LUND
UNIVERSITY

ESG Performance and Corporate Bond Spreads

By: Carl Windmar

Advisor: Thomas Fischer

May 2023

For the Degree of Bachelor of Economics

Lund University School of Economics and Management

Abstract

This paper examines the impact of ESG performance on corporate bonds spreads. The spreads are determined by the risk factors of the investment and the demand by the capital markets. It is therefore analysed whether ESG affects these determinants. The hypothesis is that increased ESG performance should lead to lower bond spreads because it has a positive effect on risk mitigation and investor demand. This is tested on 981 corporate bonds from the EMU issued during the time period 2015-2023. The empirical findings support this hypothesis showing a negative correlation between ESG performance and bond spreads. This is true for the combined ESG score and the individual pillars E, S and G. Conclusively, this study suggests that investors prefer investments with high ESG performance. From a management's perspective, the results indicate that investments in ESG will reduce the cost of debt issuing for the company.

Keywords: ESG, Financial Performance, Z-spread, Bonds, Investors

Table of contents

1. Introduction

1.1 Background

The climate crisis is becoming more severe for every year that passes. In light of this, a pressure from consumers and stakeholders on companies to improve their sustainability performance has arisen. The UN established the Sustainable Development Goals (SDG) in 2015 to inspire all institutions and companies to improve their efforts. Further sustainability concepts for companies, such as environmental social governance (ESG) and corporate social responsibility (CSR), have also been established. ESG describes a company's performance in the three areas environmental, social and governance. Therefore, an ESG score measures the level of sustainability in the areas previously mentioned that a company or organisation has. Its purpose is to provide transparency to the stakeholders.

This study seeks to shed light on how ESG performance relates to financial returns, specifically in the context of corporate bonds. It will be examined whether the effects are a result of demand for sustainable investments, if it is a result of ESG mitigating risk and how theory of the financial markets affect these factors. The three pillars of ESG, E, S and G will be analysed individually in order to determine if they have an effect on returns by themselves.

1.2 Problem Statement

The relationship between sustainability and financial performance is of great importance to both company management and investors. If management can reduce the company's cost of debt by increasing their ESG efforts, this finding would incentivise management to be more sustainable. Investors would benefit from the knowledge of whether sustainability leads to an increase, decrease or if it has no effect whatsoever on financial returns. All three scenarios could lead to a change in investor behaviour. Conclusively, an answer to the question is important for the actors on the financial markets, both the investors and the debt issuers. The theoretical views are inconclusive on whether ESG has a negative or positive relationship with returns, which is the reason it is being tested on empirical data.

The research question that will be answered is:

Does firm ESG performance affect the financial returns of corporate bond investments?

The findings of the research supports the hypothesis that there is a negative relationship between ESG and z-spread, which is used as a proxy for financial returns. This is the case both for ESG score and the three individual pillars E, S and G. The implication is that corporate bonds issued by companies with high ESG performance yield lower returns. This finding is consistent with the majority of previous empirical research. There are multiple theories that support and contradict this finding that are discussed in the paper.

1.3 Research Structure

Firstly, theoretical explanations and previous empirical results of the relationship between ESG and finance will be examined in Chapter 2. In the third Chapter, the data sample will be presented. It consists of 981 bonds collected from 12 countries, all of whom are members of the European Monetary Union (EMU). Afterwards, in Chapter 4, the method used in the study will be presented. The analysis will be conducted using a cross sectional OLS regression. Z-spread is used as the dependent variable and ESG score, as well as the individual pillars, are the variables of interest. In Chapter 5, the results will be presented as well as a robustness check and a discussion of the analysis. The end of the paper consists of the conclusions drawn from the study.

2. Literature review

2.1 ESG and risk

The core of financial economics consists of the risk reward theorem, which states that an investor should be compensated for taking additional risk. Many researchers have examined whether ESG has any effect on risk, amongst them Cornell (2020). The author mentions the legislative risk, where new legislation could impose sanctions and fees for companies that fail to reach a certain level of ESG performance. Interestingly, Cornell (2020) proposes that the existence of such risks are not sufficient to affect returns. If the markets fail to price in this risk, the performance would be unaffected. Therefore, the existence of ESG related risks may not necessarily translate into financial returns depending on the behaviour of the financial markets.

2.2 ESG and financial returns

Fitzgibbons, Pedersen and Pomorski (2019) argue that if investors incorporate ESG data in their investment thesis and they have a preference for high ESG scores then this affects the prices. This implies that the demand for sustainable corporate bonds increases and this would result in the price rising and required rate of return falling due to their inverse relationship (Fitzgibbons, Pedersen & Pomorski, 2019). The study by Fitzgibbons, Pedersen and Pomorski (2019) covers equities but the same reasoning could be applied to bonds, where the required rate of return is the yield. Therefore, if investors prefer corporate bonds with high ESG scores this explains a financial performance loss for investors. This could also be denoted as an ESG premium on the bond. The extent of the impact is dependent on the amount of investors with ESG preference, the more there are the greater the effect will be (Fitzgibbons, Pedersen & Pomorski, 2019).

If the demand for ESG investments were to rise in the future, at a quicker rate than the markets anticipate, this would be an opportunity to profit (Fitzgibbons, Pedersen & Pomorski, 2019). As demand for ESG rises the prices increase which creates profit for the holder of an ESG investment, solely due to the ESG component. This would

provide a one time financial performance gain for bonds due to the temporary mispricing.

2.3 The shareholder- and stakeholder theories

There are two main theories explaining management's perspective on ESG implementation. Firstly, the shareholder theory expresses that the purpose of a company is to generate as high returns as possible for its shareholders (Friedman, 1970). Therefore, the debate on whether ESG should be implemented or not is based entirely on its impact on financial performance. Fitzgibbons, Pedersen and Pomorski (2019) further discuss this by stating that an increase in governance, which should strengthen the management of the company, has to be weighed against the increase in cost of improving the company's governance level. If the net effect is negative, meaning that the costs of implementation are larger than the cost of debt benefit, the increase in ESG performance would have a negative effect on the company. The relationship between ESG performance and financial performance from a management perspective therefore depends on the economic efficiency of increasing ESG activity.

On the flip side, there is the stakeholder theory, concluding that a company should take all stakeholders affected by the company's actions into consideration when making a decision (Freeman & Mcvea, 2001). Thereby, other stakeholders than the shareholders such as customers, employees, governments and the environment are taken into account. One of the reasons behind this idea is to build more relationships and strengthen the company's reputation, which delivers value to the company (Freeman & Mcvea, 2001). The result is that ESG becomes a strategic objective for the firm by itself since it is valued by the stakeholders.

Both theories explain the existence of ESG in corporations. However, since the shareholder theory advocates that investments in ESG should only occur if there is a financial performance benefit, it is contingent on a positive relationship between the factors. Meanwhile, the stakeholder theory suggests that investments in ESG will always be made to some extent to limit negative externalities to other stakeholders.

Conclusively, the theoretical background does not implicate a clear direction of whether ESG has a positive or negative impact on returns.

2.4 Hypothesis and previous research

2.4.1 Empirical results for ESG performance

In this section, previous research will be investigated to see the empirical conclusions that have been drawn thus far. Research by Klein, Stellner & Zwergel (2015) shows a weakly negative relationship between the ESG rating of the issuers country and the z-spread. Although the scope of the authors study is the ESG performance of a country instead of a firm, it is an interesting result. It indicates that there is in fact a negative correlation between the variables ESG and financial returns.

