN	-	-	-	0.000183**	-	-	-	-	-	-	-	0.000512***	-	-	-	-
				(7.44e-05)								(0.000196)				
H_SO	-	-	-	-	-0.000118	-	-	-	-	-	-	-	-0.000252	-	-	-
					(0.000138)								(0.000340)			
L_SO	-	-	-	-	-	-2.23e-06	-	-	-	-	-	-	-	0.000166	-	-
						(0.000119)								(0.000295)		
H_CG	-	-	-	-	-	-	8.81e-05	-	-	-	-	-	-	-	0.000286	-
							(0.000106)								(0.000265)	
L_CG	-	-	-	-	-	-	-	9.33e-05	-	-	-	-	-	-	-	0.000192
								(7.42e-05)								(0.000181)
TDTA	-0.00971	0.0133	-0.0104	0.0233	-0.00825	-0.00899	0.00613	0.0160	0.366***	0.286***	0.359***	0.293***	0.381***	0.237***	0.371***	0.318***
	(0.0252)	(0.0185)	(0.0241)	(0.0209)	(0.0229)	(0.0196)	(0.0204)	(0.0193)	(0.0567)	(0.0434)	(0.0576)	(0.0455)	(0.0502)	(0.0511)	(0.0509)	(0.0421)
LNTA	-0.0152***	-0.0145***	-0.0158***	-0.0129***	-0.0145***	-0.0128**	-0.0133***	-0.0124***	-0.0630***	-0.0631***	-0.0618***	-0.0652***	-0.0561***	-0.0583***	-0.0525***	-0.0594***
	(0.00423)	(0.00479)	(0.00422)	(0.00483)	(0.00358)	(0.00545)	(0.00382)	(0.00439)	(0.0123)	(0.0102)	(0.0120)	(0.0108)	(0.0115)	(0.0110)	(0.0114)	(0.00888)
ICR	0.00226***	0.00212***	0.00245***	0.00205***	0.00234***	0.00203***	0.00222***	0.00223***	0.00512***	0.00378***	0.00538***	0.00359***	0.00518***	0.00366***	0.00463***	0.00410***
	(0.000219)	(0.000246)	(0.000228)	(0.000261)	(0.000246)	(0.000220)	(0.000203)	(0.000241)	(0.000542)	(0.000449)	(0.000546)	(0.000480)	(0.000524)	(0.000442)	(0.000479)	(0.000463)
PPETA	-0.0201	-0.0483*	-0.0225	-0.0363	-0.0261	-0.0575**	-0.0319	-0.0297	0.0230	-0.112	-0.0208	-0.104	-0.00257	-0.112	-0.0213	-0.0400
	(0.0259)	(0.0273)	(0.0232)	(0.0289)	(0.0220)	(0.0260)	(0.0249)	(0.0235)	(0.0719)	(0.0797)	(0.0688)	(0.0798)	(0.0667)	(0.0732)	(0.0764)	(0.0502)
OPM	0.306***	0.308***	0.291***	0.320***	0.312***	0.299***	0.269***	0.364***	0.668***	0.598***	0.661***	0.615***	0.703***	0.581***	0.589***	0.671***
	(0.0291)	(0.0348)	(0.0300)	(0.0354)	(0.0291)	(0.0345)	(0.0279)	(0.0353)	(0.0602)	(0.0505)	(0.0563)	(0.0533)	(0.0616)	(0.0538)	(0.0593)	(0.0479)
Constant	0.284***	0.229***	0.284***	0.200**	0.265***	0.222**	0.235***	0.186**	1.004***	0.971***	0.967***	1.008***	0.878***	0.921***	0.811***	0.889***
	(0.0723)	(0.0793)	(0.0727)	(0.0791)	(0.0604)	(0.0894)	(0.0661)	(0.0738)	(0.203)	(0.161)	(0.201)	(0.170)	(0.191)	(0.174)	(0.196)	(0.137)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3311	3310	3312	3309	3311	3310	3311	3310	3311	3310	3312	3309	3311	3310	3311	3310
F statistic	34.72	22.37	28.74	19.81	30.38	22.69	29.39	23.85	25.92	24.54	26.06	22.26	25.31	22.01	24.91	31.38
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R-squared (overall)	0.4571	0.4119	0.4950	0.4073	0.4365	0.3920	0.4371	0.4231	0.2371	0.2161	0.2687	0.2139	0.2507	0.2058	0.2312	0.1981

7.1.1.2 Relationship between ESG and financial risk

By looking at Table 10, it can be inferred that a one unit increase in the ESG as well as on the three individual pillars scores is only significant in explaining the variation in Credit Ratings when the scores are classified as low (below the median). When the ESG scores are classified as high, none of the independent variables is still significant.

Table 10 - H3 and H4 OLS regression results with High and Low ESG scores

Robust standard errors are presented below the coefficients between parenthesis; *** p<0.01, ** p<0.05, * p<0.1

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables					**CR**			
H_ESG	0.0113	-	-	-	-	-	-	-
	(0.00630)							
L_ESG	-	0.0139***	-	-	-	-	-	-
		(0.00420)						
H_EN	-	-	0.00126	-	-	-	-	-
			(0.00444)					
L_EN	-	-	-	0.00847***	-	-	-	-
				(0.00267)				
H_SO	-	-	-	-	0.00328	-	-	-
					(0.00545)			
L_SO	-	-	-	-	-	0.0112***	-	-
						(0.00379)		
H_CG	-	-	-	-	-	-	0.00494	-
							(0.00290)	
L_CG	-	-	-	-	-	-	-	0.00312*
								(0.00215)
TDTA	-1.112	-0.790**	-1.356	-0.559	-1.219	-0.876**	-0.796	-1.601***
	(1.122)	(0.395)	(1.049)	(0.395)	(1.066)	(0.366)	(0.822)	(0.618)
LNTA	0.346	0.646***	0.510**	0.624***	0.438**	0.695***	0.614***	0.594***
	(0.215)	(0.125)	(0.215)	(0.131)	(0.198)	(0.125)	(0.192)	(0.133)
ICR	0.0122*	0.00149	0.0141**	0.00633*	0.0126**	0.00199	0.0137**	0.00422
	(0.00642)	(0.00349)	(0.00644)	(0.00378)	(0.00621)	(0.00380)	(0.00618)	(0.00402)
PPETA	1.091	2.840***	1.029	2.899***	1.147	3.354***	2.059**	2.177**
	(1.050)	(0.860)	(0.927)	(0.869)	(0.951)	(0.893)	(0.819)	(1.095)
OPM	3.017***	1.427***	3.016***	1.075***	2.740***	1.416***	2.760***	1.478***
	(0.748)	(0.382)	(0.824)	(0.385)	(0.752)	(0.370)	(0.635)	(0.485)
Constant	7.435*	1.903	5.620	2.476	6.506*	0.934	2.702	3.525
	(3.983)	(2.102)	(3.908)	(2.174)	(3.701)	(2.110)	(3.382)	(2.252)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3311	3310	3312	3309	3311	3310	3311	3310
F statistic	4.61	7.80	4.88	8.10	4.38	9.61	5.01	6.55
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R-squared (overall)	0.2294	0.0613	0.2492	0.0485	0.2384	0.0473	0.1335	0.1417

7.1.1.3 Relationship between ESG and capital structure decisions

By looking at Table 11, it can be concluded that a one unit increase in the ESG score, as well as in the three individual pillars, is not significant in explaining the variation in TDTA in both scenarios (high vs low scores). This, therefore, goes in line with the previous findings.

