The impact of ESG Scores on sovereign credit risk

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Abstract

This dissertation analyses the relationship between a country´s environmental, social and governance (ESG) performance and its sovereign bonds and Credit Default Swaps (CDS). I compare two different markets, Europe and the United States of America (US) between 1999 and 2022. The results show that for European countries, superior ESG performance correlates with lower sovereign credit default swap spreads and sovereign bond yields. This implies an increase in creditworthiness for European countries. The opposite is found for the US, where good ESG performance is associated with a higher perceived risk of default, increasing bond yields and CDS spreads. Therefore, for the US market, ESG measures positively affect the country´s credit risk. Moreover, the social dimension is the only one with a significant association with both measures of sovereign credit risk. The environmental and governance dimensions do not show any magnitude. These empirical findings have implications for investors' decision-making, who can benefit from these ESG differences between countries. Additionally, it provides insights for governments and policymakers when analyzing indicators that affect sovereign credit risk.

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Resumo

Esta dissertação analisa a relação entre o desempenho de fatores ambientais, sociais e governamentais (*ESG)* relativo a um país e as suas obrigações soberanas e *credit default swaps (CDS)*. Eu comparo entre dois mercados diferentes, a Europa e os Estados Unidos da América (EUA) entre 1999 e 2022. Os resultados mostram que para os países europeus, um desempenho superior do *ESG* correlaciona-se com reduzidos *spreads* dos *credit default swaps (CDS)* e as *yields* das obrigações soberanas. Isto implica um aumento da solvabilidade para os países europeus. O oposto é encontrado para os EUA, onde o bom desempenho do *ESG* está associado a um maior risco de incumprimento, aumentando as *yields* das obrigações e os *spreads* dos *CDS*. Assim, para o mercado dos EUA, as medidas do *ESG* afetam positivamente o risco de crédito do país. Além disso, o pilar social é o único com uma relação significativa com ambas as variáveis de risco de crédito soberano. O pilar ambiental e de governação não demonstram qualquer magnitude. Estas conclusões empíricas, não só têm implicações na tomada de decisões dos investidores, os quais podem beneficiar destas diferenças de *ESG* entre países, como também podem fornecer perceção aos governos e aos decisores políticos ao analisar indicadores que afetam o risco de crédito soberano.

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Table of contents

List of Tables

List of Figures

I. Introduction

The impact of Environmental, Social and Governance (ESG) factors across financial assets has gained momentum within the financial markets and among investors. Therefore, it has become a topic of interest in the literature related to sustainable finance. According to KPMG (2017), 78% of the leading global companies include Corporate Social Responsibility (CSR) information in their annual financial reports.

The increased awareness of ESG in the markets has drawn the attention of investors to how non-financial factors could improve their portfolio performance and profitability and serve as risk managers (Galema et al., 2008; Lins et al., 2017). Some investors have become value oriented. Consequently, they have been willing to accept a lower return in exchange for helping to fund projects that have a greater positive impact on the sustainability of target communities (Baldi & Pandimiglio, 2022; Ghosh et al., 2013). Therefore, qualitative factors have become potential indicators to capture a country´s willingness to pursue its debt obligations. Namely, the transparency of information, capacity growth, fiscal credibility and commitment to responsible borrowing (Capelle-Blancard et al., 2019). Those factors have shown to have an impact on their credit risk (Capelle-Blancard et al., 2019; Hübel, 2022).

The aim of this dissertation is to assess the relationship between a country ESG performance and sovereign credit risk. I use two proxies of credit risk, the sovereign bond yields and sovereign credit default swaps (CDS) spreads. Additionally, I assess the relationship between ESG pillars and credit risk. To analyze the relationship between ESG scores and credit performance, I focus on ESG scores from the United States of America (US) and ten Eurozone countries, using financial and non-financial data. The time period ranges from 1999 to 2022.

I analyze whether a good ESG performance is reflected in reduced yields and spreads, indicating a decreased perceived risk of default by the market. There are various ways in which ESG performance could be linked to a country's creditworthiness. Firstly, countries more vulnerable to climate change or subjected to natural disasters, for instance, floods or hurricanes, might face higher credit risk. In the presence of higher climate risk, countries unable to adapt to such impacts may affect their own industries. This is reflected in their reduced competitive advantage. Thus, they can be perceived by the market as riskier and less likely to meet their debt obligations. Secondly, social performance is a factor to be considered when analyzing a

country´s credit risk. High levels of social unrest or inequality may result in higher borrowing costs and in a higher risk premium, because investors believe in a higher risk of default due to the state fragility. Finally, poor governance practices and low effective politic measures could lead to a weak management and oversight of a country´s economy. For example, fiscal mismanagement could result in higher levels of debt, which increases a country´s credit risk. This is associated with disrupting economic activity, translating into perceived lower creditworthiness by the market. Therefore, the presence of natural, social and government resources within a country can function as a buffer against adverse economic shocks. It optimizes their risk exposure to such shocks. Also, investors may perceive a country´s resources as an added layer of protection against potential financial losses when considering lending decisions or protecting against their possible default.

Countries want to be identified as a long-term oriented nation, committed to paying back their debt. Most of the environmental, social and governance decisions are long-term decisions to promote a stable future. Being perceived as focused on the future, their cost of debt could be lower since this signals their credibility to meet their debt obligations. Subsequently, there is an incentive for countries to invest in ESG performance. Not only their current credibility is on the line, but also their future access to debt. Furthermore, to achieve a good ESG performance, countries might need a collaboration of outside parties, translating into reducing asymmetries of information (Margaretic & Pouget, 2018). An increase in transparency makes it easier for investors to assess a country´s creditworthiness. Consequently, defaulting will result in loss of future borrowing opportunities, reputation, and ESG resources value. Altogether, governments that exhibit weak ESG performance pose greater risks, sustainably and financially related. Accordingly, investors should require a higher yield to compensate for higher risks, which would also be reflected in a higher CDS spread.

The findings of this dissertation demonstrate the complex nature of the economic relationship between sovereign risk and country´s ESG performance. For the Eurozone countries, I find that ESG performance is significant and negatively related to sovereign bond yield and to credit spreads. However, only the social pillar presents a negative substantial effect on bond yields, since it does not have a significant impact on CDS spread. In contrast, for the US market, the expected negative relationship is not found. In fact, ESG scores are positively correlated with the two measures of credit risk. The same applies to the only significant pillar, social, for both testing environments. Therefore, ESG factors are considered in both sovereign CDS and bond markets. The findings for the Eurozone countries are in line with most of the

literature related to the subject. Good ESG practices are related with lower default risk (Anand et al., 2023; Capelle-Blancard et al., 2019; Crifo et al., 2017; Hübel, 2022; Margaretic & Pouget, 2018). Although my findings related to the US market are not in accordance with the broader literature, there is none that only focuses on the US market.

In a sensitivity analysis, I compare the performance of ESG and the pillars during crisis and non-crisis period to test if the relationship becomes stronger in the wake of crisis periods. I find that there is a stronger influence of ESG performance in non-crisis periods in Europe. I perform a second test with the introduction of two variables that measure quantitative easing and monetary policy decisions from the European Central Bank (ECB) and Federal Reserve (FED). The results are robust only for the US, when controlling for quantitative easing and for conventional monetary policy.

The differences encountered between the two markets make it relevant to account for the impact of ESG performance when evaluating country creditworthiness and the impact of sustainable investing. Also, it is relevant when considering asset allocation across countries. This dissertation contributes to existing research on the relationship between ESG scores and financial variables, by focusing both on CDS spreads and bond yields. Additionally, it helps with the investigations into the determinants that influence these measures.

The remainder of the dissertation is structured as follows. Section II presents the literature review related to the research topic. Section III briefly describes the data and provides descriptive statistics. Section IV explains the methodology. Section V presents the empirical results followed by a discussion and Section VI, robustness analysis. Lastly, Section VII draws the conclusion and indicates possible extensions and limitations of the research topic.

II. Literature review

A growing literature has been analyzing the insight of ESG indicators for countries' credit risk. However, there is not a lot of research that compares specifically the two markets that this dissertation focuses on, or even the US market as a solo.

Countries presenting a superior performance in the environmental, social and governance components show long-term commitment, which is positively related to not defaulting (Eaton & Gersovitz, 1981). Moreover, each component has its own impact on the country´s credit risk. Gervich (2011) shows that a country's financial collapse could be foretold by environmental

indicators before conventional measures do. Country creditworthiness and ratings are significantly impacted by political risk, fiscal stability and governance factors (Baldacci et al., 2011; Ul Hanque et al., 1998). Social performance may act as an insurance against unfavorable legal or regulatory developments. (Godfrey et al., 2009; Koh et al., 2013).