Gigante and Manglaviti (2022) find no significant relationship in their recently published study of European corporate bonds in the time period 2018-2020. The authors use a sharp regression discontinuity design, which has rarely been used in studies on corporations before (Gigante & Manglaviti, 2022). This could explain why the results deviate from other studies.

Furthermore, there is evidence that ESG performance has an effect on lowering the cost of equity (Chen, Li, Zeng & Zhu, 2022). Chen et al (2022) show a significant relationship in their study of Chinese companies between 2010 and 2020. If ESG does lower the cost of equity, it would be reasonable to assume that it affects debt financing as well. Although the asset classes are different, fundamentally both are investments in the same company so the company's properties should be reflected in both instruments. Therefore, it points towards lower bond spreads for firms with high ESG performance.

A paper published by Lian, Zhang, Zhang and Ye (2023) analysed ESG performance and various financial metrics of corporate bonds in China. The results are that ESG performance negatively affects bond spreads and bond risk, the latter analysed by using the Altman Z-score. Interestingly, it is shown that institutions have an effect on the impact ESG has on financial metrics. It is therefore concluded that incorporating

ESG into investment analysis has a larger effect in geographies with a more well functioning market.

Friede, Busch and Bassen (2015) published a paper summarising the results of 2200 previous empirical papers on ESG and corporate financial performance, with data dating back to the 1970s. The authors find that the majority of research on ESG and financial erformance concludes a positive effect and highlight that this result is more prevalent for non-equity asset classes, such as real estate and bonds. Additionally, the large data set allowed the authors to analyse whether this relationship has changed over time. The result was that the correlation has been consistent over the examined time period. Furthermore, the authors find discrepancies between different geographies, such as developed Europe having a weaker relationship between ESG and returns compared to developed Asia and North America.

In table 1 the empirical results from previous studies have been summarised and from examining the table it is unclear whether there is a positive or a negative relationship due to a lack of consensus. Recent studies indicate a negative relationship but the meta analysis by Friede, Busch and Bassen (2015) provide convincing evidence against.

Table 1: Summarising previous empirical research

Author	Market	Study	Finding
Klein, Stellner & Zwergel (2015)	Europe	ESG performance in countries affects bond spreads	Weak negative relationship
Gigante & Manglaviti (2022)	Europe	The effect of ESG on cost of debt	No significant results
Antonopoulos, Apergis & Poufinas (2022)	Europe	ESG scores and cost of debt, including pillars	Negative relationship
Chen, Li, Zeng & Zhu (2022)	China	Cost of equity and ESG in China	Negative relationship
Lian, Zhang, Zhang & Ye (2023)	China	Corporate ESG performance and bond spreads	Negative relationship
Friede, Busch & Bassen (2015)	Worldwide	Meta analysis of ESG and corporate financial performance	Positive impact on financial performance

2.4.2 Empirical results for E, S and G pillar performance

Investigations into the three individual pillars have been found to all contribute to a lower cost of debt in a study by Antonopoulos, Apergis and Poufinas (2022). Their research shows that the social pillar S has the largest impact on performance, followed by G and lastly E. However, the authors argue that a certain pillar's impact on performance could vary a lot depending on which sector the company operates in. This makes it hard to draw a general conclusion, which is a limitation of the study. Therefore, it is difficult to determine which pillar has the largest effect on returns. Nevertheless, their research shows that all pillars by themselves affect returns negatively.

The theoretical views of the individual pillars vary. Fitzgibbons, Pedersen and Pomorski (2019) argue that an increase in S leads to an increase in performance as employee satisfaction is important for a company. However, investing in companies with high S scores implies the exclusion of high-return sectors such as gambling and

tobacco, which could decrease overall returns (Fitzgibbons, Pedersen and Pomorski 2019). Similarly, the authors state that good governance leads to better management. This argument is expanded upon by Lian, Zhang, Zhang, Ye (2023) who argue that governance reduces the debt agency of the company. The pillar E has been empirically shown by Fitzgibbons, Pedersen and Pomorski (2019) to not affect performance.

The meta analysis by Friede, Busch and Bassen (2015) also examined the effects of the individual pillars, and concluded from 634 previous studies that there is a positive correlation for all three pillars. Governance was found to have the highest correlation, followed by environmental and lastly social. However, governance was found to also have the highest amount of negative correlations, so correcting for this the environmental pillar was shown to have the biggest correlation. Conclusively, there is currently no consensus regarding research into the individual pillars.

2.4.3 Hypothesis

By combining previous research with theoretical backgrounds, the following hypotheses are formed:

- *There is a negative relationship between the z-spread and the aggregated ESG score.*
- *There is a negative relationship between the z-spread and each individual pillar of the ESG score.*

3. Data

3.1 Data collection

All data used in this study has been gathered from the Refinitiv Eikon database. The initial screening process included all bonds issued by companies with an origin from the EMU region in the time period 2015-2023. The fact that ESG has become a hot topic lately is the reason that bonds prior to 2015 have been excluded, as relationships between the variables may have been different then. As previously stated, the EMU was selected due to it being less researched than other markets, such as the US market.

Financial institutions and banks were excluded during the screening process because they fall under other regulations than other industries (Ge & Liu, 2015). This can lead to a lower cost of debt unrelated to other variables. It is also in accordance with previous papers to exclude them from the screening process. The data also only consists of fixed coupon bonds with a maturity date, as other bonds have different characteristics (Ge & Liu, 2015). Bonds in perpetuity are quite complex as the company's estimated lifetime is factored in. Variable coupon bonds have different risk levels and another payoff structure. Zero coupon bonds have different duration and convexity which will disturb the results if they are included in the same set as fixed coupon bonds. It was intended to include bonds with options embedded but the screening process returned only 21 observations, less than 1% of the entire sample, so these were removed. The z-spread data by Refinitiv Eikon is calculated by comparing the yield of the corporate bonds to an index of treasury spreads from EMU governments (Refinitiv).

After all data had been collected there was an extensive elimination process, where bonds with incomplete or missing data for variables had to be excluded. The variable which most bonds lacked was the ESG score.

3.2 Outliers

An outlier can be defined as an observation that significantly deviates from the data (Adams, Hayunga, Mansi, Reev & Verardi, 2018). The reason that they are problematic is that they can introduce bias into a regression model (Adams et al, 2018). The most common way of treating outliers in empirical finance in the time period 2008-2017 using OLS was through winsorization at 52%, followed by trimming at 17% (Adams et al, 2018). Rupert (2010) describes winsorization as transforming the outliers into the largest value that is not considered an outlier in the data set. Further, Rupert (2010) describes trimming as the method of removing the outliers completely from the set. Winsorization has the advantage of keeping the distribution more similar to the original set compared to trimming (Rupert, 2010). Meanwhile, winsorization and trimming has been criticised as the results greatly depend on what percentage of values are chosen to be altered (Adams et al, 2018). Additionally, it can potentially introduce new biases into the data sample (Adams et al, 2018). The authors Adam et al (2018) also warn that outliers may contain important information, which it could be a mistake to remove or transform.

Despite these issues, winsorization was used to eliminate outliers in the data sets for the variables where outliers were most prominent as it is the most common method. In table 2 it is displayed that debt/equity, z-spread and return on equity all have minimum and maximum values that significantly deviate from the mean, which is why they were considered outliers. Ge and Liu (2015) use the winsorization level of 98%, meaning that the top and bottom 1% of values will be transformed. The same method has been adopted in this study.