Table 11 - H5 and H6 OLS regression results with High and Low ESG scores

Robust standard errors are presented below the coefficients between parenthesis; *** p<0.01, ** p<0.05, * p<0.1

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables					**TDTA**			
H_ESG	-0.000153	-	-	-	-	-	-	-
	(0.000395)							
L_ESG	-	0.000168	-	-	-	-	-	-
		(0.000266)						
H_EN	-	-	-0.000210	-	-	-	-	-
			(0.000298)					
L_EN	-	-	-	0.000194	-	-	-	-
				(0.000179)				
H_SO	-	-	-	-	0.000252	-	-	-
					(0.000363)			
L_SO	-	-	-	-	-	0.000166	-	-
						(0.000263)		
H_CG	-	-	-	-	-	-	-5.12e-05	-
							(0.000228)	
L_CG	-	-	-	-	-	-	-	0.000133
								(0.000173)
CR	-0.00504	-0.00467*	-0.00629	-0.00336	-0.00586	-0.00492**	-0.00344	-0.00904***
	(0.00492)	(0.00247)	(0.00469)	(0.00240)	(0.00491)	(0.00226)	(0.00348)	(0.00330)
LNTA	0.00146	0.00163	0.00847	-0.00414	-0.00968	0.00705	0.000208	-0.00726
	(0.0159)	(0.0118)	(0.0162)	(0.0121)	(0.0155)	(0.0111)	(0.0136)	(0.0100)
ICR	-0.00418***	-0.00480***	-0.00396***	-0.00496***	-0.00408***	-0.00463***	-0.00449***	-0.00444***
	(0.000396)	(0.000410)	(0.000427)	(0.000413)	(0.000389)	(0.000404)	(0.000338)	(0.000383)
PPETA	-0.121*	-0.0702	-0.0935	-0.0874	-0.0670	-0.0732	-0.152***	-0.0483
	(0.0714)	(0.0837)	(0.0678)	(0.0874)	(0.0659)	(0.0774)	(0.0493)	(0.0663)
OPM	0.0173	0.0432	0.00370	0.0584	0.00664	0.0396	0.0499	0.0230
	(0.0510)	(0.0397)	(0.0560)	(0.0437)	(0.0502)	(0.0444)	(0.0448)	(0.0413)
Constant	0.392	0.346**	0.287	0.425**	0.543*	0.265	0.404	0.532***
	(0.299)	(0.174)	(0.298)	(0.187)	(0.294)	(0.164)	(0.249)	(0.152)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3311	3310	3312	3309	3311	3310	3311	3310
F statistic	12.42	11.11	10.36	11.79	12.86	11.61	16.58	10.22
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R-squared (overall)	0.1275	0.2453	0.1368	0.2334	0.2339	0.2287	0.0617	0.3271

7.1.2 Recession and expansion years

The second robustness test aimed to assess if the results still hold and, if so, if they are weaker or stronger during recessions years when compared to economic expansion years. To do this, the sample was divided in two: the first subsample includes the observations during recession years (from 2007 to 2009 and 2020), and the second one is composed by observations during expansion years (remaining years – 2006, from 2010 to 2019, 2021 and 2022).

7.1.2.1 Relationship between ESG and firm performance

In Table 12, columns (1), (3), (5), (7), (9), (11), (13) and (15) present the regression results of the recession years sub-sample and the remaining columns (2), (4), (6), (8), (10), (12), (14) and (16) present the results of the expansion years sub-sample.

It can be seen that the ESG and the EN scores are significant in explaining the variation in ROA and ROE only during economic expansion years. The SO and CG scores continue to be non-significant in explaining the variation in firm performance measures ROA and ROE in both sub-samples.

Table 12 - H1 and H2 OLS regression results with recession and expansion years

Robust standard errors are presented below the coefficients between parenthesis; *** p<0.01, ** p<0.05, * p<0.1

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Variables					**ROA**										**ROE**	
ESG	1.56e-06	0.000157**	-	-	-	-	-	-	0.000470	0.000256*	-	-	-	-	-	-
	(0.000157)	(7.02e-05)							(0.000316)	(0.000197)						
EN	-	-	0.000117	0.000121**	-	-	-	-	-	-	0.000470	0.000284**	-	-	-	-
			(0.000100)	(5.24e-05)							(0.000216)	(0.000139)				
SO	-	-	-	-	2.01e-05	9.76e-05	-	-	-	-	-	-	0.000272	-3.04e-05	-	-
					(0.000152)	(6.43e-05)							(0.000308)	(0.000166)		
CG	-	-	-	-	-	-	2.07e-07	6.26e-05	-	-	-	-	-	-	0.000180	0.000135
							(9.42e-05)	(4.06e-05)							(0.000197)	(0.000115)
TDTA	-0.0126	0.0192	-0.0124	0.0195	-0.0130	0.0188	-0.0126	0.0190	0.328***	0.359***	0.332***	0.360***	0.326***	0.359***	0.330***	0.359***
	(0.0310)	(0.0138)	(0.0311)	(0.0138)	(0.0311)	(0.0139)	(0.0310)	(0.0138)	(0.0637)	(0.0379)	(0.0638)	(0.0379)	(0.0634)	(0.0379)	(0.0636)	(0.0379)
LNTA	-0.00424	-0.00906***	-0.00524	-0.00932***	-0.00435	-0.00883**	-0.00424	-0.00858**	-0.0374***	-0.0526***	-0.0395***	-0.0536***	-0.0371***	-0.0515***	-0.0354***	-0.0519***
	(0.00513)	(0.00340)	(0.00509)	(0.00344)	(0.00509)	(0.00343)	(0.00511)	(0.00340)	(0.0106)	(0.00764)	(0.0104)	(0.00766)	(0.0107)	(0.00765)	(0.0105)	(0.00767)
ICR	0.00277***	0.00209***	0.00277***	0.00209***	0.00277***	0.00209***	0.00277***	0.00209***	0.00479***	0.00413***	0.00482***	0.00414***	0.00481***	0.00414***	0.00482***	0.00413***
	(0.000299)	(0.000192)	(0.000298)	(0.000192)	(0.000300)	(0.000192)	(0.000299)	(0.000191)	(0.000618)	(0.000394)	(0.000618)	(0.000395)	(0.000620)	(0.000394)	(0.000617)	(0.000393)
PPETA	-0.0374	-0.00357	-0.0379	-0.00431	-0.0375	-0.00403	-0.0374	-0.00318	-0.0926	0.000718	-0.0934	-0.000989	-0.0923	0.000770	-0.0932	0.00158
	(0.0303)	(0.0162)	(0.0301)	(0.0162)	(0.0303)	(0.0163)	(0.0303)	(0.0163)	(0.0683)	(0.0509)	(0.0680)	(0.0506)	(0.0687)	(0.0509)	(0.0684)	(0.0510)
OPM	0.316***	0.318***	0.317***	0.318***	0.316***	0.318***	0.316***	0.319***	0.600***	0.645***	0.600***	0.644***	0.598***	0.646***	0.601***	0.646***
	(0.0336)	(0.0261)	(0.0338)	(0.0260)	(0.0336)	(0.0260)	(0.0335)	(0.0261)	(0.0543)	(0.0451)	(0.0550)	(0.0450)	(0.0540)	(0.0452)	(0.0539)	(0.0451)
Constant	0.0683	0.139**	0.0781	0.146**	0.0691	0.137**	0.0683	0.133**	0.572***	0.784***	0.609***	0.805***	0.579***	0.776***	0.557***	0.775***
	(0.0915)	(0.0576)	(0.0908)	(0.0582)	(0.0911)	(0.0580)	(0.0910)	(0.0578)	(0.186)	(0.122)	(0.183)	(0.122)	(0.186)	(0.122)	(0.186)	(0.122)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1502	5119	1502	5119	1502	5119	1502	5119	1502	5119	1502	5119	1502	5119	1502	5119
F statistic	42.34	38.78	42.54	38.84	42.49	38.09	42.34	38.59	52.54	41.11	51.83	41.31	52.99	41.16	53.28	40.98
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R-squared (overall)	0.4375	0.4075	0.4467	0.4100	0.4381	0.4041	0.4374	0.4009	0.2886	0.1973	0.2919	0.2001	0.2790	0.1918	0.2773	0.1937

7.1.2.2 Relationship between ESG and financial risk

In Table 13, columns (1), (3), (5), (7), (9), (11), (13) and (15) present the regression results of the recession years sub-sample and the remaining columns (2), (4), (6), (8), (10), (12), (14) and (16) present the results of the expansion years sub-sample.

By looking at the ESG coefficients, it can be concluded that the ESG score as well as the individual pillar scores are significant in explaining the variation in credit ratings both during recession and expansion years. It can also be observed that the ESG coefficients are slightly higher during recession years when compared to expansion years in the four scenarios.