Considering the impact of ESG on sovereign bonds, Crifo et al. (2017) find evidence that ESG country ratings decrease substantially the government bond spreads. Margaretic and Pouget (2018) argue that ESG performance negatively influences sovereign bond spreads, through the governance and social pillars. They show that the long-term impact of the social pillar indicates the long-term commitment of the country to pay back its debt. This study finds similar results concerning the environmental factor as I, of no evidence of a relationship. This conclusion is also shared by Capelle-Blancard et al. (2019), who focus on OECD countries. They point out that good ESG practices are related to reduced bond yield spreads and therefore imply lower default risk. Therefore, countries with low social and governance practices are considered riskier. Investors would demand a higher yield to bear the risk, when performing asset allocation throughout countries. Nevertheless, environmental indicators could also explain sovereign yields on a small scale. According to Painter (2020), counties more susceptible to climate events experience higher underwriting fees and initial yields when issuing long-term municipal bonds. Moreover, Painter´s data leads him to conclude that the difference in issuance costs between climate-affected counties and non-affected rose after the 2006 Stern Review[1]. Drut (2010) goes beyond this mere association and investigates the impact on the efficient frontier of portfolios containing ESG factors. He finds that those portfolios integrating socially responsible factors do not compromise diversification and therefore financial performance. On the other hand, Stellner et al. (2015) do not account for the relationship between country ESG performance and bonds yields. Although, they demonstrate that companies can derive advantages from higher ratings and lower spreads by performing in line with the respective country ESG performance. In brief, it suggests that ESG performance mirrors a country´s prospects about its creditworthiness and could act as a buffer against shocks.

Determinants of sovereign bond yields have been broadly investigated, nonetheless the literature is inconclusive about the leading driver. Barbosa and Costa (2010) highlight that Euro area government bond yields are related to the public debt and risk indicators, as well as measures of financial sustainability. Macroeconomic variables like the fiscal space – debt/

[1] The Stern Review on the Economic Effects of Climate Change.

GDP, deficits/ tax – and other economic fundamentals such as GDP growth, aside from aggregate and contagion risks (trade openness or currency crises) have shown to be factors of sovereign debt sensitivity (Eaton & Fernández, 1995; Van Rijckeghem & Weder, 2004).

In the same way, credit default swaps have also been studied in relation to ESG factors, as CDS have been shown to be a highly effective proxy for credit risk (Fabozzi et al., 2003). Jeanneret (2018) notes that within a worldwide sample of seventy-four countries, the ones with better effective government policies decrease default risk. Consequently, these countries exhibit smaller sovereign CDS spreads. They highlight that debt repayments count on the ability of the government´s sustainable stream of revenue through taxes. Taxes, as other revenue sources, rely on political stability and prospects for the economy. This aligns with the observation of the fiscal fatigue model presented by Ghosh et al. (2013). Anand et al. (2023) complement the previous research by concluding that investors are willing to bear lower risk premiums for high ESG-performing countries. Those nations indicate to have a buffer against social, governance and climate shocks. Hübel (2022) concludes that high ESG countries present lower CDS spreads and, emphasized above-average ESG scores result in a flatter CDS credit curve. Therefore, as is highlighted for sovereign bonds, the risk mitigation of ESG improvements is priced by the CDS market. Barth et al. (2022) find that credit markets reflect differently the impact of ESG corporate practices on the pricing of CDS in European countries and the United States of America. Despite the non-significance results for the US, ESG has a risk mitigation effect. Barth et al. lend support to Stellner et al. (2015), who discover that lower corporate zero volatility spreads (Z-spreads) are associated with corporate social responsibility practices engagement. However, only for companies located in high ESG countries within the Eurozone. Thus, it should be accounted the differences between the US and Eurozone markets.

The literature has pointed out that the main determinants of sovereign credit risk are the strength of political institutions, local and global economic conditions, and the financial health of the governments (Afonso, 2003; Uribe & Yue, 2003). According to Longstaff et al. (2011), regional economic variables, global market liquidity variables and global risk premium measures have a significant impact on the sovereign CDS markets.

Nevertheless, the following literature suggests that, after the Global Financial Crisis (GFC), sovereign credit risk and macroeconomic foundations do not appear to correlate as strongly as before. De Grauwe and Ji (2012) claim that shifting debt-to-GDP ratios does not explain a decrease in spreads. Poghosyan (2014) observes that US bond yields have been trending lower

even though the growing level of public debt in the aftermath of the GFC. Therefore, these results have sparked a resurgence of interest in other factors that influence sovereign credit risk, in which the ESG indicators are one of them.

This dissertation contributes to the existing literature, by comparing the impact of ESG performance on two markets, the Eurozone and the United States of America. This is through sovereign bond yields and sovereign credit default swaps spreads. Sovereign yields provide a more direct insight into the perception of a country's creditworthiness. Besides the economic health and monetary policy stance through the cost of borrowing. In terms of scope, it covers a wider range of years until 2022. In terms of approaches, tests are performed to distinguish how sensitive the markets are to the presence of a financial crisis and to the decisions of monetary policy.

III. Data

3.1 Credit Default Swap Spread and Bond Yield

The sample comprises yearly data for ten-euro area countries: Austria, Belgium, Finland, France, Germany, Ireland, Italy, The Netherlands, Portugal and Spain, and the United States of America. I retrieve from Refinitiv DataStream database the 5-year CDS mid spread denominated in United States Dollars (USD) since CDS with a maturity of 5 years is the most traded maturity segment (Andersson et al., 2009; Jeanneret, 2018). The CDS is applied to senior foreign unsecured debt, with a full restructuring credit event clause. The restructuring indicates that the protection buyer can deliver bonds with any maturity obligation following the debt restructuring (Fontana & Scheicher, 2016). The availability of data for the eleven countries starts in 2008 until 2022, restricting, thus, the analysis of ESG impact.

Data on 10-year government bond yields are from the same database, ranging from 1999 to 2022.

3.2 ESG

The availability of ESG scores for countries is limited and not accessible, and if available, it is very time-constraint, as it is the only publicly available data for companies. To address this issue, I construct yearly ESG scores using eighteen country indicators. Firstly, as mentioned by the literature, there is no consensus on which indicators, how many should be used and how to measure when analyzing ESG. However, I followed the existing literature on the topic (Capelle-

Blancard et al., 2019; Margaretic & Pouget, 2018; Pineau et al., 2022) which describes indicators that would better characterize each country´s performance in terms of Environmental, Social and Governance measures. Secondly, all ESG factors are only available on a yearly basis. Therefore, for the environmental pillar, I focused on three categories: Resource use, Emissions and Renewable sources; for the social pillar, Gender equality, Demography, Employment, and Innovation; and governance is based on Regulation and Management. Each indicator/ data point I use for each category is described in Table 10 of the Appendix. Due to data availability reasons, for some data points of 2021 and 2022, I use the average growth rate of the past years.

For the methodology to calculate the ESG country score, I follow the 2022 Refinitiv methodology[2]. It describes scores ranging from zero to one for corporations and I apply it to countries. In fact, ESG methodologies vary among rating agencies and financial services companies. The reason to choose this one is due to the full description provided and the reliability of the data as it is carefully treated. The quantitative methodology starts by giving relative scores to each country's data point (percentile scores) relative to its peers for all years. In this case, all countries in this dissertation belong to the developed market, so I compare them. Thus, the score follows the following method, considering the polarity of indicators, whether a higher value is beneficial or prejudicial:

$$score = \frac{\#countries\ with\ a\ worse\ value + \frac{\#countries\ with\ the\ same\ value\ included\ in\ the\ current\ one}{2}}{\#countries\ with\ a\ value}$$

Thereafter, the percentile scores are summed into the respective category and the process is applied again to achieve the percentile score for the category.

Refinitiv methodology starts calculating a magnitude weight, followed by a category weight. Refinitiv argues that Governance factors are equally important for all industries. Thus, in this case, all countries belong to the same benchmark and all data points are assumed to be equally considered. Therefore, I follow the magnitude weight calculation of corporate governance. The magnitude weight is computed by dividing the number of data points of each category by the whole number of data points in the pillar. After, it is multiplied by a default weight of five points for each category. As an example, the management category has four data

[2] https://www.refinitiv.com/en/sustainable-finance/esg-scores#methodology

points and the governance pillar has six. Since the governance pillar has two categories, the default weight is ten points. Therefore, it is $\frac{4}{6} \times 10 = 6.67$ points.