Table 2: comparison of winsorized variables data, denoted by "w", to unaltered variables data.

Variable	Mean	Median	Std. dev.	Min.	Max.
Z-spread	219	135	514	-32	9,807
Z-spread w	192	135	186	29	1,351
Total Debt to Total Equity (%)	164	120	157	14	1,399
Total Debt to Total Equity w (%)	162	120	150	17	779
Return On Equity (% annually)	16	12	34	-119	323
Return On Equity w (% annually)	14	12	16	-36	100

3.3 The variables

3.1 The dependent variable

The dependent variable has to be related to the financial performance of the bonds, as we are examining the effects on financial performance. A common variable is using the yield spread over treasury bonds, that is the difference in yield between the corporate bond and the treasury bond. However, by simply looking at a fixed yield of the treasury bond one fails to take the yield curve into account since a fixed yield implies a flat curve (Klein & Stellner, 2013). In reality the yield curve is rarely flat but for the most part it is upwards sloping, although it has been known to invert before incoming recessions.

Here the zero volatility spread ("z-spread") is used which is implicitly defined by equation 1. It takes the yield curve into account by discounting the coupons at each time period. Therefore the z-spread will be a shift up over the yield curve for treasury bonds by a certain yield premium for the added risk of corporate bonds. Each bond has one z-spread value which added to the risk free yield equals the total yield of the bond. However, since the ESG scores of a company is assumed to have no impact on the treasury bond yield, only the z-spread is used. Z-spread has been increasingly

common in bond research which also makes this study more comparable to existing research.

Some previous research of corporate bonds has looked at credit rating from one of the large credit rating agencies as the dependent variable. This would indeed be interesting to look at, but it is not within the scope of this study as it is focused on performance and not credit risk.

Equation 1:

$$P = \sum_{t=1}^{n} \left[\frac{C_n}{\left(1+\frac{r_n+Z}{2}\right)^{2n}} \right]$$

Here P is the price of the bond, C is the coupon size, r is the yield from treasury bonds and Z is the z-spread. The price can be inferred from summarising all future coupons of the bond and discounting them with the rate of return for treasury bonds in addition to the z-spread.

3.2 Variable of interest

The variables that are examined in the study are ESG scores and scores for the three individual pillars. All the ESG data was gathered from the Refinitiv Eikon database. Eikon is one of the world's leading providers of ESG data with over 12,500 companies featured with an ESG score. The scores are entirely driven by data from public sources. The score is based on 10 different categories within the three pillars environmental, social and governance. Combined the values are compared to other companies in the same industry, resulting in a score of 0-100 where 100 is best in the peer group and 0 is the worst performer. The scores assigned are thereby relative to each other. There are other providers of ESG data, such as Bloomberg and Standard & Poor, that could have also been used.

3.3 Control variables

Control variables are variables that have an effect on the dependent variable. They help explain the relationship, and also improve the model by reducing the bias. First,

the bond instrument level control variables will be introduced, followed by firm specific variables. Lastly, the fixed effects variables are covered.

Bid-ask spread

Liquidity risks exist across all assets, although to a highly varying degree. Not being able to liquidise a position results in less flexibility and may hinder an investor from selling at the right time. Therefore, a liquidity risk should be compensated by a yield premium. Previous studies have used the bid-ask spread as such a measure, as a larger spread results in increased difficulties in selling the asset (Klein, Stellner & Zwergel 2015).

Maturity

Maturity is the time period your money is being borrowed. The longer your money is borrowed, the longer is the time period that the company may default. Additionally, long maturity provides the investor with less access to their money in case they would suddenly need it. To account for the fact that not all bonds were issued simultaneously, maturity is measured as remaining time to maturity. It is calculated by subtracting the maturity date with the date of issue.The additional risk that comes with higher maturity translates into a positive relationship to the z-spread (Ge & Liu, 2015). Maturity is measured in years in this study.

Modified duration

Duration is calculated by taking the first derivative of the yield, which is shown in equation 2. Duration is a linear measurement for the bonds price sensitivity to a change in yield. The reason to include duration was that it can be interpreted as a measurement of the amount of years it takes an investor to recoup their initial investment (Klein, Stellner & Zwergel 2015). Another reason was its property of conveying price sensitivity. A high duration is unfavourable for the investor and has to be compensated by higher spreads. The issue with using duration is that it assumes a linear relation between price and yield which differs from reality (Asgharian & Nordén, 2011). This results in an underestimation in price increase when the yield

decreases and vice versa. For this reason it is a good estimator of small yield changes but not for volatile markets (Asgharian & Nordén, 2011). In this study the modified duration was used instead of duration, the difference between them is shown in equation 2.

Equation 2:

$$d = \frac{1}{P}\sum_{t=1}^{n}\frac{tC_t}{(1+Y)^t}$$

$$Mod\,d = \frac{d}{(1+Y)}$$

Here P is the price of the bond, C is the coupon, t is the time period and Y is the yield. Duration can be calculated from summing all future cash flows and multiplying by the amount of years to maturity. It is then discounted by the yield and normalised by its price. Lastly, the duration is normalised by the yield to get the modified duration.

Convexity

Convexity is calculated by taking the second derivative of the bond's yield, the formula is displayed in equation 3. Convexity measures how the price changes in percent when there is a change in yield, similarly to duration. However, it displays a convex relationship between yield and price which makes it a more accurate measurement for large fluctuations in yield (Asgharian & Nordén, 2011). Therefore it can be used to measure a bond's volatility (Asgharian & Nordén, 2011). High convexity means that the bond is more volatile, however convexity can be seen as a benefit for investors as higher convexity bonds tend to outperform when the yield changes (Asgharian & Nordén, 2011).

Equation 3:

$$Conv = \frac{1}{P}\frac{1}{(1+Y)^2}\left[\sum_{t=1}^{n}\frac{t(1+t)C_t}{(1+Y)^t}\right]$$

Here P is the price of the bond, C is the coupon, t is the time period and Y is the yield. All the cash flows are summarised and discounted. This is then normalised by dividing with the price and the discount factor powered to two.

Convexity was removed from the regression due to collinearity which will be discussed in further detail where the model is specified.

Nominal amount issued

Issuing a large amount of debt at once results in economies of scale, resulting in cheaper costs, such as the fees from investment banks, for the issuer. Therefore it can be argued that the firms can afford to issue a higher yield, resulting in a positive relationship with z-spreads (Ge & Liu, 2015). Another effect of the nominal amount issued is that larger firms typically raise more money in absolute terms than smaller firms. As larger firms are usually more stable, the nominal amount issued is also a measure of lower risk (Ge & Liu, 2015). Combined these two effects lead to an increase in z-spread.

Return on Equity (ROE)

Return on equity (ROE) is defined in equation 4 as the net income divided by the shareholders equity. There are multiple ways to measure financial efficiency, common measures are return on invested capital, return on assets and return on equity. The multiples measure return as the net income, which is then divided by different variables. ROE measures how efficiently the company's equity capital is being used. A more effective use of capital results in a lower risk of the company defaulting and is expected to be negatively related to the z-spread.

Equation 4:

$$Return\ on\ Equity\ = \frac{Net\ Income}{Shareholders\ Equity}$$

Return on equity is calculated by dividing net income by shareholders equity.