Table 13 - H3 and H4 OLS regression results with recession and expansion years

Robust standard errors are presented below the coefficients between parenthesis; *** p<0.01, ** p<0.05, * p<0.1

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables					**CR**			
ESG	0.0155***	0.0123***	-	-	-	-	-	-
	(0.00533)	(0.00284)						
EN	-	-	0.0121***	0.00739***	-	-	-	-
			(0.00334)	(0.00192)				
SO	-	-	-	-	0.00769***	0.00600***	-	-
					(0.00453)	(0.00232)		
CG	-	-	-	-	-	-	0.00811***	0.00481***
							(0.00268)	(0.00147)
TDTA	-1.119	-1.268***	-1.000	-1.252***	-1.127	-1.299***	-1.075	-1.278***
	(0.900)	(0.469)	(0.913)	(0.475)	(0.896)	(0.470)	(0.905)	(0.475)
LNTA	0.956***	0.602***	0.918***	0.597***	0.986***	0.620***	1.023***	0.640***
	(0.169)	(0.0991)	(0.168)	(0.101)	(0.172)	(0.0996)	(0.171)	(0.102)
ICR	0.0160**	0.00476	0.0172**	0.00519	0.0169**	0.00498	0.0166**	0.00487
	(0.00712)	(0.00408)	(0.00715)	(0.00410)	(0.00720)	(0.00407)	(0.00713)	(0.00413)
PPETA	3.075**	2.590***	3.064**	2.544***	3.095**	2.554***	3.035**	2.620***
	(1.292)	(0.586)	(1.268)	(0.593)	(1.327)	(0.592)	(1.312)	(0.599)
OPM	2.109***	2.323***	2.092***	2.313***	2.027***	2.311***	2.159***	2.386***
	(0.743)	(0.457)	(0.733)	(0.462)	(0.754)	(0.459)	(0.754)	(0.461)
Constant	-4.567	2.845*	-3.666	3.223*	-4.449	2.699	-5.218	2.407
	(3.169)	(1.707)	(3.136)	(1.737)	(3.188)	(1.713)	(3.201)	(1.747)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1502	5119	1502	5119	1502	5119	1502	5119
F statistic	15.28	13.33	15.95	13.67	14.05	12.38	14.89	12.58
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R-squared (overall)	0.1697	0.1236	0.1695	0.1193	0.1623	0.1258	0.1585	0.1078

7.1.2.3 Relationship between ESG and capital structure decisions

In Table 14, columns (1), (3), (5), (7), (9), (11), (13) and (15) present the regression results of the recession years sub-sample and the remaining columns (2), (4), (6), (8), (10), (12), (14) and (16) present the results of the expansion years sub-sample.

By looking at the coefficients, it can be inferred that ESG as well as its individual pillars are not significant in explaining the variation in TDTA during recession and expansion years. Such results go in line with the previous findings – that is, when the whole sample is considered, ESG and the individual pillar scores are also not significant in explaining TDTA.

Table 14 - H5 and H6 OLS regression results with recession and expansion years

Robust standard errors are presented below the coefficients between parenthesis; *** p<0.01, ** p<0.05, * p<0.1

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables					**TDTA**			
ESG	0.000426	3.19e-05	-	-	-	-	-	-
	(0.000327)	(0.000189)						
EN	-	-	-1.18e-05	-4.69e-05	-	-	-	-
			(0.000212)	(0.000124)				
SO	-	-	-	-	0.000837	0.000169	-	-
					(0.000310)	(0.000169)		
CG	-	-	-	-	-	-	0.000172	3.27e-05
							(0.000167)	(0.000113)
CR	-0.00460	-0.00640***	-0.00415	-0.00631***	-0.00452	-0.00652***	-0.00440	-0.00640***
	(0.00358)	(0.00232)	(0.00368)	(0.00234)	(0.00349)	(0.00231)	(0.00360)	(0.00234)
LNTA	-0.0128	-0.00602	-0.0114	-0.00563	-0.0159	-0.00645	-0.0112	-0.00596
	(0.0116)	(0.00823)	(0.0117)	(0.00829)	(0.0116)	(0.00822)	(0.0117)	(0.00821)
ICR	-0.00448***	-0.00498***	-0.00446***	-0.00498***	-0.00449***	-0.00498***	-0.00447***	-0.00498***
	(0.000460)	(0.000323)	(0.000461)	(0.000322)	(0.000455)	(0.000322)	(0.000460)	(0.000322)
PPETA	-0.0450	-0.0533	-0.0454	-0.0533	-0.0461	-0.0537	-0.0463	-0.0531
	(0.0771)	(0.0436)	(0.0779)	(0.0434)	(0.0763)	(0.0433)	(0.0775)	(0.0435)
OPM	0.0216	0.0797*	0.0187	0.0799*	0.0178	0.0789*	0.0218	0.0800*
	(0.0502)	(0.0408)	(0.0506)	(0.0408)	(0.0492)	(0.0406)	(0.0505)	(0.0407)
Constant	0.618***	0.493***	0.617***	0.487***	0.640***	0.497***	0.605***	0.492***
	(0.202)	(0.137)	(0.204)	(0.139)	(0.199)	(0.137)	(0.205)	(0.138)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1502	5119	1502	5119	1502	5119	1502	5119
F statistic	23.06	22.81	23.07	22.88	24.07	22.72	23.03	22.79
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R-squared (overall)	0.2925	0.2931	0.2783	0.2898	0.2938	0.2966	0.2839	0.2930

7.1.3 Multicollinearity test

As previously pointed out in section [4.3], there seems to exist some multicollinearity problems since some independent variables used in the same regression are collinear and significant. To account for this, this robustness test will consist in running the same regressions but without the most problematic variables to see if the results hold or not. The independent variables that were removed were LNTA (correlated with CR, ESG, EN and SO), PPETA (correlated with TDTA) and ICR (correlated with CR and TDTA).

7.1.3.1 Relationship between ESG and firm performance

The ESG coefficients presented in Table 15 without the multicollinear variables are consistent with the ones found before (with all the variables considered) since the ESG score as well as the Environmental pillar score are positive and significant in explaining the variation in ROA and ROE for a 10% significance level.

Table 15 - H1 and H2 OLS regression results without multicollinear variables

Robust standard errors are presented below the coefficients between parenthesis; *** p<0.01, ** p<0.05, * p<0.1

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables			**ROA**				**ROE**	
ESG	0.000103*	-	-	-	8.80e-05*	-	-	-
	(7.94e-05)				(0.000200)			
EN	-	5.99e-05*	-	-	-	7.11e-05*	-	-
		(5.60e-05)				(0.000142)		
SO	-	-	5.23e-05	-	-	-	-0.000179	-
			(7.42e-05)				(0.000164)	
CG	-	-	-	7.91e-05	-	-	-	0.000180
				(4.51e-05)				(0.000112)
TDTA	-0.0618***	-0.0616***	-0.0621***	-0.0619***	0.198***	0.198***	0.199***	0.198***
	(0.0143)	(0.0143)	(0.0143)	(0.0143)	(0.0357)	(0.0356)	(0.0357)	(0.0357)
OPM	0.404***	0.404***	0.404***	0.405***	0.802***	0.802***	0.804***	0.803***
	(0.0261)	(0.0260)	(0.0260)	(0.0261)	(0.0411)	(0.0411)	(0.0412)	(0.0410)
Constant	0.0288***	0.0312***	0.0305***	0.0286***	0.0119	0.0136	0.0210	0.00666
	(0.00677)	(0.00627)	(0.00675)	(0.00653)	(0.0143)	(0.0137)	(0.0142)	(0.0145)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6621	6621	6621	6621	6621	6621	6621	6621
Number of firms	496	496	496	496	496	496	496	496
F statistic	25.26	25.26	25.27	25.27	31.89	31.62	31.70	31.90
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R-squared (overall)	0.1670	0.1665	0.1668	0.1663	0.1003	0.1002	0.0972	0.1003

7.1.3.2 Relationship between ESG and financial risk

The coefficients presented in Table 16 indicate that when we take out the multicollinear variables LNTA, ICR and PPETA, the results are consistent with the previous findings – that is, ESG as well as its individual pillar scores are all positive and significant in explaining the variation in CR.