The category weight is achieved by dividing the magnitude weight of each category by the sum of all magnitude weights. Since this measure considers all magnitude weights for all dimensions, a new category weight is constructed for each pillar. I divide the previously achieved category weight by the sum of all weights for each pillar. Finally, a weighted average is used to compute the final score. For ESG, the sum of the category percentile score multiplied by the category weight. For each pillar, the sum of the category percentile score by the new category weight.

3.3 Control Variables

Based on previous literature, I use the annual **growth rate of the gross domestic product (GDP)**, which reflects a country´s wealth. According to Cantor and Packer (1996), high country growth rates improve a country´s capacity to pay back its debt. Thus, I expect to observe a negative link between GDP growth and sovereign credit risk proxies.

Trade openness is the sum of exports and imports, as a percentage of GDP. This variable contributes to explaining the cost of borrowing of an economy. In an open economy, the penalization of sovereign default in terms of capital reversion is higher compared to a closed economy (Ferrucci, 2003). The higher the ratio, the higher probability to generate trade surpluses by a country to refinance its debt or finance new debt. I expect a negative association between the measures.

In order to assess the fiscal condition of a country, I incorporate the **gross government debt in terms of GDP**. Countries characterized by higher debt loads and/ or fiscal deficits are likely to be perceived as less creditworthy, which would increase the risk of default (Gruber & Kamin, 2012). It is expected the impact of this variable to be positive. Nevertheless, from the perspective of Kumar and Baldacci (2010), if agents are forward-looking, there may be some Ricardian equivalence, meaning private savings grow as fiscals' deficits increase. This will require more country borrowing in anticipation of future tax increases to satisfy the temporal budget constraint. Consequently, this may reduce the impact on credit risk. Therefore, there is a dual effect with this variable.

Another measure is the **current account as a percentage of GDP**, foreseen to have a negative impact, as it is a measure of competitiveness and ability to fund the country's debt. Thus, when the ratio improves, the lower would be spreads and yields.

Nickel et al. (2011) claims that the effect of **inflation** on sovereign risk could be either positive or negative. First, higher inflation rates are associated with greater macroeconomic instability and potentially harm a country´s creditworthiness. On the contrary, elevated inflation rates broaden the nation's tax base, lowering the real value of domestic debt outstanding. Also, it eases the nation's financial constraints, which should lead to lower bond spreads on borrowing in foreign currencies. Therefore, it is an ambiguous effect.

Lastly, I include a global financial factor as a proxy for a degree of **expected market uncertainty**. For the US market, I use the **VIX** - implied volatility based on S&P500 index options – and **VSTOXX,** for the Euro area, which measures the implied volatility of the Euro Stoxx 50 index options. Therefore, a rise in the index suggests more expected uncertainty being priced in the market and increased perceived risk. This translates into a rise in the spreads and bond yields. Each variable, described in Table 11 of the Appendix, is collected from the period of 1999 to 2022.

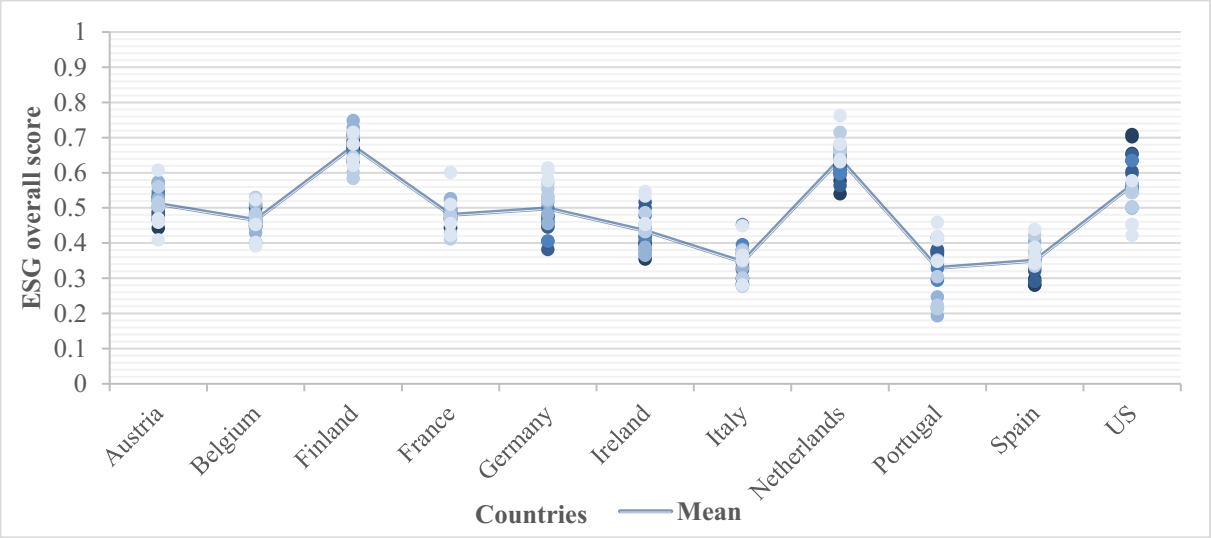
3.4 Descriptive Statistics

Table 1 presents the descriptive statistics for all variables. The standard deviation is higher for the governance pillar (0.29) for the European market, compared to social (0.16) and environmental (0.15). These high-income countries are more homogeneous in terms of green practices and social behavior. However, there are still differences between the three ESG dimensions. For the US market, social (0.14) has a higher standard deviation compared to governance (0.07) and environmental (0.06). The US has a more spread social measure, which could be associated with which party, Democrats or Republicans, has the majority in the Congress or the executive branch of the US. Each party is more sensitive at their own level to some law's implementation. Values closer to one indicate stronger performance in sustainability practices. Figure 1 illustrates the heterogeneity regarding the ESG global score across countries.

To evaluate the relation between ESG dimensions, from Table 12 of the Appendix, there is a positive association between environmental and governance factors (23.5%), but a negative for social (-26.1%). This indicates that when policies focus on environmental problems, there

is less prioritization on social factors. For the US market, better green practices are associated with better governance (11.6%). Also, it is associated, even though lower, with favorable social conditions, (8.4%) as shown in Table 13 of the Appendix. There is a high correlation between social and governance, in which governance measures have a significant impact on social indicators for Europe (34.5%) and US market (58.9%).

Figure 1. Distribution of the ESG score across countries



When governments invest in ESG, they also become more efficient in managing resources, considering the long-term commitment of ESG indicators. This can reduce the likelihood of financial instability that leads to higher government debt. The positive relationship between current account and ESG pillars suggests that sustainability and economic growth can be mutually reinforcing. Beneficial environmental impacts are captured through environmental regulations, such as the European Union´s Emissions Trading System. Nevertheless, it can also increase the cost of production for industries. Consequently, it could reduce the competitiveness of exports (Trade openness), which could be reflected in the GDP growth. Secondly, a higher social score signals a stable and productive workforce, contributing also to positive trade balance and enhanced productivity (GDP growth). A higher score in governance indicates through its factors a transparent and stable regulatory environment that could attract foreign direct investment. Effective government policies, such as trade agreements between countries, explain the positive correlation with trade openness and the increased economic performance. The 51% negative correlation between the social pillar in the US and the current account could be explained by income inequality. The wealthy population in the US tends to not spend as much on domestically produced goods and services. This leads to the trade deficit of the

country, impacting the current account balance. ESG dimensions correlate negatively with US inflation, imposing an obstacle to the progress of environmental goals. Additionally, inflation increases the cost of living, intensifying social inequalities, such as in education and healthcare. Also, it signals the weak performance of monetary policy decisions. The opposite is seen for the uncertainty measure, except for the environmental pillar. The US market perceives an increase in the performance of social and governance pillars as an increase of expenses. This can increase the short-term market volatility, therefore the value of VIX. The positive relationship between the environmental and social pillars and GDP growth comes from the US being less regulated compared to Europe. Additionally, the fact that there is a heavier conflict between political parties in the US Government can affect economic growth.