Some previous researchers have chosen to add Altman Z-score, which measures financial efficiency by including multiple similar financial metrics to ROE. Using both the variables in the same study would risk creating a collinearity problem. Since both measure the same thing albeit by different methods, ROE was chosen as the data from Eikon was more comprehensive than for the Altman Z-score.

Total Debt/Total Equity

This is a measure of a firm's leverage. High leverage could be a significant contribution to a firm's financial health, as it allows it to increase its returns. However, debt investors have fixed returns and are not affected by the upside of leverage, only the downside which is increased risk. Higher leverage means that there are more interest payments, which increase the risk of default. Conclusively, total liabilities/equity is predicted to have a positive correlation to the z-spread (Ge & Liu, 2015).

Year of issue, Industry and country

Some effects on the dependent variable may not be due to the bond characteristics but instead arise from other factors, known as fixed effects (Klein & Stellner, 2013). The fixed effects are included to provide more accurate results of the variables in the model. Sectors are included as companies in different sectors can differ quite a lot, for instance some sectors feature more risk, affecting the z-spread. Year of issue is included to observe if any macroeconomic effects in different time periods impact the results. Lastly, the country of issue is included to account for different economic conditions in different geographic areas. These variables are all included as dummy variables in the model.

3.4 Descriptive statistics

In this section the data of the observations used in the study are presented. Since the ESG score, as well as the individual pillars, are calculated relative to their peers, the mean and average of all companies in the Refinitiv Eikon database are 50. The fact

that the data collected in this study has a mean ESG score of 75 means that the data is skewed towards higher scoring companies. This is a limitation of the study as the sample does not accurately represent the entire population. This is not an uncommon data characteristic in this research field as Apergis, Poufinas and Antonopoulos (2023) had an ESG score mean of 67.

Table 3: Descriptive statistics of the data used in the study.

Variable	**Mean**	**Median**	**Std. dev.**	**Min.**	**Max.**
Amount issued	629.0	598.0	360.0	15.0	3,017.0
Z-spread	191.6	135.4	186.1	28.6	1,351.4
ESG Score	75.3	77.9	13.1	17.0	94.6
D/E	162%	120%	150%	17%	779%
ROE	14%	12%	16%	-36%	100%
E Score	74.9	77.3	16.4	5.8	99.1
S Score	79.3	83.8	14.1	5.6	97.5
G Score	69.5	75.7	20.4	3.4	97.4
Mod duration	5.2	4.4	3.2	1.0	20.9
BAS	0.53%	0.37%	0.46%	0.04%	4.0%
TTM	5.5	4.3	5.1	0.4	46.9

The dependent variable z-spread has been logarithmized. TTM is the time to maturity measured in years, D/E is the debt to equity ratio, ROE is the annual return on equity and BAS is the bid-ask spread. Amount issued is measured in million euro.

The geographical location of the companies in the sample was heavily skewed towards France, where 389 out of the total 981 observations were collected from. Figure 1 shows that the second largest country of origin was Germany, followed by Italy. The distribution of the year of issue is for the most part evenly distributed, with the exception of 2015 and 2023 which is displayed in figure 2. The sector distribution of the sample was well rounded and included every sector apart from financial institutions. The sectors are displayed in figure 3 and the largest sectors were service- other, utility- other and telecommunications. The large representation in the

first two sectors can be explained by them being an umbrella term that includes many subsectors. Telecommunications is a capital intensive sector, which explains why the companies issue many bonds.

Figure 1: Descriptive statistics of the country of origin of the bond issuer.

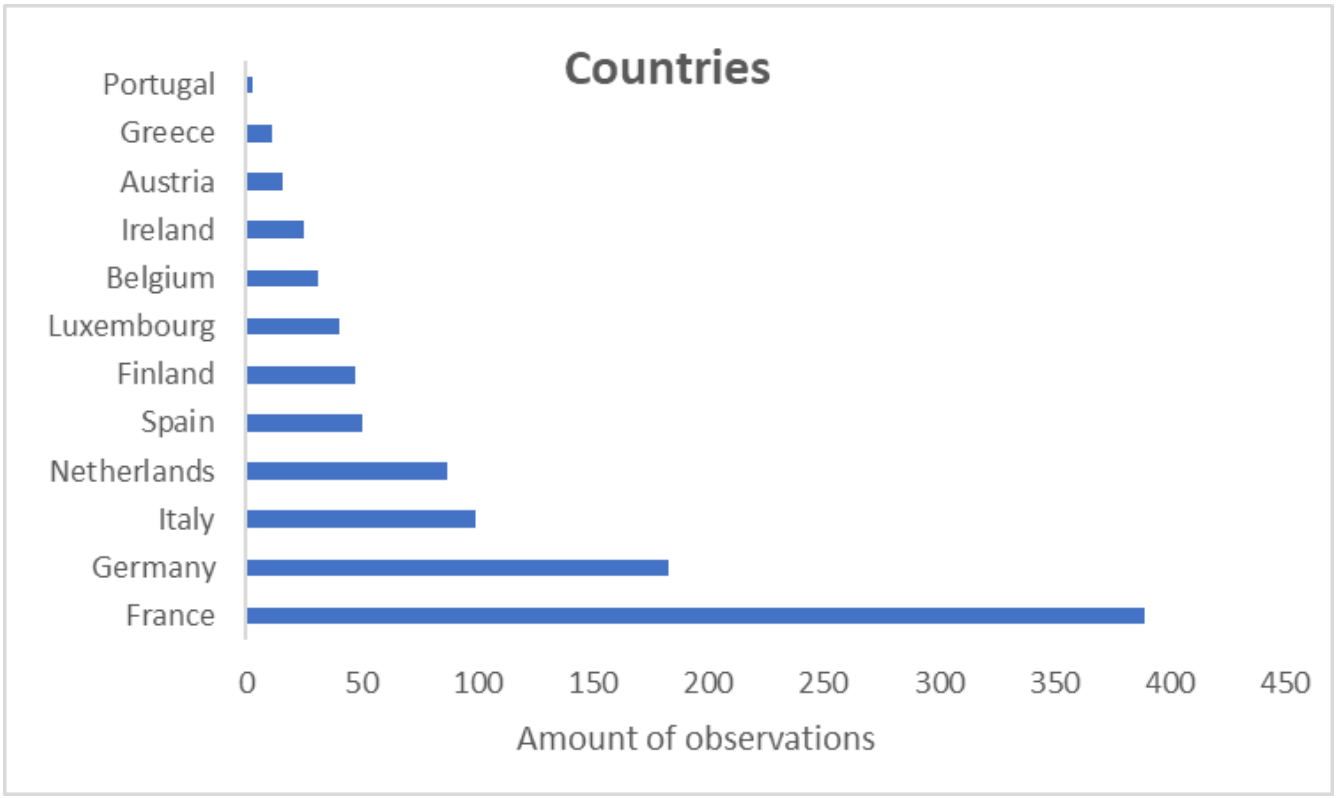


Figure 2: Descriptive statistics of the observations distribution by year of issue.