Table 16 - H3 and H4 OLS regression results without multicollinear variables

Robust standard errors are presented below the coefficients between parenthesis; *** p<0.01, ** p<0.05, * p<0.1

	(1)	(2)	(3)	(4)
Variables		**CR**		
ESG	0.0170***	-	-	-
	(0.00332)			
EN	-	0.0111***	-	-
		(0.00209)		
SO	-	-	0.0111***	-
			(0.00270)	
CG	-	-	-	0.00649***
				(0.00164)
TDTA	-1.377***	-1.337***	-1.440***	-1.393***
	(0.493)	(0.498)	(0.492)	(0.500)
OPM	2.372***	2.373***	2.354***	2.458***
	(0.417)	(0.423)	(0.418)	(0.427)
Constant	13.29***	13.66***	13.48***	13.56***
	(0.215)	(0.170)	(0.210)	(0.186)
Firm fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Observations	6621	6621	6621	6621
Number of firms	496	496	496	496
F statistic	10.31	10.45	9.90	9.63
Prob > F	0.0000	0.0000	0.0000	0.0000
R-squared (overall)	0.2181	0.2109	0.2100	0.1390

7.1.3.3 Relationship between ESG and capital structure decisions

By looking at the coefficients presented in Table 17, it can be inferred than when the multicollinear variables LNTA, ICR and PPETA are taken out, the results are consistent with the previous findings – that is, ESG as well as its individual pillar scores are still not significant in explaining the variation in TDTA.

Table 17 - H5 and H6 OLS regression results without multicollinear variables

Robust standard errors are presented below the coefficients between parenthesis; *** p<0.01, ** p<0.05, * p<0.1

	(1)	(2)	(3)	(4)
Variables		**TDTA**		
ESG	4.45e-05	-	-	-
	(0.000217)			
EN	-	-8.28e-05	-	-
		(0.000139)		
SO	-	-	0.000288	-
			(0.000193)	
CG	-	-	-	2.93e-05
				(0.000120)
CR	-0.00749***	-0.00727***	-0.00775***	-0.00747***
	(0.00262)	(0.00265)	(0.00259)	(0.00264)
OPM	-0.169***	-0.169***	-0.170***	-0.169***
	(0.0311)	(0.0311)	(0.0310)	(0.0311)
Constant	0.360***	0.360***	0.355***	0.360***
	(0.0375)	(0.0370)	(0.0374)	(0.0372)
Firm fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Observations	6621	6621	6621	6621
Number of firms	496	496	496	496
F statistic	11.64	11.55	12.13	11.51
Prob > F	0.0000	0.0000	0.0000	0.0000
R-squared (overall)	0.0801	0.0760	0.0840	0.0797

7.2 Alternative statistical methods

As mentioned before, this robustness tests section will be focused on running the same regressions presented in the methodology but using different statistical techniques to understand if the results still hold or not. The first test uses OLS with lagged independent variables [7.2.1], the second one uses Seemingly Unrelated Regressions [7.2.2] and the last one uses Two-Stage Least Squares regressions [7.2.4].

7.2.1 OLS with lagged independent variables

To study the relationships of interest (between ESG and firm performance, financial risk, and capital structure decisions) this robustness test uses one year lagged independent variables in the regressions conducted.

The main reason to do this is to address reverse causality – since for instance ESG initiatives may affect financial performance but it is also possible that firms with better performance invest more in ESG. By using lagged independent variables, this test tries to mitigate this concern as it is less likely that this year's ROA, ROE, CR and TDTA caused last year's ESG and its individual pillars scores. Also, considering that the impact of ESG practices might not be immediate in firm performance, risk, and capital structure decisions, it makes sense to use lagged independent variables to capture such delayed effects with more accuracy.

7.2.1.1 Relationship between ESG and firm performance

By looking at the results presented in Table 18, it can be inferred that the results overall change when compared to the OLS model with all the variables in the same period – ESG is no longer significant in explaining the variation in firm performance measures ROA and ROE. However, what still holds between the two models is the significance and positive sign of the EN pillar score for both measures. It is also worth mentioning that the EN coefficients are slightly lower using this statistical technique (0.000115 with ROA and 0.000313 with ROE as dependent variable) when compared to the baseline OLS model (0.000131 with ROA and 0.000366 with ROE as dependent variable). Again, the F statistics indicate that the models are good since the p-values are zero in the eight scenarios.

Table 18 - H1 and H2 OLS regression results with lagged independent variables

Robust standard errors are presented below the coefficients between parenthesis; *** p<0.01, ** p<0.05, * p<0.1

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables			**ROA**				**ROE**	
ESG	0.000102	-	-	-	0.000304	-	-	-
	(8.63e-05)				(0.000210)			
EN	-	0.000115*	-	-	-	0.000313**	-	-
		(5.86e-05)				(0.000146)		
SO	-	-	0.000103	-	-	-	8.90e-05	-
			(8.46e-05)				(0.000172)	
CG	-	-	-	9.68e-06	-	-	-	9.00e-05
				(5.18e-05)				(0.000116)
TDTA	0.0233	0.0241	0.0226	0.0233	0.337***	0.339***	0.336***	0.337***
	(0.0151)	(0.0152)	(0.0151)	(0.0151)	(0.0371)	(0.0371)	(0.0371)	(0.0371)
LNTA	-0.0241***	-0.0245***	-0.0241***	-0.0237***	-0.0702***	-0.0712***	-0.0694***	-0.0692***
	(0.00438)	(0.00440)	(0.00439)	(0.00439)	(0.00838)	(0.00840)	(0.00844)	(0.00839)
ICR	0.000791***	0.000798***	0.000791***	0.000796***	0.00148***	0.00150***	0.00149***	0.00149***
	(0.000161)	(0.000161)	(0.000161)	(0.000161)	(0.000323)	(0.000324)	(0.000324)	(0.000323)
PPETA	-0.0216	-0.0224	-0.0219	-0.0215	-0.0254	-0.0275	-0.0254	-0.0248
	(0.0202)	(0.0201)	(0.0202)	(0.0202)	(0.0569)	(0.0565)	(0.0570)	(0.0571)
OPM	0.187***	0.186***	0.186***	0.187***	0.387***	0.385***	0.387***	0.388***
	(0.0220)	(0.0220)	(0.0218)	(0.0219)	(0.0372)	(0.0373)	(0.0371)	(0.0373)
Constant	0.439***	0.446***	0.440***	0.439***	1.238***	1.256***	1.241***	1.236***
	(0.0785)	(0.0783)	(0.0785)	(0.0787)	(0.144)	(0.143)	(0.144)	(0.144)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6060	6060	6060	6060	6060	6060	6060	6060
Number of firms	493	493	493	493	493	493	493	493
F statistic	16.39	16.51	16.63	16.57	21.92	22.04	22.08	21.97
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R-squared (overall)	0.2694	0.2738	0.2695	0.2635	0.1071	0.1094	0.1038	0.1031

7.2.1.2 Relationship between ESG and financial risk

The coefficients and p-values presented in Table 19 are consistent with the ones obtained through the OLS model with all the variables in the same year since ESG as well as its three individual pillar scores are positive and significant in explaining the variation in the financial risk measure CR. In here it is relevant to mention that the ESG, EN, SO and CG coefficients are lower using this statistical method (0.0107 for ESG, 0.00621 for EN, 0.00552 for SO and 0.00475 for CG) when compared to the OLS baseline model (0.0131 for ESG, 0.00792 for EN, 0.00764 for SO and 0.00591 for CG). Again, the F statistics indicate that the models are good since the p-values are zero in the four scenarios.

Table 19 - H3 and H4 OLS regression results with lagged independent variables

Robust standard errors are presented below the coefficients between parenthesis; *** p<0.01, ** p<0.05, * p<0.1

	(1)	(2)	(3)	(4)
Variables		**CR**		
ESG	0.0107***	-	-	-
	(0.00289)			
EN	-	0.00621***	-	-
		(0.00188)		
SO	-	-	0.00552**	-
			(0.00238)	
CG	-	-	-	0.00475***
				(0.00147)
TDTA	-1.266**	-1.222**	-1.299**	-1.273**
	(0.507)	(0.513)	(0.506)	(0.510)
LNTA	0.651***	0.648***	0.667***	0.684***
	(0.114)	(0.115)	(0.115)	(0.116)
ICR	0.00934**	0.0100**	0.00961**	0.00944**
	(0.00394)	(0.00397)	(0.00396)	(0.00398)
PPETA	2.076***	2.039***	2.068***	2.102***
	(0.765)	(0.770)	(0.769)	(0.765)
OPM	2.516***	2.493***	2.507***	2.580***
	(0.418)	(0.419)	(0.418)	(0.421)
Constant	1.320	1.706	1.408	1.143
	(2.197)	(2.195)	(2.205)	(2.214)
Firm fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Observations	6060	6060	6060	6060
Number of firms	493	493	493	493
F statistic	11.27	11.43	11.04	11.09
Prob > F	0.0000	0.0000	0.0000	0.0000
R-squared (overall)	0.1636	0.1600	0.1623	0.1485

7.2.1.3 Relationship between ESG and capital structure choices

The results displayed in Table 20 are consistent with the ones obtained through the OLS model with all the variables in the same year since ESG as well as its three individual pillar scores are not significant in explaining the variation in the dependent variable TDTA. Again, the F statistics indicate that the models are good since the p-values are zero in the four scenarios.