Given the correlation matrix for the European market, there are no significant values above 80%, which could indicate a high degree of multicollinearity, according to some literature. Exceptionally, for the relationship between gross government US debt and ESG global score and the social dimension. Accordingly, I use the Variance Inflation Factors (VIF) and the degree of tolerance to analyze multicollinearity. Daoud (2017) and Mansfield and Helms (1982) document that to detect multicollinearity, each independent variable needs a VIF higher than five and a Tolerance less than 0.10. All VIF values in Table 14 of the Appendix show to be below 5 and with a degree of Tolerance higher than 0.10. Therefore, it indicates a low-to-moderate level of multicollinearity among the variables. Hence, based on the output, multicollinearity is not a very significant concern in the regression model but still exists.

ESG has an average value of 0.47 and a relatively low standard deviation of 0.12 for the European countries, making it a bit higher for the US, 0.57, and even lower variation, 0.08. Figure 2 shows the distribution of the ESG score from 1999 to 2022. ESG has been stable over the years throughout the eleven countries with a slight increase. Nonetheless, between 2011 and 2016 there is a higher variation in ESG performance. It can be associated with the following years of recovery after the Global Financial Crisis and the European Sovereign Debt Crisis. For Europe, it was the period of Troika reforms in Ireland and Portugal due to the bailouts and the austerity policies in Spain and Italy to contain market pressure. Moreover, 50% of the data ranges between 0.3 and 0.7 scores. For most of the years, the ESG scores are above the median, indicating countries performance commitment in this regard.

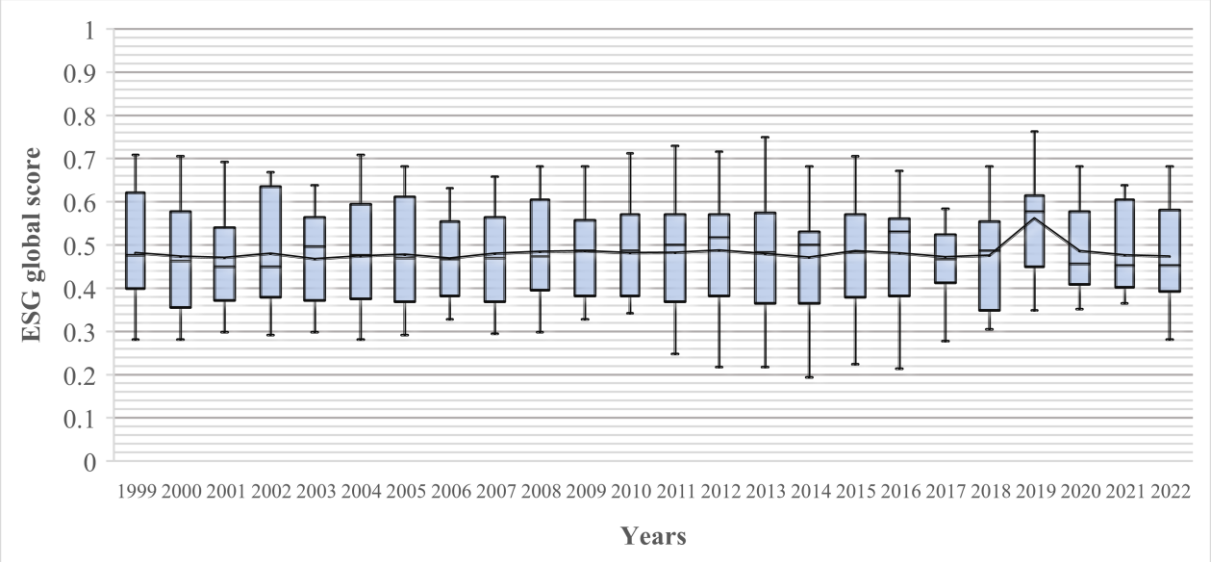
The environmental score is the one with more pronounced ups and downs, as demonstrated in Figure 3 of the Appendix. There is an increase in the mean value of the environmental score

from 2018 onwards, reaching a peak in 2020. This can be explained by the lockdown that forced people to stay at home and reduced industry production, decreasing carbon emissions and imposing a more sustainable use of resources. In 2015 and 2016, there are some variations that could be explained by the Paris Agreement.

The social score remained practically stable during the 24 years, remaining almost the same in the last 4 years. The interquartile range for 1999 is high as for 2015, which can be explained by the introduction of the euro back in 1999 and follow up of austerity measures implemented upon the crisis.

The governance score has not changed significantly since 1999, due to the fact the sample focuses on developed countries.

Figure 2. Distribution of the ESG score throughout the years



The mean of the bond yield (3.26%) is higher for the US, as the US has higher risk-free rates, but interestingly is the opposite for the CDS (2.83 basis points) compared to the Eurozone 2.99% and 3.69 basis points, respectively. It is expected to see more variation over time for the Eurozone, as the ten countries have been through different economic situations. Overall, the credit risk for Europe has varied considerably in relation to the US. The yields have been traded negatively for Europe. With the recent pandemic, some European bonds started to yield below 0% with the European Central Bank flagging their bond-buying program expansion and the presence of negative interest rates.

Regarding the European macro variables, Trade Openness has an average value of 4.48% and a low standard deviation of 0.43, as Debt, with 0.38. This suggests that there are no large variations in debt and trade levels. Inflation has a mean of 2.02% and a high standard deviation of 1.80, translating into some significant variation over time. GDP has an average value of 1.83% and a high standard deviation of 3.45, suggesting that GDP growth rates have been volatile. Finally, the current account has an average value of 0.89%, which indicates a relatively stable market, but a high standard deviation (4.76). Uncertainty measure has a mean of 3.07, which could indicate a not-very-high degree of doubt about the future. For the US, Trade Openness has a mean value of 3.27% with a low standard deviation of 0.099, indicating that it has remained stable over time. The same applies for debt levels. The opposite can be seen with inflation with an average value of 2.48% and variation of 1.64, resulting in consumer price index changes substantially relevant. GDP has a mean value of 2.14% and a high standard deviation of 1.93, meaning that the growth of the US might not be straightforward. Interestingly, the current account has a negative mean value of -3.24%. It means that the US is spending more outside than receiving from the rest of the world, according to its trade deficit. Finally, uncertainty has a high mean of 2.97, almost like in Europe.

Table 1 - Descriptive statistics

	N	Mean	St. Dev	Min	Max	p5	p95
Panel A: EUR							
Bond yield	240	2.989	2.038	-0.570	11.190	-0.123	5.476
ESG	240	0.473	0.122	0.194	0.763	0.285	0.682
Env	240	0.453	0.148	0.046	0.742	0.167	0.682
Soc	240	0.467	0.157	0.106	0.818	0.242	0.727
Gov	240	0.501	0.290	0.055	0.955	0.045	0.955
(X+M)/GDP	240	4.482	0.432	3.798	5.530	3.929	5.243
Debt/GDP	240	4.301	0.384	3.161	5.024	3.652	4.883
ΔP/P	240	2.024	1.800	-1.700	12.000	-0.195	5.080
ΔGDP/GDP	240	1.829	3.450	-11.330	24.370	-4.049	6.199
CA/GDP	240	0.894	4.763	-19.800	14.200	-8.900	8.485
VSTOXX	240	3.070	0.344	2.434	3.814	2.635	3.740
CDS	150	3.695	1.170	1.730	7.010	2.055	5.840
Panel B: US							
Bond yield	24	3.258	1.375	0.927	6.371	1.516	5.133
ESG	24	0.565	0.075	0.423	0.709	0.453	0.702
Env	24	0.654	0.064	0.561	0.773	0.561	0.773
Soc	24	0.587	0.135	0.409	0.848	0.409	0.833
Gov	24	0.375	0.072	0.197	0.500	0.258	0.470
(X+M)/GDP	24	3.272	0.099	3.104	3.429	3.108	3.424
Debt/GDP	24	4.439	0.303	3.972	4.894	3.973	4.839

ΔP/P	24	2.483	1.639	-0.300	8.100	-0.200	7.250
ΔGDP/GDP	24	2.136	1.927	-2.768	5.945	-2.600	4.794
CA/GDP	24	-3.421	1.262	-5.900	-1.900	-5.850	-1.925
VIX	24	2.968	0.308	2.406	3.487	2.550	3.449
CDS	15	2.826	0.636	1.834	4.094	1.836	4.090

Panel A reports statistics for Eurozone variables. Panel B reports statistics for US variables. CDS spreads, trade openness, government debt, VIX and VSTOXX are in natural logarithm.