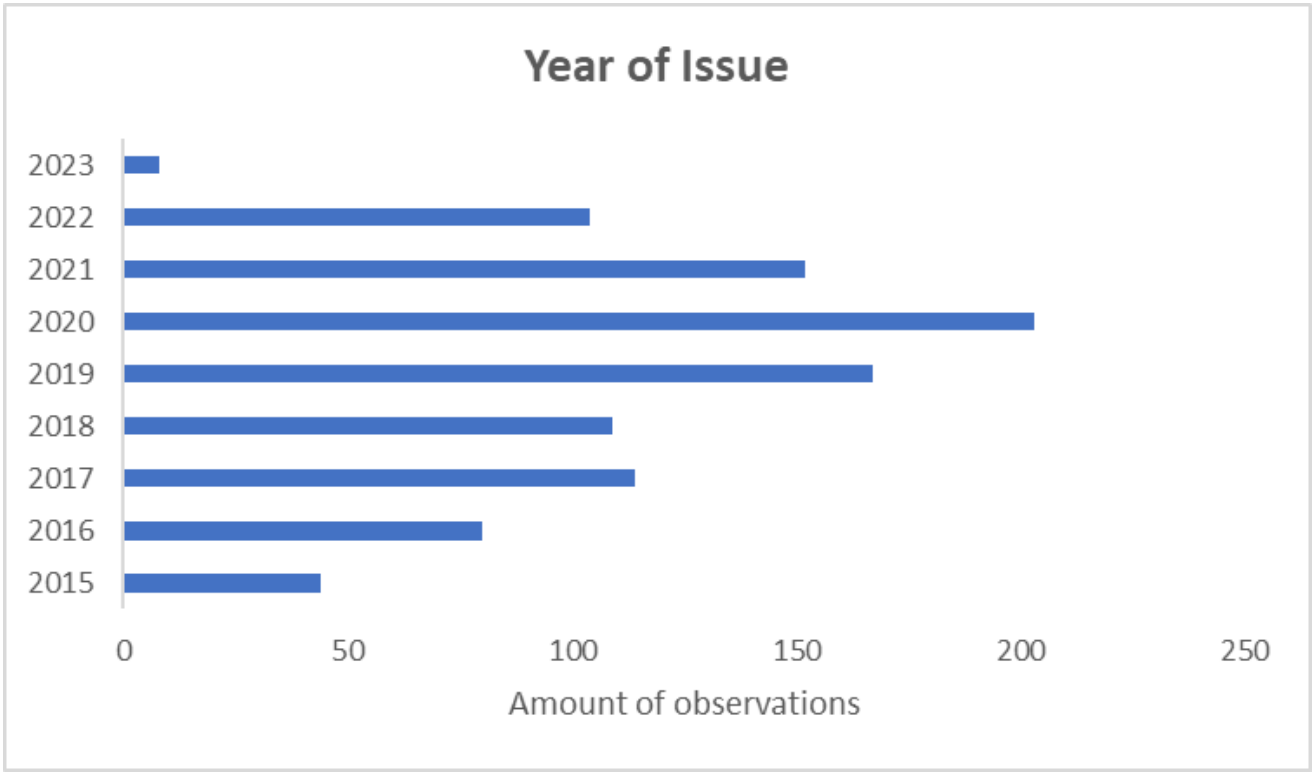
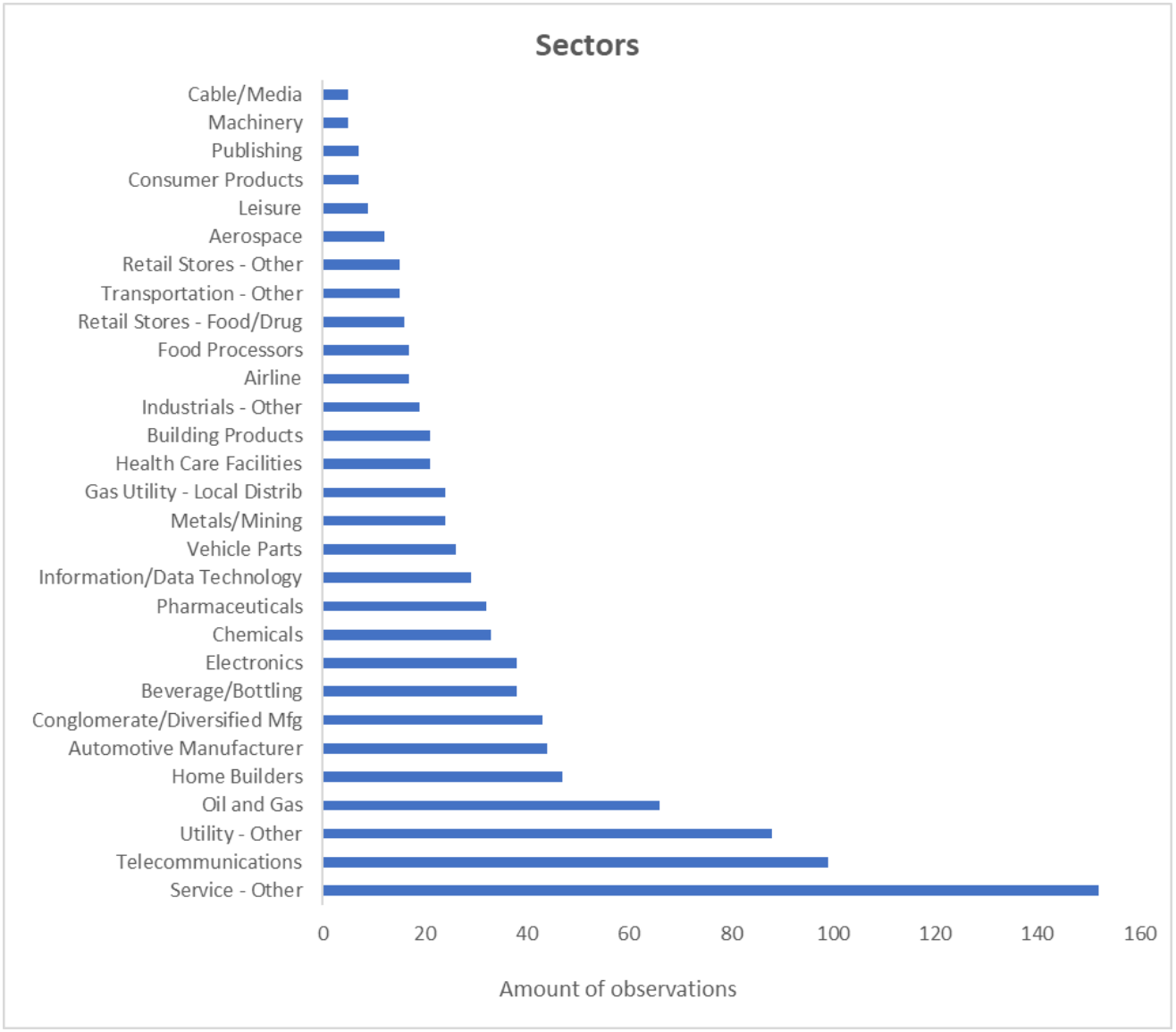


Figure 3: Descriptive statistics of the distribution by sector for the bond issuers.