Table 20 - H5 and H6 OLS regression results with lagged independent variables

Robust standard errors are presented below the coefficients between parenthesis; *** p<0.01, ** p<0.05, * p<0.1

	(1)	(2)	(3)	(4)
Variables		**TDTA**		
ESG	9.58e-05	-	-	-
	(0.000202)			
EN	-	-0.000125	-	-
		(0.000132)		
SO	-	-	0.000265	-
			(0.000177)	
CG	-	-	-	0.000128
				(0.000112)
CR	-0.00299	-0.00271	-0.00309	-0.00304
	(0.00283)	(0.00286)	(0.00280)	(0.00282)
LNTA	-0.000366	0.000614	-0.00102	-0.000129
	(0.00886)	(0.00889)	(0.00888)	(0.00891)
ICR	-0.00280***	-0.00280***	-0.00281***	-0.00281***
	(0.000279)	(0.000278)	(0.000280)	(0.000278)
PPETA	-0.0111	-0.0108	-0.0114	-0.0104
	(0.0515)	(0.0515)	(0.0513)	(0.0515)
OPM	-0.0180	-0.0173	-0.0194	-0.0167
	(0.0334)	(0.0333)	(0.0333)	(0.0334)
Constant	0.388**	0.382**	0.389**	0.382**
	(0.157)	(0.157)	(0.156)	(0.158)
Firm fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Observations	6060	6060	6060	6060
Number of firms	493	493	493	493
F statistic	13.83	13.88	13.92	13.82
Prob > F	0.0000	0.0000	0.0000	0.0000
R-squared (overall)	0.2302	0.2199	0.2343	0.2309

7.2.2 Seemingly unrelated regression models (SUREG)

In this sub-section, the regressions of interest will be ran using seemingly unrelated regression models instead of OLS to see if the results hold or not.

Seemingly unrelated regressions are typically used when several relationships are being studied – and, therefore, there are multiple regression equations – and it is believed that the error terms across those equations are correlated. This correlation may be due to unobserved factors that affect the dependent variables in each equation.

In this specific study, it makes sense to use SUREG since there are unobserved factors – that, therefore, are captured by the error term – that are likely to simultaneously influence the dependent variables ROA, ROE, CR and TDTA. Some unobserved factors can be for example macroeconomic conditions, market trends and management practices.

The way this statistical technique works is the following: firstly, each equation is estimated separately using OLS. The preliminary estimates and residuals come from this estimation. Then, the residuals are used to compute the covariance matrix of the error terms. Lastly, all the regressions are estimated again simultaneously using Generalized Least Squares (GLS) and taking into consideration the covariance matrix. By doing so, this adjusts the coefficients to the error terms correlation.

The interpretation of the SUREG coefficients is done in the same way as the OLS coefficients but those betas are in principle more reliable and efficient since they take into consideration the errors correlation. However, it is important to take into consideration that this statistical method does not allow for the addition of time and firm fixed effects.

To understand if SUREG should be used, the Breusch-Pagan test needs to be performed. The null hypothesis of this test states that the residuals are independent. If the null hypothesis is rejected, that means that there is significant correlation between the errors of the equations. If so, SUREG is appropriate for the analysis. If the null hypothesis fails to be rejected, which means that the error terms are not significantly correlated, it may be more accurate to use OLS.

To apply this statistical technique, four seemingly unrelated regressions were conducted. The first one contained four regressions which had the ESG score as independent variable and ROA, ROE, CR and TDTA as dependent variables. The second one contained four regression which hat the EN score as independent variable and the ROA, ROE, CR and TDTA as dependent variables. The same logic was applied to the SO and CG pillar scores.

The table presented above displays the four seemingly unrelated regression models conducted – (1), (2), (3) and (4) are the result of the first seemingly unrelated regression, (5), (6), (7) and (8) from the second, (9), (10), (11), (12) from the third and (13), (14), (15) and (16) from the fourth. As mentioned before, the criteria used was to group regressions based on their independent variable of interest (ESG, EN, SO and CG).

By looking at the ESG and its individual pillars coefficients, it can be concluded that all of them (ESG, EN, SO and CG) are significant and positive in explaining the variation in ROA, ROE, CR and TDTA.

In terms of firm performance, the ESG and EN scores (not the SO and CG scores though) coefficients are consistent with the baseline results using OLS since those coefficients are also positive and significant. Regarding the OLS with lagged independent variables, the SUREG results are only consistent – in the sense that the coefficients are also positive and significant - for the EN score (not for the ESG one). It can also be stated that the ESG and EN coefficients are higher using SUREG (ESG coefficients of 0.000417 with ROA and 0.00146 with ROE as dependent variables and EN coefficients of 0.000343 with ROA and 0.00104 with ROE as dependent variables) when compared to the OLS baseline ones (ESG coefficients of 0.000132 with ROA and 0.000332 with ROE as dependent variables and EN coefficients of 0.000131 with ROA and 0.000366 with ROE as dependent variables).

When it comes to financial risk, the results of the SUREG model also go in line with the OLS and OLS with lagged independent variables models as all the coefficients (ESG, EN, SO and CG) are positive and significant. It can also be mentioned that the ESG, EN, SO and CG coefficients are higher using SUREG (0.0228 for ESG, 0.0150 for EN, 0.0233 for SO and 0.00653 for CG) when compared to the OLS baseline model (0.0131 for ESG, 0.00792 for EN, 0.00764 for SO and 0.00591 for CG).

However, when it comes to the relationship between ESG and capital structure decisions, the results of this statistical model are not consistent with the OLS (with lagged and non-lagged independent variables) ones, since all the coefficients (ESG, EN, SO and CG) are positive and significant using SUREG but are not significant according to the OLS techniques.

The Chi-square statistics and corresponding p-values are the output of the Breusch-Pagan test, which tests if the residuals in the different regressions are uncorrelated. Since the p-values are all 0.0000, the null hypotheses are rejected, and the residuals are considered to be correlated across equations. Bearing this in mind, using SUREG was more appropriate than OLS as it provides more efficient estimates by accounting for the error's correlations.

Table 21 - SUREG regression results

Robust standard errors are presented below the coefficients between parenthesis; *** p<0.01, ** p<0.05,