IV. Methodology

To assess the effect of the ESG performance on sovereign credit risk, I use a panel model with country-fixed effects[3] for Eurozone countries. This is to control unobserved country characteristics that might influence CDS spreads and bond yields. For the US, a time-series regression is used. The following equations are estimated:

$$Yield_{i,t}/Ln\left(CDS_{i,t}\right) = \alpha + \beta ESG_{i,t-1} + \beta_2 X_{i,t} + \varepsilon_{i,t} \quad (1)$$

$$Yield_{i,t}/Ln\left(CDS_{i,t}\right) = \alpha + \beta Env_{i,t-1} + \beta_2 Soc_{i,t-1} + \beta_3 Gov_{i,t-1} + \beta_4 X_{i,t} + \varepsilon_{i,t} \quad (2)$$

where $i = 1\ to\ n$ (number of countries) and $t = 1\ to\ T$ (number of periods), and X represents the explanatory macroeconomic variables.

Based on the related literature (Caiazza et al., 2023; Hübel, 2022; Jeanneret, 2018), CDS Mid spread is quoted in basis points, which can reach high values. Therefore, I use the natural logarithm to align all variables on the same scale, as for trade openness, government debt, and the two financial measures. Furthermore, using the natural logarithm in CDS spreads mitigates the business cycles and makes it possible to have a linear relationship between variables (Cantor & Packer, 1996).

Secondly, I assess the role of the individual ESG dimension in reducing credit risk through the second regression. I analyze whether there is a heterogenous impact on sovereign credit risk measures. The governance indicators are more closely related to the effectiveness and efficiency of economic practices, while social and environmental variables may be more related to long-term commitment. Therefore, I expect a negative correlation between ESG factors and CDS spreads and bond yields. Nonetheless, from the correlation matrix in Table 13 from the Appendix, there is a preview that the US market does not behave accordingly.

[3] I perform a Hausman test, which results indicate that it is necessary to estimate the fixed effects model instead random effects model (p-value below 1%).

One of the limitations of my analysis is the endogeneity issue, through the bidirectional causality in the sustainability-risk relation which has been identified by many other researchers. Lower debt loads could help countries to invest in more ESG practices. Therefore, countries with lower credit risk perform better in terms of ESG scores. To mitigate this issue, I follow the literature and use lagged ESG variables by one year (Agnese & Giacomini, 2023; Capelle-Blancard et al.,2019; Gao et al., 2021; Hübel, 2022; Margaretic & Pouget, 2018; Stellner et al., 2015). Firstly, as I use yearly data, the number of lags is usually small not to lose too many degrees of freedom (Wooldridge, 2013). Secondly, using ESG values from a previous time period as a predictor of sovereign credit risk proxies establishes a clear temporal ordering and direction of causality. The changes in ESG are not influenced by changes in the dependent variable by making sure that ESG is measured before the dependent variable. This helps to mitigate endogeneity concerns. Also, ESG is updated by the end of each year. Therefore, lagging allows financial market participants to incorporate ESG data in terms of price formation at time *t*.

Furthermore, I use a dummy variable for crisis periods to test if the relationship between ESG scores and credit risk is stronger in those periods. It helps to account for unobserved heterogeneity and time-varying factors that may influence both variables, reducing the possibility of simultaneity bias. The dummy variable distinguishes between changes in ESG and sovereign credit risk that can be driven by exogenous factors such as global economic shocks. I also include two measures for quantitative easing and conventional monetary policy to check the robustness of my results. It can help to mitigate the endogeneity problem as changes in monetary policy are less likely to be influenced by changes in ESG or sovereign credit risk. Therefore, it provides a more exogenous source of variation in the model.

V. Empirical results

First, I estimate Eq. (1) for the full European and American sample on bond yields and report the results in Table 2.

On the left side of the table, the results show that ESG and social pillar are negative and statistically significant, at 1% for the overall ESG score and at 5% for the pillar. This suggests that ESG scores have a negative influence on sovereign bond yields. An improvement in ESG performance reduce the credit risk of Eurozone countries. To be specific, an improvement of one unit in ESG reduces bond yields by 9.89%. These inferences follow the related literature (Capelle-Blancard et al., 2019; Crifo et al., 2017; Drut, 2010; Margaretic & Pouget, 2018).

Looking into detail at the ESG pillars, the social pillar reduces 10-year sovereign bond yields by 5.34%. In fact, the effect of ESG comes mainly from social performance. These later findings contrast with some findings of Capelle-Blachard et al. (2019) and Pineau et al. (2022), who find that governance has a major pillar effect on advanced economies. However, it supports the heterogenous analysis between the different dimensions. For sovereign risk analysis, social concerns are the most relevant issue, whether environmental and governance indicators do not seem to play a role here. In short, including ESG in sovereign risk analysis adds value.

The social dimension lowers the likelihood of a perceived country debt default. Also, shows the long-term orientation of the social performance contributing to creditworthiness and reinforcing the long-term commitment of a country to repay its debt. For the European market, countries´ social performance changes should enhance the sovereign portfolio´s risk-adjusted returns. Margaretic and Pouget (2018) find that asset allocation based on social performance generates greater returns for investors. Long-short strategies have larger risk-adjusted returns for sovereign bond portfolios.

ESG explains a portion of the variation in bond yields, in addition to other macroeconomic variables. I obtain statistically significant coefficients with the expected signs for trade openness, inflation, and global financial factor (VSTOXX). Interestingly, the current account presents a positive coefficient for both analyses, but it seems that it does not explain the variation of sovereign bond yields. The market considers trade openness a key factor in the overall measure of a country´s competitiveness.

The right panel of the table presents the results for the US market, being the opposite of the ones for the Eurozone countries. Therefore, all else constant, an increase of one unit in ESG, raises the sovereign bond yield by approximately 15%. Although, as observed in the European market, this result comes from the only significant pillar, social. It increases sovereign bond yields by 6.37%, when there is an improvement of one unit in the social dimension. This latter finding goes in accordance with Margaretic and Pouget (2018). They show that the social dimension exhibits a positive and significant coefficient with the first lag, but a negative one with the second lagged estimated coefficient. In this case, an increased 10-year sovereign bond yield could lead the US government to borrow more expensively in the future through bond issuances. This contributes to potential implications at fiscal policy and debt sustainability levels. Furthermore, this positive effect indicates that the US market is pricing in an alternative way improvements in ESG compared to the European market. Also, it is downsizing the

creditworthiness of the United States of America. The perceived risk of default increases when the US government invests in social indicators, which are not perceived as acting as a buffer against shocks.

Regarding the macroeconomic variables, the results demonstrate the ambiguous side of debt. Besides that, inflation, and measure of competitiveness (current account in relation to GDP) explain the variation of the US bond yields. The annual growth rate of GDP seems that is only significant when accounting for the ESG global score.

Table 2 - Bond Yield: Effect of ESG and its pillars performance

	EUR Sovereign bond yield 10YR	
VARIABLES	Basic	Extended
ESG (lagged)	-9.890***	
	(1.838)	
ENV (lagged)		-0.538
		(1.246)
SOC (lagged)		-5.359**
		(2.299)
GOV (lagged)		-1.817
		(2.957)
(X+M)/GDP	-8.984***	-9.467***
	(2.057)	(1.939)
Debt/GDP	-0.408	-0.227
	(1.451)	(1.561)
ΔP/P	0.285***	0.299***
	(0.0715)	(0.0695)
ΔGDP/GDP	-0.0579	-0.0273
	(0.0394)	(0.0445)
CA/GDP	0.0434	0.0431
	(0.0743)	(0.0734)
VSTOXX	0.540**	0.636**
	(0.227)	(0.238)
Constant	47.48***	47.46***
	(8.965)	(8.623)
Observations	230	230
R-squared	0.47	0.46
Country Fixed effects	Yes	Yes

	US Sovereign bond yield 10YR	
VARIABLES	Basic	Extended
ESG (lagged)	14.99***	
	(2.478)	
ENV (lagged)		2.736
		(1.871)
SOC (lagged)		6.367***
		(1.770)
GOV (lagged)		4.848
		(3.461)
(X+M)/GDP	0.761	-0.0603
	(1.577)	(1.440)
Debt/GDP	-1.468***	-1.238***
	(0.334)	(0.303)
ΔP/P	1.156***	1.074***
	(0.233)	(0.207)
ΔGDP/GDP	0.269**	0.146
	(0.0995)	(0.107)
CA/GDP	-0.309**	-0.284*
	(0.141)	(0.153)
VIX	-0.364	-0.797
	(0.529)	(0.572)
Constant	-7.876	-2.788
	(6.431)	(5.753)
Observations	23	23
Adjusted R-squared	0.79	0.83
Country Fixed effects	No	No

Standard errors for Eurozone are clustered by country and reported in parentheses. For the time-series analysis, the standard errors are reported in paratheses. The test of Breusch-Pagan (p-value = 0.59) and White (p-value = 0.40) test is used to check for homoscedasticity for Eq. 1. Both values do not reject the null hypothesis of homoscedasticity, therefore the use of standard errors and not robust standard errors. The same is performed for Eq. 2 with the same output. ***, **, * denotes p<0.01, p<0.05, p<0.1, respectively.