4. Method

4.1 The regression model

The analysis will be conducted with a cross sectional OLS regression. To avoid collinearity between the ESG score and the individual pillars which the ESG score is calculated from, there are two separate regressions being performed. Regression 1 investigates the ESG score and regression 2 analyses the pillars. X is a vector containing all the control variables and epsilon is the error term. The final models are presented below.

$$(1)\ ln\, Z_{i,j,k,l} = \beta_1 + \beta_2\, ESG_{i,j,k,l} + X_{i,j,k,l} + \varepsilon_{i,j,k,l}$$

$$(2)\ ln\, Z_{i,j,k,l} = \beta_1 + \beta_2 E_{i,j,k,l} + \beta_3\, S_{i,j,k,l} + \beta_4 G_{i,j,k,l} + X_{i,j,k,l} + \varepsilon_{i,j,k,l}$$

The observation is denoted by i, country is denoted by j, sector denoted by k and year of issue is denoted with l.

4.4 Specifications of the model

Multiple tests of the models were performed in order to analyse its statistical efficiency and correctness. Some common issues with OLS models are discussed and appropriate adjustments were made before running the final model.

4.4.1 Linearity

OLS is a model for linear regression models, so it has to be investigated if there really is a linear relationship between the variables. The original model was therefore tested for linearity in the data with the Ramsey reset test. The test showed that the data suffered from nonlinearity, which means that OLS cannot be performed in its current form. This is expressed in table 7 in the appendix where the p-value for the test is below 5%. However, by instead taking the logarithm or squaring variables the problem can be circumvented. As long as the model is linear in parameters it does

not have to be linear in data to run OLS. Research by Apergis, Poufinas and Antonopoulos (2023) argue that taking the logarithm actually provides better results because of the z-spread having an uneven distribution, favoured towards the positive side. An issue with using the logarithm is that it can not be applied to negative observations, as this is not mathematically defined. The data sample used in the model featured no negative z-spread observations so this is not an issue in this case. Therefore the z-spread was replaced with the natural logarithm of the z-spread. It is important to note that applying a log-lin model means that the dependent variable should be interpreted as a percentage change, not a nominal change.

4.4.2 Multicollinearity

The next test was the Variance Inflation Factor (VIF) test. The test investigates if the model suffers from collinearity. The results are displayed in table 8 in the appendix and were that duration, convexity and time to maturity showed the values 8.7, 15.6 and 19.4 respectively. Values over 10 are regarded as having high correlation and may therefore introduce collinearity. The reason that the variables displayed collinearity is because time to maturity is included in the formula for calculating both convexity and duration (see equation 2 and equation 3). To resolve this problem, all different combinations of keeping two out of the three variables were tested. Keeping time to maturity and duration showed the best specification of the model according to new VIF tests. Conclusively, convexity was removed from the model.

4.4.3 Heterogeneity

Homoscedastic error terms means that the variance of the error terms are constant across all observations. A common violation of this would be larger observations having larger error terms. This means that the model will have inconsistent standard errors which affects the analysis. The model was tested for homoscedastic error terms using the Breusch Pagan test. The results are shown in the appendix in table 9 and they indicate that the original model did suffer from heteroscedasticity. This can be adjusted for by using robust standard errors (also commonly referred to as White's standard errors), which are consistent despite heteroscedastic error terms.

5. Results

5.1 OLS results

Two separate regressions with the same vector were run in order to obtain the results. Regression 1 has ESG score as the variable of interest and the second regression has the three individual pillars E, S and G. Table 4 shows the results of the regressions.

Table 4: Results from the regression models. Regression (1) had ESG score as the variable of interest and regression (2) had the pillars as the variables of interest.

Variable	**(1)**		**(2)**	
ESG Score	−0.0139 (0.0022)	***		
E Score			−0.0049 (0.0019)	***
S Score			−0.0044 (0.0017)	***
G Score			−0.0052 (0.0010)	***
D/E	0.0012 (0.0002)	***	0.0012 (0.0002)	***
ROE	−0.0046 (0.0014)	***	−0.0045 (0.0014)	***
Modified Duration	−0.0605 (0.0158)	***	−0.0573 (0.0157)	***
BidAskSpread	0.3819 (0.0544)	***	0.3812 (0.0532)	***
AmountIssued	−0.1725 (0.0501)	***	−0.1752 (0.0512)	***
TTM	0.0552 (0.0096)	***	0.0530 (0.0095)	***
Year	Yes		Yes	
Sector	Yes		Yes	
Country	Yes		Yes	
N	981		981	
R^2	0.58		0.58	

The dependent variable z-spread has been logarithmized. TTM is the time to maturity, D/E is the debt to equity ratio and ROE is the return on equity. The significance levels are denoted by stars:(5% level), **(1% level), *** (0.1% level) and no stars indicate a significance level higher than 5%. The standard deviations are expressed in parenthesis.*

The hypothesis that ESG score would have a negative relationship with z-spread is proven at a statistically significant level of 0.1%, with a beta of -0.0139. Since this is a log-lin model, the interpretation is that if the ESG score increases by 1 unit, the z-spread decreases by 1.4% (not percentage points). The individual pillars also showed a negative correlation with z-spread at a statistically significant level of 0.1%. The most impactful pillar was found to be governance, with an estimated coefficient of -0.0052 followed closely by environmental at -0.0049 and lastly social at -0.0044. The interpretation of the results is that a 1 point increase in governance score results in a decrease of z-spread by 0.52%. The magnitude of the relationship is therefore not particularly large.

Moving on to the control variables, Debt to equity shows a positive correlation with z-spread. This is in accordance with theory as higher leverage implies a higher risk. Similarly, bid-ask spread also leads to higher risk and has a positive coefficient with the value 0.38 and thereby has the largest positive impact on z-spread. Time to maturity was also positive which follows the same reasoning. The control variables with a negative coefficient were ROE, duration and amount issued. The result for duration was surprising, as theoretically it should be positively related to z-spread.

The adjusted R squared shows the explanatory power of the model. This model has an R squared of 58%, which is slightly lower compared to the study by Klein, Stellner and Zwergel (2015) that had 62%, but not abnormally low. The explanatory power of the model is therefore seen as sufficient.

5.2 Robustness Checks

In order to check the robustness of the model above, some control variables are replaced or modified. Changes are also made to the fixed effect variables. If the outcome is the same in this case, it can be assumed that the results are robust.

Firstly, the variable duration was replaced with convexity. As was discussed earlier, this introduces slightly more collinearity into the regression but may still be a better variable to explain z-spread. Secondly, return on equity was replaced with return on

assets (ROA). ROA is similar to ROE but the denominator is replaced with assets instead of equity. Lastly, in accordance with the study by Apergis, Poufinas and Antonopoulos (2023) the variables amount issued and time to maturity were transformed to the natural logarithmic scale. The authors suggest that this improves the data by taking large size differences into account. Another robustness check was performed with the altered model, which did not include any fixed effect variables. In one robustness check the fixed effect year was removed while the remaining fixed effects were included. Additionally, one robustness test featured the original model but without any fixed effects. The new models described above were applied to the regressions for ESG score and the individual pillars.

Table 5: Robustness Checks for ESG score. (1) is the original model for comparison, the remaining regressions are robustness checks.