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Variables	**ROA**	**ROE**	**CR**	**TDTA**	**ROA**	**ROE**	**CR**	**TDTA**	**ROA**	**ROE**	**CR**	**TDTA**	**ROA**	**ROE**	**CR**	**TDTA**
ESG	0.000417***	0.00146***	0.0228***	0.00140***	-	-	-	-	-	-	-	-	-	-	-	-
	(3.27e-05)	(9.25e-05)	(0.00153)	(8.70e-05)												
EN	-	-	-	-	0.000343***	0.00104***	0.0150***	0.000858***	-	-	-	-	-	-	-	-
					(2.29e-05)	(6.82e-05)	(0.00106)	(6.28e-05)								
SO	-	-	-	-	-	-	-	-	0.000290***	0.000968***	0.0233***	0.00140***	-	-	-	-
									(2.99e-05)	(8.43e-05)	(0.00137)	(7.53e-05)				
CG	-	-	-	-	-	-	-	-	-	-	-	-	0.000196***	0.000795***	0.00653***	0.000478***
													(2.83e-05)	(8.11e-05)	(0.00136)	(7.76e-05)
TDTA	0.0919***	0.376***	-5.188***	-	0.0924***	0.381***	-5.026***	-	0.0928***	0.380***	-5.390***	-	0.0985***	0.397***	-4.500***	-
	(0.00574)	(0.0166)	(0.224)		(0.00569)	(0.0165)	(0.224)		(0.00582)	(0.0169)	(0.222)		(0.00574)	(0.0169)	(0.230)	
LNTA	-0.0108***	-0.0145***	0.523***	-0.0177***	-0.0116***	-0.0155***	0.522***	-0.0177***	-0.0100***	-0.0113***	0.516***	-0.0172***	-0.00884***	-0.00802***	0.656***	-0.0125***
	(0.000534)	(0.00139)	(0.0250)	(0.00149)	(0.000539)	(0.00141)	(0.0251)	(0.00152)	(0.000544)	(0.00136)	(0.0250)	(0.00146)	(0.000497)	(0.00130)	(0.0235)	(0.00144)
ICR	0.00330***	0.00634***	0.0445***	-0.00635***	0.00331***	0.00642***	0.0466***	-0.00632***	0.00332***	0.00642***	0.0423***	-0.00632***	0.00340***	0.00665***	0.0526***	-0.00637***
	(7.93e-05)	(0.000197)	(0.00323)	(0.000155)	(7.84e-05)	(0.000195)	(0.00322)	(0.000157)	(8.05e-05)	(0.000199)	(0.00323)	(0.000156)	(7.87e-05)	(0.000199)	(0.00325)	(0.000157)
PPETA	-0.00709***	-0.0965***	0.525***	0.117***	-0.00906***	-0.102***	0.450***	0.114***	-0.00538**	-0.0906***	0.627***	0.122***	-0.00723***	-0.0980***	0.518***	0.121***
	(0.00213)	(0.00581)	(0.0995)	(0.00589)	(0.00213)	(0.00585)	(0.100)	(0.00600)	(0.00213)	(0.00581)	(0.0989)	(0.00581)	(0.00217)	(0.00595)	(0.0994)	(0.00597)
OPM	0.157***	0.260***	2.486***	0.241***	0.160***	0.265***	2.526***	0.244***	0.155***	0.250***	2.406***	0.234***	0.154***	0.250***	2.229***	0.231***
	(0.00749)	(0.0172)	(0.287)	(0.0166)	(0.00746)	(0.0173)	(0.289)	(0.0167)	(0.00755)	(0.0175)	(0.282)	(0.0165)	(0.00754)	(0.0175)	(0.289)	(0.0169)
CR	-	-	-	-0.0172***	-	-	-	-0.0167***	-	-	-	-0.0178***	-	-	-	-0.0149***
				(0.000758)				(0.000763)				(0.000753)				(0.000779)
Constant	0.141***	0.153***	4.173***	0.740***	0.160***	0.198***	4.658***	0.769***	0.133***	0.121***	4.279***	0.736***	0.116***	0.0701***	2.563***	0.671***
	(0.00964)	(0.0236)	(0.432)	(0.0223)	(0.00984)	(0.0243)	(0.442)	(0.0230)	(0.00982)	(0.0234)	(0.433)	(0.0222)	(0.00943)	(0.0230)	(0.426)	(0.0219)
Observations	6621	6621	6621	6621	6621	6621	6621	6621	6621	6621	6621	6621	6621	6621	6621	6621
Number of firms	496	496	496	496	496	496	496	496	496	496	496	496	496	496	496	496
Chi2	5071.92	2713.56	3197.56	6025.61	5290.48	2728.22	3124.47	5795.51	4960.39	2576.94	3424.03	5881.97	4738.86	2536.35	2915.59	5601.37
P>Chi2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R-squared	0.505	0.317	0.306	0.402	0.509	0.318	0.305	0.398	0.500	0.306	0.310	0.405	0.497	0.303	0.294	0.390

7.2.3 Two-stage least squares regressions (2SLS)

Table 7 and 8 show that TDTA is significant in explaining the variation in Credit Ratings and that Credit Ratings are significant in explaining the variation in TDTA.

This therefore reveals a reverse causality issue since the total debt amount that firms have affect their credit ratings - because if firms have more debt their probability of default increases and, as they become riskier, their credit rating goes down – but the attributed credit ratings can also affect the total debt amount that firms have - because firms with higher credit ratings are perceived as less risk and have access to lower costs of debt which can incentivize the use of debt. However, in here it is important to consider that firms may also want to decrease/maintain their debt when they have good credit ratings to avoid being downgraded.

Bearing this endogeneity problem in in mind, this sub-section will use instrumental variables (IVs) to account for the reverse causality between CR and TDTA. An IV solves this issue because it provides a source of exogenous variation that affects the explanatory variable but not the dependent one. Such tests will only be applicable for the hypotheses 3,4, 5 and 6 (since credit ratings are not considered in the regressions ran for H1 and H2).

To have a good IV, two conditions need to be satisfied: relevance - it needs to be correlated with the endogenous variable - and exogeneity – it must be uncorrelated with the error term in the outcome equation. In here it is important to mention that a weak instrument can lead to biased estimates.

As IVs are being used, the statistical method used is the Two-Stage Least Squares (2SLS) regression model instead of OLS. By using this statistical method, more consistent estimators should be obtained since the bias problem that OLS regressions would present is being accounted for.

The way a 2SLS regression works is the following: in the first stage, the endogenous variable is regressed on all the exogenous variables and on the instrumental variable. In this stage, it is important to check if the coefficient of the IV is statistically significant and if the F-statistic is greater than 10 to ensure that we have a good instrument. With those coefficients, the predicted values of the endogenous variable are obtained. On the second stage, the dependent variable is regressed on the predicted values from the first stage and on the other exogenous variables. The coefficients obtained from this regression are the 2SLS ones and their interpretation is the same as in an OLS regression – the impact of the independent variable on the dependent one – but correcting for endogeneity.

7.2.3.1 Instrumental variables (IVs)

This section will present the IVs chosen. To do so, first a theoretically reasoning will be pointed out, and then the variables themselves will be further explained (as well as where they were taken from).

The instrumental variable chosen to test the 3rd and 4th hypothesis was the U.S. corporate tax rate (TR). The reasoning for this choice is that the corporate tax, which is set by the government, may affect firms' decision to use more debt (mainly due to the interest tax shield) but it is unlikely to directly affect firms' financial risk and, therefore, their credit rating. Based on this reasoning, the tax rate may be a good IV since it seems to only affect the dependent variable through the endogenous independent variable TDTA.

Until 2017, the corporate tax rate in the US was determined based on the value of Earnings Before Taxes. However, from 2018 on, following the US tax reform "Tax Cuts and Jobs Act", all firms in the US pay a fixed 21% corporate tax. Bearing this in mind, it can be seen below the tax rates considered in this study (*ProCon.org*, 2021).

Table 22 - US corporate tax rates

In which EBT is presented in U.S. dollars

Years	EBT	Tax rate
2006 - 2017	< 0	0
	0 - 50000	0,15
	50001 - 75000	0,25
	75001 - 100000	0,34
	100001 - 335000	0,39
	335001 - 10000000	0,34
	10000001 - 15000000	0,35
	15000001 - 18333333	0,38
	> 18333333	0,35
2018 - 2022	< 0	0
	Not applicable	0,21

The IV selected for the 5th and 6th hypothesis were changes in credit reporting regulations in the U.S. This instrument was chosen since regulatory changes influence how credit ratings are calculated and, therefore, can change firms credit ratings even if everything else remains the same, but such changes are unlikely to directly affect the TDTA ratio. Bearing in mind that changes in credit regulations are likely to only affect TDTA through the endogenous variable CR – because if credit ratings deteriorate firms may choose to use less

debt in their capital structure as their cost of debt goes up - such changes have the potential to be a good IV.

The main changes that happened during the 2006-2022 timeframe were the following: in 2006 the Congress passed the "Credit Rating Agency Reform Act" which aimed to improve ratings quality to protect investors and promote transparency, accountability, and competition in the credit ratings industry. Also, in 2010, following the 2007-2009 financial crisis, the "Dodd-Frank Wall Street Reform and Consumer Protection Act" was implemented since credit rating agencies allegedly did not provide accurate securities ratings, as aspect that contributed to the market collapse. This Act imposed, amongst other measures, new disclosure, reporting and examination requirements to address the factors that were perceived to have contributed to the CRAs inflated ratings and, therefore, try to avoid another crisis (*Credit Rating Agencies: Regulation and Recent Developments*, 2021).

To account for this, a dummy variable was created (CCR) which takes the value one if in that year there was a relevant change in credit ratings regulation and zero otherwise.

7.2.3.2 Relationship between ESG and financial risk

Table 23 displays the 4 2SLS regressions that were ran to test the third and fourth hypothesis. The first stages are presented in columns (1), (3), (5) and (7) and the respective second stages on columns (2), (4), (6) and (8).

By looking at the results from the first stages (1), (3), (5) and (7), the tax rate (TR) seems to be a good IV for two reasons: the F-statistic is greater than 10 and the tax rate coefficient is significant in explaining the variation in the dependent variable TDTA for a 5% significance level in the four scenarios.