The results for the impact of ESG performance on CDS spreads are reported in Table 3, in the left panel for the Eurozone countries and in the right panel for the US. As already demonstrated for the bond yields, ESG performance in the Eurozone countries mitigates the credit risk proxied by the CDS spread. High ESG countries offer investors higher creditworthiness, as indicated by reduced credit spreads. This negative relationship between ESG ratings and the spread levels follows the literature (Anand et al., 2023; Gao et al., 2021; Hübel, 2022). All else constant, an increase of one unit in ESG reduces the CDS spread by 393 basis points, meaning 3.93%. To assess the contribution of the pillars, Eq. 2 is performed. The results show that environmental and social pilar present negative coefficients, except for governance. However, contrary to the European bond yields, none seems to contribute to the explanation of the variation of CDS spreads. This can be explained that for the CDS European market, investors look more for the overall ESG score than its pillars. Even the impact of ESG is, thereafter, more significant when comparing bond yields to CDS spreads. Therefore, Eurozone countries with improved ESG performance indicate less perceived default risk to investors, bearing a reduced credit spread. For the European market, ESG appears to be a determinant of sovereign credit risk.

Some of the coefficients of the macroeconomic variables explain the credit default swaps spread, such as trade openness and the volatility of Euro Stoxx 50 index options. The last variable exhibits a positive influence as expected, even though only significant for Eq. (2). Inflation is also a significant explanatory variable along with the fiscal condition proxied by debt levels.

Concerning the US, the results contrast the findings from the Eurozone countries. A one-unit increase in ESG increases the CDS spread by 1113 basis points, corresponding to 11%. As observed with the bond yields, the ESG effect comes mainly through the social pillar. All other pillars are positive but not significant. Therefore, all else constant, an increase of one unit in the social dimension, rises by 5.84% the CDS spread, 584 basis points. As observed in the European market, the influence of ESG is more significant when analyzing sovereign bond yields. In brief, an improvement in ESG performance and in the social indicators would increase the 5-year credit default spreads. Therefore, there is a negative perception in the US market of allocating resources to upgraded social practices. Consequently, there is an increased perceived risk of default by raising the spreads when ESG scores improve.

Besides the explanatory power of ESG and its pillar, trade openness affects positively, as inflation, credit default spreads. The positive relationship between the trade openness and CDS spreads is due to the US relying significantly on imports. Therefore, an increase in trade openness may expose the US to external shocks, supply disruptions and currency fluctuations. This has a negative impact on the US economy, posing a risk of meeting its debt obligations. Even though the government has free trade agreements with some countries, as an example the critical minerals supply chains agreement with Japan. A disruption on that would impose a risk for the transaction to clean energy. Moreover, I obtain a statistically negative significant coefficient for debt but only using ESG as a global score, showing the ambiguous sign of this variable as mentioned in Section III.

Table 3 – Credit Default Swap Spread: Effect of ESG and its pillars performance

	EUR CDS spread 5YR	
VARIABLES	Basic	Extended
ESG (lagged)	-3.933*	
	(1.824)	
ENV (lagged)		-0.262
		(1.683)
SOC (lagged)		-1.026
		(1.848)
GOV (lagged)		0.976
		(2.269)
Trade	-5.761***	-6.243***
	(0.673)	(0.868)
Debt	0.378***	0.838
	(0.0873)	(0.656)
Inflation	-0.0532**	0.0722**
	(0.0170)	(0.0236)
GDP	-0.0254	0.00844
	(0.0167)	(0.0261)
CAC	-0.0167	-0.0249
	(0.0221)	(0.0207)
VSTOXX	0.339	0.428**
	(0.187)	(0.184)
Constant	30.37***	27.01***
	(2.988)	(3.527)
Observations	140	140
R-squared	0.42	0.32
Country Fixed effects	Yes	Yes

	US CDS spread 5YR	
VARIABLES	Basic	Extended
ESG (lagged)	11.13**	
	(4.187)	
ENV (lagged)		1.901
		(1.415)
SOC (lagged)		5.835**
		(1.508)
GOV (lagged)		0.132
		(2.567)
Trade	3.913**	4.645**
	(1.545)	(1.375)
Debt	-0.655**	-0.423
	(0.257)	(0.208)
Inflation	0.557**	0.347*
	(0.196)	(0.137)
GDP	0.172	0.0480
	(0.120)	(0.107)
CAC	0.00841	-0.306
	(0.564)	(0.551)
VIX	0.611	-0.193
	(1.003)	(1.072)
Constant	-18.14***	-17.16**
	(4.814)	(4.031)
Observations	14	14
Adjusted R-squared	0.62	0.75
Country Fixed effects	No	No

Standard errors for Eurozone are clustered by country and reported in parentheses. For the time-series analysis, the standard errors are reported in paratheses. The test of Breusch-Pagan (p-value = 0.72) and White (p-value = 0.34) test is used to check for homoskedasticity for Eq.1. Both values do not reject the null hypothesis of homoscedasticity, therefore the use of standard errors and not robust standard errors. The same is performed for Eq. 2 with the same output. ***, **, * denotes p<0.01, p<0.05, p<0.1, respectively.

Altogether, ESG and the social pillar are priced by sovereign bond and CDS markets, as also global and local market conditions. Consequently, the results show a heterogenous effect among ESG dimensions. The environmental pillar does not show an influence on both measures of sovereign credit risk, as in accordance with the literature (Capelle-Blancard et al., 2019; Margaretic & Pouget, 2018). It contradicts the hypothesis that natural resources depletion, changes in emissions and renewable sources excessive use pose a major risk to economic growth. In fact, the period in analysis suggests that environmental risks are not perceived as having a greater level of materiality. In fact, the awareness of green measures adoption to contribute to a sustainable future only came alive a few years ago.

The results suggest that the market does not perceive governance issues as a significant driver of sovereign credit risk. The governance measure refers to political measures and perceptions by the community on government actions. Factors related to macroeconomic instability and external vulnerabilities coming from governance measures might be considered more important. In this way, outweighs the importance of the governance indicators themselves. As it is also focused on the perception of the community, it might be subjective, limiting the ability to explain the variation in CDS spreads and bond yields. Anand et al. (2023) also suggest that good governance does not necessarily lower CDS spreads. They conclude that enhancement in governance performance is foreseen to be more related to low or medium-performing countries.

One of the major differences is the fact that bond yields and spreads in the US are positively affected by ESG scores while in Europe they are negatively affected. Several reasons could explain this difference. Firstly, Europe has been incorporating ESG practices and performance in investment decisions for a longer time compared to the US. According to the RobecoSAM country sustainability ranking[4], the top twenty countries are mainly European, leading the Nordic countries, Finland in the first place. For this reason, the market has already been pricing the ESG hazards and opportunities. This increases investor confidence in the European countries managing their sustainable debt levels, leading to a lower reduction in the perceived

[4]https://www.robeco.com/en-int/sustainable-investing/expertise/most-sustainable-countries-in-the-world

risk of default. The American market is still maturing in this ESG topic. The United States of America has one of the largest economies, however, boasts the world´s biggest national debt in terms of dollars. US faces Japan and China in terms of the gross national debt, according to the US Census Bureau[5]. But due to its economy, the debt level to GDP is not one of the highest. Therefore, considering these debt loads and the additional investment in ESG performance could also explain the positive association between the two variables. Financial markets perceive that investing in social performance is a synonym for extra government spending since the results are going to be perceived in the long run. This way, the economy is penalized with higher yields and higher cost of protection against the probability of default due to its lower creditworthiness.