Variable	**(1)**		**(2)**		**(3)**		**(4)**		**(5)**	
ESG Score	−0.0139 (0.0022)	***	-0.0151 (0.0018)	***	−0.0159 (0.0022)	***	−0.0155 (0.0018)	***	-0.0147 (0.0023)	***
D/E	0.0012 (0.0002)	***	0.0010 (0.0001)	***	0.0010 (0.0002)	***	0.0008 (0.0001)	***	0.0010 (0.0002)	***
ROE	−0.0046 (0.0014)	***	-0.0054 (0.0011)	***						
ROA	-				−0.0010 (0.0004)	**	−0.0006 (0.0003)	*	-0.0010 (0.0004)	**
Mod duration	−0.0605 (0.0158)	***	-0.0423 (0.0129)	***						
Convexity					−0.4844 (0.0345)		−0.0923 (0.0340)	***	-0.5130 (0.0859)	***
BidAskSpread	0.3819 (0.0544)	***	0.4470 (0.0555)	***	0.4101 (0.0600)	***	0.4283 (0.0575)	***	0.4044 (0.0579)	***
AmountIssued	−0.1725 (0.0501)	**	-0.2434 (0.0501)	***					-0.1697 (0.0485)	***
TTM	0.0552 (0.0096)	***	0.0379 (0.0069)	***					0.0841 (0.0108)	***
Ln Issued					-0.1081 (0.0255)	***	−0.1523 (0.0284)	***		
Ln TTM					0.1884 (0.0287)	***	0.1560 (0.0314)	***		
Year	Yes		No		No		No		Yes	
Sector	Yes		No		Yes		No		Yes	
Country	Yes		No		Yes		No		Yes	
N	981		981		981		981		981	
R^2	0.58		0.40		0.55		0.40		0.58	

The dependent variable z-spread has been logarithmized. TTM is the time to maturity, D/E is the debt to equity ratio and ROE stands for return on equity. The significance levels are denoted by stars:(5% level), **(1% level), *** (0.1% level) and no stars indicate a significance level higher than 5%. The standard deviations are expressed in parenthesis.*

Table 6: Robustness Checks for the ESG pillars. (1) is the original model for comparison, the remaining regressions are robustness checks.

Variable	**(1)**		**(2)**		**(3)**		**(4)**		**(5)**	
E Score	−0.0049 (0.0019)	***	-0.0053 (0.0013)	***	−0.0050 (0.0018)	***	−0.0044 (0.0014)	***	-0.0052 (0.0019)	**
S Score	−0.0044 (0.0017)	***	-0.0057 (0.0014)	***	−0.0053 (0.0015)	***	−0.0058 (0.0014)	***	-0.0051 (0.0015)	***
G Score	−0.0052 (0.0010)	***	-0.0044 (0.0009)	***	−0.0062 (0.0010)	***	−0.0054 (0.0008)	***	-0.0054 (0.0010)	***
D/E	0.0012 (0.0002)	***	0.0010 (0.0001)	***	0.0010 (0.0001)	***	0.0007 (0.0001)	***	0.0010 (0.0001)	***
ROE	−0.0045 (0.0014)	***	-0.0052 (0.0011)	***						
ROA					−0.0010 (0.0004)	**	−0.0006 (0.0003)	*	-0.0010 (0.0004)	**
Mod Duration	−0.0573 (0.0157)	***	-0.0401 (0.0130)	***						
Convexity					−0.0538 (0.0337)		−0.0994 (0.0336)	***	-0.5037 (0.0846)	***
Bidaskspread	0.3812 (0.0532)	***	0.4159 (0.0545)	***	0.3891 (0.0576)	***	0.4286 (0.0565)	***	0.3918 (0.0556)	***
Amountissued	−0.1752 (0.0512)	***	-0.2454 (0.0512)	***					-0.1744 (0.0495)	***
TTM	0.0530 (0.0095)	***	-0.0365 (0.0069)	***					0.0826 (0.0107)	***
Ln Issued					−0.1080 (0.0256)	***	−0.1541 (0.0285)	***		
Ln TTM					0.1914 (0.0287)	***	0.1574 (0.0313)	***		
Year	Yes		No		No		No		Yes	
Sector	Yes		No		Yes		No		Yes	
Country	Yes		No		Yes		No		Yes	
N	981		981		981		981		981	
R^2	0.58		0.40		0.55		0.41		0.59	

The dependent variable z-spread has been logarithmized. TTM is the time to maturity, D/E is the debt to equity ratio and ROE stands for return on equity. The significance levels are denoted by stars:(5% level), **(1% level), *** (0.1% level) and no stars indicate a significance level higher than 5%. The standard deviations are expressed in parenthesis.*

These OLS regressions still return significant results for all three individual pillars. In the four robustness checks, G and S is the largest pillar twice each while E is never the largest pillar. Therefore, it can be concluded that the model is sensitive to changes regarding the pillars. The combined ESG score still has a negative impact on z-spread, albeit slightly higher than the original model presented. The ESG score also shows statistical significance in this model. For the regressions for ESG score in the robustness checks, the correlation to z-spread is similar to the original model and does not fluctuate significantly. Additionally, the robustness checks show that including the fixed effects in the regressions dramatically improves the R squared. Conclusively, the assumption can be made that the general results from the analysis are robust. However, the pillar results relative to each other are not conclusive as they change with different models.

5.3 Discussion

The results of the study prove the hypothesis of ESG scores having a negative effect on z-spreads. This is also true if ESG is split into three separate categories E, S and G. The results are similar to Antonopoulos, Apergis and Poufinas (2022), with the difference that this study has G as the most impactful pillar, compared to Antonopoulos, Apergis and Poufinas (2022) that has S instead. However, the results for the pillars in the authors' papers are not robust and neither are the results in this paper. It is therefore not clear which pillar has the largest impact on the spread. The main difference between this paper and the research by Antonopoulos, Apergis and Poufinas (2022) is that this analysis shows E as more impactful, as in the results it had the second largest impact on z-spread.

As previously mentioned, the robustness tests showed a lack of robustness for the order of importance for the individual pillars, although there was a bias towards governance and social being the most impactful pillar. This can be interpreted as the environmental pillar being the least important factor for financial performance, which is in line with the theory presented by Fitzgibbons, Pedersen and Pomorski (2019). Meanwhile, the fact that the results for the pillars fluctuated a lot in the robustness tests could also be interpreted as investors not having a preference for a specific pillar. This would mean that the pillars by themselves are not taken into account in investment decisions, only the total ESG score. This interpretation is strengthened by a lack of consensus for pillar order of importance in previous empirical research.

The results in this study differ from the meta analysis by Friede, Busch and Bassen (2015) covering 2200 research papers. An explanation could be a difference in proxy used for ESG performance. This study uses ESG scores, which was not available for a large part of the papers analysed by Friede, Busch and Bassen (2015). The explanation for this is that said papers were published at a time period before ESG scores were readily available. The difference in the proxy for the variable of interest could therefore explain the different results.

The results regarding the overall ESG score are in line with a study by Lian, Zhang, Zhang, Ye (2023) that also covers the relationship with credit spreads. The authors found a reduction in both risk and in financial performance. The study by Lian, Zhang, Zhang, Ye (2023) examines China and since the authors find similar results as this paper, it can be concluded that this finding is not exclusive to the EMU region. In support of this, Friede, Busch and Bassen (2015) find the relationship to be true in multiple parts of the world in their meta analysis of ESG studies.

Chen et al (2022) performed a study analysing ESG and equity performance, with the finding of a significant negative relationship. Combining the study by Chen et al (2022) with this paper, it can be concluded that both the cost of equity and the cost of debt improve as a result of ESG performance. Therefore, it can be argued that ESG has the effect of lowering the total cost of capital.