The second stage column (2) shows that ESG and OPM are significant for a 1% significance level, TDTA and LNTA for a 5% significance level and ICR for a 10% significance level in explaining the variation in CR. Only PPETA is not significant in explaining the variation in the dependent variable. The TDTA coefficient is equal to -20.29. What this means is that when firms decide to use 1% more debt on their capital structure, the CR deteriorates by 0.2029 units. The ESG coefficient interpretation is the following: when the ESG score increases by one unit, the CR improves by 0.0133 units. The fact that the ESG coefficient is positive and significant goes in line with the previous OLS (lagged and non-lagged independent variables) and SUREG findings. This result is very similar to the one obtained through the baseline OLS model (0.0131 coefficient).

By observing the coefficients of the individual ESG pillars in the second stages (4), (6) and (8), it can be inferred that SO and CG are significant in explaining the variation in the dependent variable CR for a 5% significance level. The interpretations of those coefficients are the following: when the SO and CG scores increase by one unit, the credit rating improves, respectively, by 0.0123 and 0.00704 units. Even though the significance of the EN pillar no longer holds, SO and CG are still significant in explaining the variation in TDTA, which is consistent with the OLS and SUREG findings. It can also be inferred that the SO and CG coefficients are higher using 2SLS (0.0123 for SO and 0.00704 for CG) than using the baseline OLS technique (0.00764 for SO and 0.00591 for CG).

Table 23 - H3 and H4 2SLS regression results

Robust standard errors are presented below the coefficients between parenthesis; *** p<0.01, ** p<0.05, * p<0.1

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	**TDTA**	**CR**	**TDTA**	**CR**	**TDTA**	**CR**	**TDTA**	**CR**
TR	-0.0513**	-	-0.0504**	-	-0.0520**	-	-0.0518**	-
	(0.0236)		(0.0236)		(0.0235)		(0.0235)	
TDTA	-	-20.29**	-	-21.27**	-	-20.81**	-	-20.33**
		(9.717)		(10.29)		(9.778)		(9.648)
ESG	2.37e-05	0.0133***	-	-	-	-	-	-
	(0.000198)	(0.00510)						
EN	-	-	-0.000157	0.00462	-	-	-	-
			(0.000128)	(0.00364)				
SO	-	-	-	-	0.000242	0.0123**	-	-
					(0.000175)	(0.00506)		
CG	-	-	-	-	-	-	6.84e-05	0.00704**
							(0.000108)	(0.00279)
LNTA	-0.00755	0.566**	-0.00626	0.578**	-0.00851	0.563**	-0.00756	0.609***
	(0.00839)	(0.222)	(0.00845)	(0.230)	(0.00840)	(0.227)	(0.00840)	(0.225)
ICR	-0.00466***	-0.0812*	-0.00466***	-0.0852*	-0.00466***	-0.0833*	-0.00467***	-0.0813*
	(0.000292)	(0.0456)	(0.000290)	(0.0483)	(0.000292)	(0.0459)	(0.000291)	(0.0454)
PPETA	-0.0825*	1.102	-0.0813*	0.994	-0.0832*	1.029	-0.0822*	1.137
	(0.0479)	(1.349)	(0.0477)	(1.403)	(0.0477)	(1.370)	(0.0479)	(1.346)
OPM	0.0421	2.432***	0.0427	2.450***	0.0411	2.396***	0.0429	2.502***
	(0.0378)	(0.821)	(0.0378)	(0.861)	(0.0376)	(0.831)	(0.0377)	(0.827)
Constant	0.455***	9.480*	0.437***	9.960*	0.463***	9.703*	0.453***	8.894*
	(0.137)	(5.398)	(0.137)	(5.521)	(0.137)	(5.482)	(0.137)	(5.379)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6621	6621	6621	6621	6621	6621	6621	6621
Number of firms	496	496	496	496	496	496	496	496
F statistic	20.18	-	20.33	-	20.14	-	20.19	-
Prob > F	0.0000	-	0.0000	-	0.0000	-	0.0000	-
R-squared (overall)	0.2079	0.1424	0.2023	0.1333	0.2109	0.1422	0.2093	0.1342

7.2.3.3 Relationship between ESG and capital structure decisions

Table 23 shows the 4 2SLS regressions that were ran to test the fifth and sixth hypothesis. The first stages are presented in columns (1), (3), (5) and (7) and the respective second stages on columns (2), (4), (6) and (8).

By looking at the results from the first stages (1), (3), (5) and (7), the change in credit ratings regulation (CCR) seems to be a good IV for two reasons: the F-statistic is greater than 10 and the CCR coefficient is significant in explaining the variation in the dependent variable CR for a 1% significance level in the four scenarios.

By observing the coefficients of the ESG scores in the second stages (2), (4), (6) and (8), it can be stated that the results using IVs are consistent with the ones achieved using the OLS models since ESG, EN, SO and CG are still not significant in explaining the variation in TDTA.

Table 24 - H5 and H6 2SLS regression results

Robust standard errors are presented below the coefficients between parenthesis; *** p<0.01, ** p<0.05, * p<0.1

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	**CR**	**TDTA**	**CR**	**TDTA**	**CR**	**TDTA**	**CR**	**TDTA**
CCR	1.039***	-	0.946***	-	0.833***	-	0.759***	-
	(0.224)		(0.213)		(0.211)		(0.190)	
CR	-	-0.0294*	-	-0.0296*	-	-0.0299*	-	-0.0290*
		(0.0173)		(0.0177)		(0.0174)		(0.0171)
ESG	0.0131***	0.000396	-	-	-	-	-	-
	(0.00299)	(0.000286)						
EN	-	-	0.00808***	7.66e-05	-	-	-	-
			(0.00195)	(0.000191)				
SO	-	-	-	-	0.00738***	0.000455	-	-
					(0.00244)	(0.000206)		
CG	-	-	-	-	-	-	0.00585***	0.000228
							(0.00148)	(0.000149)
LNTA	0.717***	0.0137	0.710***	0.0148	0.739***	0.0136	0.762***	0.0146
	(0.107)	(0.0164)	(0.108)	(0.0166)	(0.107)	(0.0168)	(0.109)	(0.0168)
ICR	0.0144***	-0.00429***	0.0149***	-0.00427***	0.0149***	-0.00427***	0.0145***	-0.00429***
	(0.00370)	(0.000399)	(0.00368)	(0.000409)	(0.00369)	(0.000405)	(0.00371)	(0.000397)
PPETA	2.739***	-	2.684***	-	2.722***	-	2.771***	-
	(0.729)		(0.730)		(0.738)		(0.739)	
OPM	1.950***	0.0812*	1.926***	0.0816*	1.928***	0.0801	2.010***	0.0825*
	(0.428)	(0.0488)	(0.429)	(0.0492)	(0.428)	(0.0487)	(0.431)	(0.0491)
Constant	-0.496	0.456***	0.0311	0.451***	-0.467	0.460***	-0.786	0.438***
	(1.955)	(0.153)	(1.952)	(0.156)	(1.960)	(0.153)	(1.985)	(0.154)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6621	6621	6621	6621	6621	6621	6621	6621
Number of firms	496	496	496	496	496	496	496	496
F statistic	12.11	-	12.34	-	11.51	-	11.82	-
Prob > F	0.0000	-	0.0000	-	0.0000	-	0.0000	-
R-squared (overall)	0.1139	0.2740	0.1116	0.2684	0.1127	0.2749	0.0999	0.2704

8 Key findings

This section will present the findings of this study regarding the three relationships of interest – ESG and firm performance [8.1], financial risk [8.2], and capital structure decisions [8.3]. To do so, it is important to start by briefly summarizing our findings in the table below.