Secondly, the US is more industry-oriented, with massive production. Enforcing ESG, the US government might be seen as less business-friendly. Therefore, high ESG scores in the US are associated with increased regulation and compliance costs. Consequently, it has a negative impact on corporate profitability. This could influence the economy and the country´s fiscal position, leading to rising bond yields and spreads. Additionally, some investors might see high ESG scores as a signal of reduced exposure to controversial industries or policies, which could impact the economic growth of the US. For example, improved ESG ratings might be related to avoiding fossil fuels or other industries that have been historically associated with the US economic growth. Consequently, it affects employment rates, innovation in the public and private sectors, and population growth due to unstable conditions. In this case, investors who prioritize growth potential might show a lower willingness to invest in bonds and CDS from a country that is restricting development. This leads to increased bond yields and decreased creditworthiness for the US.

Additionally, the political affiliate of the US States has an impact on this ESG performance perspective. Firms have higher ESG scores when headquartered in Democratic rather than Republican-leaning states (Di Giuli & Kostovetsky, 2014). Accordingly, the Republican Party has the majority in the United States House of Representatives, which is the Party less sensitive to sustainability issues (Caiazza et al., 2023). Therefore, this imposes an obstacle to the enhancement of ESG indicators. Thus, when seeking improvement, there is a perception of higher sovereign default. According to Sutherlin and Rovella (2023), ESG bonds are increasing in popularity globally and across Europe. In America, they are getting hammered due to

[5] https://worldpopulationreview.com/country-rankings/countries-by-national-debt

political conflicts from the Republican Party. In fact, some US States have prohibited considering ESG criteria in asset management decisions.

Overall, an increase in ESG scores increases the perceived sovereign credit risk in the US due to perceived risks to business-friendly policies. In contrast decreases in Europe due to greater investor demand for socially responsible investments and more advanced ESG integration in the market. The differences encountered make it relevant for investors to consider the determinants of the cost of sovereign debt and the fee to pay against a possible default.

One of the problems that could arise from this regression and has been identified in the literature, is endogeneity. Ullah et al. (2021) argue that endogeneity is a frequent problem in nowadays research and it could occur through three sources, simultaneously bias being one of them. The concern here is that higher ESG factors can lead to a lower perceived risk of default by investors. But, at the same time, countries with lower credit risk or low levels of public debt can afford to spend more on investing to increase the performance of ESG indicators. This way, both variables may occur simultaneously, originating bidirectional causality. Although there is evidence of a correlation between variables, it does not imply that one variable causes the other and vice-versa. Correlation is also driven by other factors, namely macroeconomic conditions for which I try to control with the control variables.

To check the robustness of my results, I use two-stage least squares (2SLS) to analyze this source of endogeneity, as indicated by Caiazza et al. (2023), Jiraporn et al. (2014) and Stellner at al. (2015). The challenge is to find a good instrumental variable that exhibits a correlation with the endogenous variable, however not with the error term. In line with Crifo et al. (2017), the instrumental variable is the incarceration rate (Prisoners per 100,000 population) for the social pillar score. I only apply this for the United States of America, since data for each Eurozone country is not available on the World Prison Brief website. Despite the significance of the findings of the study, my results show that this variable is not strong enough to be used as an instrument. I perform the following tests for both measures of sovereign credit risk: in the Sanderson-Windmeijer test, the F-statistics is lower than the critical value, as for the Cragg-Donald Wald test to identify weak identification. Therefore, I cannot reject the hypothesis of weakly instrument correlation and show the lack of strength to identify the effect of the social pillar on bond yield and spreads, respectively. Moreover, the F-test of excluded instruments in the first-stage regression presents that the incarceration rate is not a significant predictor of the endogenous variable.

VI. Robustness tests

In this section, I describe three additional tests to check the robustness of my results. The aim of these tests is to check whether the original results are robust to the inclusion of new variables that have an impact on sovereign credit risk. Also, if ESG is still an explanatory variable of the variation in CDS spreads and sovereign bond yields.

First, I include a dummy variable for crisis years and its interaction with ESG factors. I investigate if the relationship between ESG dimensions and sovereign credit risk changes from economic crisis periods to non-crisis periods. Thus, for the European market, I follow the literature (Agnese & Giacomini, 2023; Caiazza et al., 2023; Capelle-Blancard et al., 2019; Pineau et al., 2022), taking the dummy a value of 1 for the: global financial crisis (2007 to 2008); European sovereign debt crisis (2010 to 2012); year of covid-19, limiting only to 2020, and 0 otherwise. For the US market, I substitute the European crisis for the dot-com bubble from 2000 to 2002 (Becchetti et al., 2015).

Second, I include two measures for policy decisions. I include a proxy for unconventional monetary policy decisions, quantitative easing and a proxy for monetary policy pronouncements.

Quantitative easing targets money supply and credit rise, in a change of purchases of government bonds and other securities from financial institutions. This leads to money injection into the economy and, therefore, stimulates economic activity. Lenza and Slacalek (2018) find that quantitative easing has an impact on housing wealth, explaining why European Central Bank´s asset purchases have helped to reduce net wealth inequality. I follow the literature and use the changes in total assets from FED and ECB balance sheets. I apply the natural logarithm in the proxy of unconventional monetary policy. In the case of Europe, I assume there was no change from 1999 to 2000 and utilize the difference from 1999 to 2000 to 1998 and 1999, as prior data was not available.

Conventional monetary policy affects the expectations of future inflation and interest rates and, consequently, credit supply and asset prices. As a proxy, I use the Federal Fund Effective Rate (FFER), as it is a benchmark for the FED monetary policy decisions. FFER is the weighted average short-term interest rate at which depository institutions lend or borrow funds overnight from each other to meet their reserve requirements. For Europe, I use a similar interest rate, the Euro Overnight Index Average (EONIA). EONIA is the weighted average of overnight

borrowing rates between banks for the Euro area. Thus, changes in monetary policy decisions have a direct impact on the cost of borrowing and lending. I use the same value from 2021 to 2022, as EONIA was discontinued, and the euro short-term (STR) came after. Values for the US are retrieved from the Federal Reserve Bank of St. Louis and from the ECB website for the Eurozone.

6.1 Crisis vs. non-crisis periods

The results from bond yields are presented in Table 4 and the CDS spreads are in Table 5. For the European yields, the ESG and ESG dimensions stay negatively associated with bond yield, except for environmental indicators. Even though the global score and social are still the significant ones. A one-unit increase in ESG score indicates a decrease of 8.75% in 10-year sovereign bond yields. Furthermore, the coefficient of crisis is positive and significant for both regressions. This means that considering the years of the crisis, bond yields have increased. The interaction term is significant and negative for ESG at the 1% and 5% level for the social pillar and environmental pillar, respectively. Therefore, ESG, as well as social indicators, have a weaker negative effect on sovereign bond yields during crisis periods, compared to non-crisis periods. Despite the significance of the interaction term between the environmental pillar and crisis years, this dimension does not explain the variation in yields. Unlike Margaretic and Pouget (2018), my macroeconomic variables, trade openness, financial variable and inflation are still robust to the results. There are even more pronounced results for the two first variables.

The same conclusion applies to the CDS market, where the ESG is still negatively associated with country bond yields, as also to the interaction term. The coefficient suggests that the influence of ESG performance on CDS spreads is not that strong during crisis periods, compared to non-crisis periods. The positive coefficients of the dummy variable (2.19 and 1.63), also suggest an increase in the CDS spreads during crisis years. These findings allow to draw the conclusion that other macroeconomic variables are more influential during crisis periods. Therefore, it corresponds to a more pronounced ESG performance on credit risk during less volatile economic times. As risk aversion rises, investors would rely on better-known macroeconomic variables. In this regard, Pineau et al. (2022) document that during crisis periods, non-ESG factors explain better creditworthiness compared to ESG measures. Additionally, government actions during periods of instability could lead to changes in policy and regulations not related directly to ESG indicators. Therefore, sustains the weaker relationship during crisis years.

The results are not significant for the US market, not being possible to make a comparison between crisis and non-crisis periods. However, ESG and the social pillar remain significant, at a 10% level for the pillar, and positive as before. The governance pillar becomes a significant explanatory variable at a 10% level, increasing yields by 8.34%. Interestingly, ESG indicators lose their significance for the CDS market. This suggests that changes in economic and financial conditions have no appreciable impact on the positive effect of ESG performance. This is the finding from Gao et al. (2021) that shows no statistical results when accounting for a dummy crisis between Corporate Social Responsibility and CDS for US entities.