Limitations

There is one major limitation of the study and it is using ESG scores as a measurement of a firm's ESG performance. There are some issues with using the third party providers of ESG scores that could impact the results. Firstly, there is an absence of regulatory definition and methodology for ESG scores- and ratings (ESMA, 2021). This could lead to heterogeneity among the scores published by different firms, as each could have their own perspective on what should be incorporated into the score. It could have a serious impact on the results of this study and its comparability to other studies. Secondly, as the firms providing ESG scores typically also provide other services, there is a risk of bias as the firm could benefit from deviating from an objective score (ESMA, 2021). Despite these challenges, ESG scores are the best alternative available today and are therefore used in this paper.

Another limitation of the study is that the bonds in the sample are denoted in different currencies. Currency fluctuations have an effect on bond yield as they affect real returns. If the markets assume that a certain currency will depreciate, investors must be compensated by higher returns in order to consider the investment (Asgharian & Nordén, 2011). Therefore, research that includes bond data issued in different currencies might have yield spreads that are affected by this phenomenon and not the variable of interest. However, the majority of the bonds in the sample in this study were denoted in euros so this effect should be limited.

6. Conclusion

In this study, it is investigated whether ESG performance affects the financial returns for corporate bonds. To analyse these variables, ESG score and z-spreads have been used as proxies in an OLS regression model. This negative relationship has been shown to be true and is statistically significant. This is the case both for the combined ESG score and for the three individual pillars. The study was conducted with a sample size of 981 bonds issued from members of the European Monetary Union between 2015 and 2023.

The implications of the findings are that companies with high ESG scores are preferred compared to non ESG companies. Therefore, debt investments into ESG companies offer a lower yield. From a company management perspective, investing in ESG will lead to a lower cost of debt. The company is thereby financially benefited from becoming more sustainable. Finally, the results are an indicator that the market has priced in a company's ESG performance in investment decisions. The explanation for these findings is that an ESG company is regarded as a better company. Conclusively, investing in corporate bonds issued by companies with a high ESG score will result in lower returns.

For future research, it would be interesting to examine the risk component of ESG investing. Perhaps looking at credit ratings would further explain more components of the attractiveness ESG has for investors. Additionally, more research into the different pillars would be interesting to examine as it is still uncertain which pillars are most impactful on financial performance.

7. Reference list

Adams, J., Hayunga, D., Mansi, S., Reev, D., Verardi, V. (2019). Identifying and treating outliers in finance, *Financial Management,* vol. 48, pp 345-384

Antonopoulos, A., Apergis N., & Poufinas, T. (2022). ESG scores and cost of debt, *Energy Economics,* vol. 112

Asgharian, H. & Nordén, L. (2011). Räntebärande instrument: värdering och riskhantering, Sweden: Studentlitteratur

Bassen, A., Busch, T., & Friede G. (2015). ESG and financial performance: aggregated evidence from more than 2000 empirical studies, *Journal of Sustainable Finance & Investment,* vol. 4, pp 210-233

Bax, K., Czado, C., Paterlini, S. & Sahin, Ö. (2023). ESG, risk and tail dependence, *International Review of Financial Analysis,* vol. 87

Chen, Y., Li, T., Zeng, Q., & Zhu, B. (2022). Effect of ESG performance on the cost of equity capital: Evidence from China, *International Review of Economics & Finance,* vol. 83, pp 348-364

Cornell, B. (2020). ESG preferences, risk and return, *European Financial Management,* vol. 27, pp. 12-19

European Securities and Markets Authority. (2021). ESG ratings: status and key issues ahead, Available online: https://www.esma.europa.eu/sites/default/files/trv_2021_1-ESG_ratings_status_and_key_issues_ahead.pdf [Accessed 19 February 2023]

Fitzgibbons, S., Pedersen, L., & Pomorski, L. (2019). Responsible Investing: the ESG efficient frontier, *Journal of Financial Economics,* vol. 142, pp. 572-597

Freeman, E., & Mcvea, F. (2001). A stakeholder approach to strategic management, *SSRN Electronic Journal.* Available online: https://www.researchgate.net/publication/228320877_A_Stakeholder_Approach_to_Strategic_Management [Accessed 15 May 2023]

Friedman, M. (1970). The social responsibility of business is to increase its profits, *New York Times Magazine,* 13 September 1970, pp. 122-126

Garrett, K & Reifman, A. (2010). Winsorize, *Encyclopedia of Research Design,* pp. 1636-1638

Gigante, G., & Manglaviti, D. (2022). The ESG effect on the cost of debt financing: a sharp RD analysis, *International Review of Financial Analysis,* vol. 84

Klein, C., & Stellner, C. (2013). Does sovereign risk matter? New evidence from eurozone corporate bond ratings and zero-volatility spreads, *Review of Financial Economics,* vol.23, pp. 64-74

Klein, C., Stellner, C., & Zwergel, B. (2015). Corporate social responsibility and Eurozone corporate bonds: The moderating role of country sustainability, *Journal of Banking & Finance,* pp. 538-549

Lian, Y., Zhang, L., Zhang, Y. & Ye, T. (2023). How does corporate ESG performance affect bond credit spreads: empirical evidence from China, *International Review of Economics & Finance,* vol. 85, pp. 352-371

Liu, M., & Ge, W. (2015). Corporate social responsibility and the cost of corporate bonds, *Journal of Accounting and Public Policy,* vol. 34, pp. 597-624

Refinitiv. (2023). ESG Company Scores, Available online: https://www.refinitiv.com/en/sustainable-finance/ESG-scores [Accessed 11 February 2023]

8. Appendix

Table 7: Ramsey Reset Test

Variable	**Coefficient**	
ESG Score	2.3460 (0.6265)	***
D/E	-0.2111 (0.0637)	***
ROE	-0.6286 (0.3587)	*
ModifiedDuration	-10.7987 (5.0118)	**
BidAskSpread	-72.9629 (16.9224)	***
AmountIssued	-17.2657 (13.3460)	
TTM	-3.9521 (2.9521)	
yhat^2	0.0028 (0.0002)	***
Year	Yes	
Sector	Yes	
Country	Yes	
N	979	
P-value	0.0000	

TTM is the time to maturity, D/E is the debt to equity ratio and ROE stands for return on equity. The significance levels are denoted by stars:(5% level), **(1% level), *** (0.1% level) and no stars indicate a significance level higher than 5%. The standard deviations are expressed in parenthesis.*

Table 8: Variance Inflation Factors test

Variables	**Values**
AmountIssued	1.066
ESG Score	1.262
Debt to Equity	1.212
ROE	1.048
ModifiedDuration	8.694
BidAskSpread	1.119
Time to maturity	19.409
Convexity	15.585

Values > 10.0 may indicate a collinearity problem.

Table 9: Breusch-Pagan test for heteroskedasticity

Variable	**Coefficient**	
ESG Score	-0.0171 (0.0081)	**
D/E	0.0012 (0.0008)	
ROE	-0.0048 (0.0011)	***
ModifiedDuration	-0.1982 (0.0778)	***
BidAskSpread	0.8899 (0.1862)	***
AmountIssued	-0.2298 (0.2509)	
TTM	0.0827 (0.0482)	*
Year	Yes	
Sector	Yes	
Country	Yes	
N	979	
P-value	0.0000	

TTM is the time to maturity, D/E is the debt to equity ratio and ROE stands for return on equity. The significance levels are denoted by stars:(5% level), **(1% level), *** (0.1% level) and no stars indicate a significance level higher than 5%. The standard deviations are expressed in parenthesis.*