Table 25 - Statistical methods coefficients conclusions

This table indicates, for each statistical method, the sign and significance of the ESG, EN, SO and CG coefficients

		Statistical methods			
Dependent var.	**Independent var.**	**OLS**	**OLS with lagged independent var.**	**SUREG**	**2SLS**
ROA	**ESG**	Positive and significant	Not significant	Positive and significant	Not applicable
	EN	Positive and significant	Positive and significant	Positive and significant	
	SO	Not significant	Not significant	Positive and significant	
	CG	Not significant	Not significant	Positive and significant	
ROE	**ESG**	Positive and significant	Not significant	Positive and significant	Not applicable
	EN	Positive and significant	Positive and significant	Positive and significant	
	SO	Not significant	Not significant	Positive and significant	
	CG	Not significant	Not significant	Positive and significant	
CR	**ESG**	Positive and significant	Positive and significant	Positive and significant	Positive and significant
	EN	Positive and significant	Positive and significant	Positive and significant	Not significant
	SO	Positive and significant	Positive and significant	Positive and significant	Positive and significant
	CG	Positive and significant	Positive and significant	Positive and significant	Positive and significant
TDTA	**ESG**	Not significant	Not significant	Positive and significant	Not significant
	EN	Not significant	Not significant	Positive and significant	Not significant
	SO	Not significant	Not significant	Positive and significant	Not significant
	CG	Not significant	Not significant	Positive and significant	Not significant

The criteria used to accept hypotheses was the results being consistent across the four (or three in the case of firm performance) statistical methods. If different models yield different results, the hypotheses will be deemed as inconclusive.

8.1 Relationship between ESG and firm performance

Table 25 indicates that the relationship between ESG and firm performance measures ROA and ROE is not consistent across the three statistical methods used – is it positive and significant using OLS and SUREG but not significant when we use OLS with lagged independent variables. Bearing this in mind, **Hypothesis 1 is inconclusive** since different methods yield different results.

The OLS and SUREG models support the findings of Friede et al. (2015), Khan et al. (2016) and Alareeni et al. (2020) since they find a positive relationship between ESG scores and firm performance measures ROA and ROE. The main reasons that are presented in the literature for this are: better reputation that leads to talent attraction (Montgomery et al., 2003) and customer loyalty (Creyer, 1997), efficiency gains (Schoenherr, 2012), risk mitigation (Karpoff et al., 2005) and improved access to capital markets (Kurtz, 2020).

Bearing this in mind, it can be mentioned that the OLS and SUREG models results go in line with the Stakeholder theory (Freeman & McVea, 2017) - which states thar firms must be managed considering the interests of all stakeholders (and not only shareholders) and supports investment in ESG practices.

When it comes to the relationship between firm performance and the individual pillar scores, only the Environmental pillar score coefficient is positive and significant on the three scenarios (Social and Governance are not significant in two of them). This does not go in line with the results of Kim et al. (2021) whose findings indicate that the most significant pillar is corporate governance and, therefore, allows to **reject Hypothesis 2.**

On a smaller note, it is also important to mention that, according to the OLS method only, the ESG and EN pillar scores are only significant in explaining the variation in ROA and ROE when the scores are considered low and during economic expansion years.

8.2 Relationship between ESG and financial risk

When it comes to the relationship between credit ratings and ESG scores, the results are consistent across the four methods – there is a positive and significant relationship between ESG scores and credit ratings which allows to **accept Hypothesis 3**. Some of the reasons that are presented in the literature to justify this are the fact that ESG practices reduce overall risk (Devalle et al., 2017) and that firms with such practices usually have a high degree of transparency in their operations (Agnese et al., 2023). Such results are therefore in line with the findings of Brogi et al. (2022) which inferred that firms with a high level of ESG awareness are more creditworthy.

When it comes to the impact of the individual pillars, only the Social and Governance pillar scores display positive and significant relationships with credit ratings along the four scenarios (EN is not significant using the 2SLS method). This allows to **accept Hypothesis 4** and goes in line with the results of Brogi et al. (2022), whose findings indicate the same relationship.

On another note, it is important to consider that, according to the OLS model only, ESG as well as its three pillars' scores are only significant in explaining the variation in credit ratings when the scores are classified as low. Also, according to the OLS model, the four scores are significant in explaining the variation in CR both during recession and expansion years but are stronger in recession years.

8.3 Relationship between ESG and capital structure decisions

The relationship between ESG as well as the individual pillar scores and TDTA is inconclusive since the coefficients are positive and significant using SUREG but are not significant when using OLS, OLS with lagged independent variables and 2SLS. Bearing this in mind, **Hypotheses 5 and 6 are inconclusive** as different methods yield different results.

It can therefore be mentioned that the OLS, OLS with lagged independent variables and 2SLS models support the findings of Kounduri et al. (2021), which conclude that ESG is not relevant for efficient capital structure choices.

The SUREG model, on the other hand, supports the findings of Apergis et al. (2022) which state that firms with higher ESG scores use more leverage in their capital structure financing since – by being perceived as less risky and having access to cheaper debt - debt financing becomes more attractive.

To conclude, according to the OLS model only, the four pillar scores (ESG, EN, SO and CG) are not significant in explaining the variation in TDTA when we consider either high vs low scores or when we consider recession vs expansion years.

9 Limitations and further research

This section will present the main limitations attached to the findings of this study, which can serve as interesting topics for further research.

Firstly, it is important to consider that, as this study considers U.S. firms, there is a geographical constraint as it only sheds light on the relationships between ESG and firm performance, financial risk, and capital structure decisions for that specific economy. Considering this, it would be interesting to conduct the same research for other countries/economies – for instance using only European firms or sub-dividing economies in developed and developing - to understand if these results would be consistent.

Secondly, even though S&P500 index firms were chosen due to larger ESG data availability, there is still a lot of ESG data missing, especially in earlier years of the sample selected. Keeping this in mind, it could be interesting to conduct this study some years from now considering a more recent time frame with more ESG data available and assess if the results still go in line with the ones presented here.

Thirdly, the use of S&P500 index firms limits this research to large cap firms. Bearing this in mind, it could be relevant to explore such relationships for firms with different sizes – for example medium size firms - to conclude if the relationships are the same or not. The problem associated with this is that, if even for large firms there is ESG data missing, it will still take some years for that information to be available for smaller sized firms.

Also, to conduct this study, some specific control variables were selected. The criteria used was to understand what are the main factors that influence ROA, ROE, CR and TDTA (size, tangibility, operational performance…) and then select, for each factor, a variable that measures that (LNTA, PPETA, OPM…). However, there are other control variables that were not included in this research which influence the dependent variables and, therefore, could be relevant for this study. So, further research could include other relevant variables and assess if the results are like the ones presented here. Here it is also worth mentioning that some of the variables included are multicollinear, which may also be biasing the estimates.

It is also important to mention that, even though a great effort was put in finding good IVs to account for the reverse causality between CR and TDTA, there may be better IVs for this matter. For example, the dummy CCR takes the value one if there was a change in credit regulation in that year and zero otherwise. This is therefore implying that the reform had an effect in credit ratings on that year and on that year only, which is not accurate since such changes will impact credit ratings on the following years as well.

It would also be interesting to run the High vs Low ESG scores and recession vs expansion years robustness tests using the other statistical techniques, that is, OLS with lagged independent variables, SUREG and 2SLS to see if such results would be consistent or not.

Finally, the main limitation of this research is the fact that it is difficult to establish causality between ESG performance and firm performance, credit ratings and capital structure choices since it is hard to understand if ESG influences those factors, if those factors influence ESG or if indeed there is reverse causality – in this case, both will influence each other. Taking this into account, further research could use other statistical techniques that help to identify causality – for examples IVs that influence ESG but not firm performance, credit ratings and capital structure choices. Future changes in ESG rules or regulation may provide the setting for this.

10 Conclusion

ESG's importance has been growing for the last two decades following the Principles for Responsible Investment (2006) and the Paris Agreement (2015). Due to this increasing relevance, it is important to understand the relationship between ESG and firm metrics so that companies can make informed investments on such issues.

Since contradicting results have been found in the literature, the goal of this study was to shed light on the relationship between ESG scores and firm performance, financial risk, and capital structure decisions. On top of this, this research also explored what are the ESG pillars that potentially drive such relationships.

To do so, this research starts by using the OLS statistical method. However, in the robustness tests section, other statistical methods – OLS with lagged independent variables, SUREG and 2SLS - are used to see if the results are consistent.

The findings of this research were the following: there is an inconclusive relationship between ESG scores (and Social and Governance pillars scores) and firm performance measures ROA and ROE since different statistical models yield different results. However, this study finds a positive relationship between the Environmental Pillar Score and ROA and ROE.

Regarding the relationship between ESG and financial risk, a positive and significant relationship across the four statistical methods tested is found. Also, the Social and Governance pillar scores contribute to this on the four scenarios.

When it comes to the relationship between ESG and capital structure decisions, conclusions are once again inconclusive since different methods provide different results.

To finalize, even though this study is not conclusive regarding three of the six hypotheses tested, it helps to understand why indeed there are conflicting results in the literature – because different statistical methods yield different conclusions using the same dataset.

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