Table 4 - ESG factors and bond yields: crisis vs. non-crisis periods

	EUR Sovereign bond yield 10YR	
VARIABLES	Basic	Extended
ESG (lagged)	-8.746***	
	(1.462)	
ENV (lagged)		0.821
		(0.791)
SOC (lagged)		-4.984**
		(1.828)
GOV (lagged)		-1.885
		(2.154)
(X+M)/GDP	-9.779***	-10.07***
	(2.396)	(2.333)
Debt/GDP	-0.403	-0.390
	(1.227)	(1.283)
ΔP/P	0.255***	0.277***
	(0.0683)	(0.0586)
ΔGDP/GDP	0.00335	0.0422
	(0.0403)	(0.0442)
CA/GDP	0.0737	0.0709
	(0.0750)	(0.0682)
VSTOXX	0.603*	0.773**
	(0.268)	(0.299)
Crisis	4.657***	5.787***
	(0.865)	(1.303)
crisis×env		-5.049**
		(1.969)
crisis×soc		-4.766**
		(2.033)
crisis×gov		-0.110
		(1.055)
crisis×esg	-7.078***	

	US Sovereign bond yield 10YR	
VARIABLES	Basic	Extended
ESG (lagged)	14.71**	
	(5.718)	
ENV (lagged)		1.771
		(2.150)
SOC (lagged)		7.056*
		(3.337)
GOV (lagged)		8.378*
		(4.438)
(X+M)/GDP	0.807	0.667
	(1.832)	(1.581)
Debt/GDP	-1.468***	-1.185**
	(0.419)	(0.399)
ΔP/P	1.150***	1.192***
	(0.336)	(0.344)
ΔGDP/GDP	0.265	0.158
	(0.166)	(0.170)
CA/GDP	-0.320	-0.204
	(0.268)	(0.305)
VIX	-0.384	-0.827
	(0.622)	(0.636)
Crisis	-0.288	-4.140
	(6.315)	(7.888)
crisis×env		11.10
		(11.39)
crisis×soc		1.903
		(15.97)
crisis×gov		-11.39
		(21.77)
crisis×esg	0.507	

	(1.633)			(10.22)	
Constant	49.90***	49.28***	Constant	-7.827	-6.378
	(10.45)	(10.01)		(6.950)	(6.423)
Observations	230	230	Observations	23	23
R-squared	0.57	0.55	R-squared	0.76	0.82
Country Fixed effects	Yes	Yes	Country Fixed effects	No	No

Standard errors for Eurozone are clustered by country and reported in parentheses. For the time-series analysis, the standard errors are reported in paratheses. ***, **, * denotes p<0.01, p<0.05, p<0.1, respectively.

Table 5 - ESG factors and CDS spreads: crisis vs. non-crisis periods

	EUR CDS spread 5YR			US CDS spread 5YR	
VARIABLES	Basic	Extended	VARIABLES	Basic	Extended
ESG (lagged)	-4.377**		ESG (lagged)	7.096	
	(1.821)			(4.595)	
ENV (lagged)		0.0393	ENV (lagged)		1.471
		(1.310)			(1.482)
SOC (lagged)		-1.310	SOC (lagged)		2.693
		(2.066)			(3.506)
GOV (lagged)		0.601	GOV (lagged)		-5.172
		(2.036)			(5.927)
(X+M)/GDP	-4.132***	-5.021***	(X+M)/GDP	3.706**	4.195*
	(0.638)	(0.888)		(1.400)	(1.450)
Debt/GDP	0.286	0.558	Debt/GDP	-0.314	-0.114
	(0.489)	(0.636)		(0.321)	(0.374)
ΔP/P	0.0241	0.0397	ΔP/P	0.247	-0.0491
	(0.0189)	(0.0231)		(0.268)	(0.421)
ΔGDP/GDP	0.0169	0.0366	ΔGDP/GDP	-0.0470	-0.119
	(0.0291)	(0.0349)		(0.179)	(0.200)
CA/GDP	-0.00353	-0.00661	CA/GDP	-0.408	-0.216
	(0.0189)	(0.0225)		(0.576)	(0.559)
VSTOXX	0.384*	0.492**	VIX	-0.101	0.316
	(0.190)	(0.168)		(1.015)	(1.190)
Crisis	2.189***	1.626*	Crisis	-1.045	-1.730
	(0.529)	(0.804)		(0.678)	(1.742)
crisis×env		-0.835	crisis×env		-1.516
		(0.789)			(0.917)
crisis×soc		-0.588	crisis×soc		-1.056
		(1.372)			(1.425)
crisis×gov		-0.103	crisis×gov		-6.010
		(0.522)			(6.051)
crisis×esg	-2.378**		crisis×esg	-1.811	
	(0.964)			(1.174)	
Constant	21.76***	22.43***	Constant	-13.82**	-12.40
	(2.411)	(3.008)		(5.165)	(6.271)

Observations	140	140	Observations	14	14
R-squared	0.52	0.47	R-squared	0.69	0.75
Country Fixed effects	Yes	Yes	Country Fixed effects	No	No

Standard errors for Eurozone are clustered by country and reported in parentheses. For the time-series analysis, the standard errors are reported in paratheses. ***, **, * denotes p<0.01, p<0.05, p<0.1, respectively.

6.2 Quantitative Easing

The results for sovereign bond yields are presented in Table 6 and Table 7 for the CDS. For European bond yields, the original results do not sustain. All ESG dimensions become positive and do not explain the changes in sovereign bond yields. There is now a similarity with the results from the American market. Furthermore, the quantitative easing measure does not explain European sovereign bond yields. The only significant result obtained is the interaction term between ESG and quantitative easing. ESG performance increases the country´s creditworthiness, by reducing bond yields, with a contracting balance sheet compared to an expanding one. Therefore, the impact of ESG dimensions on sovereign credit risk depends on the value of the ECB balance sheet. The contracting balance sheet can indicate that the ECB is not applying the quantitative easing policy anymore, as the economy is starting to rebound. Accordingly, countries can afford to spend more on the improvement of ESG indicators, which would be reflected in a decreased perceived risk of default by the market. These improvements can be associated with investments in friendly-business projects, enhanced social welfare and increased support for governance reforms. This can explain the stronger relationship of ESG on sovereign credit risk during balance sheet contraction. However, since both variables are not significant, this conclusion cannot materialize for analyzing single effects. For the CDS market, the same conclusions apply, except only the global score turns positive. In addition, I find non-statistically significant results for the new variable and the interaction term.

Looking at the American market, the results are the same. Therefore, all ESG dimensions, except for the governance factor, remain positive. Even though ESG and social pillar performance are the only ones that still contribute to the increase in US bond yields. Unexpectedly, the value of both coefficients rises to extremely high levels. A one-unit increase in ESG performance increases bond yields by 166%. Analyzing sub-indicators together increases bond yields by 75%. These values suggest that ESG factors in the US market are extremely sensitive to decisions in asset purchases by the FED. Moreover, an increase of one percent in the difference in the value of total assets would lead to a rise in bond yields by 0.07 units. This means that quantitative easing actions are not effective in reducing bond yields.

Nevertheless, the size and duration of the quantitative program are also factors that should be considered for the effectiveness of the policy. Henceforth, there could be two reasons for the rise in bonds´ yields: investors expect higher inflation with the increased money supply, leading to bond payments being less valuable. Therefore, they would demand higher yields to compensate for the increased inflation risk; The market sentiment can change to less risk-averse when the quantitative easing program is adopted. Investors will demand safer assets, such as treasury bonds, pushing up the yields even with quantitative easing in effect. The joint effect of quantitative easing decisions and ESG is negative, as followed by the European market. It suggests that the impact of ESG on bond yields is greater when the FED is reducing its unconventional monetary policy compared to when the FED is purchasing assets. Facing this policy, the market takes into consideration FED´s actions that measure what could drive up the ESG performance impact. For the CDS market, no statistically significant results are found, but the coefficients remain positive except for the environmental dimension.

Table 6 - ESG factors and bond yields: macro variables effects

	EUR Sovereign bond yield 10YR			US Sovereign bond yield 10YR	
VARIABLES	Basic	Extended	VARIABLES	Basic	Extended
ESG (lagged)	13.28		ESG (lagged)	165.5**	
	(8.480)			(63.17)	
ENV (lagged)		5.855	ENV (lagged)		29.16
		(6.638)			(49.07)
SOC (lagged)		0.147	SOC (lagged)		74.85*
		(10.69)			(36.59)
GOV (lagged)		4.179	GOV (lagged)		-94.55
		(2.599)			(70.44)
(X+M)/GDP	-1.203	-0.473	(X+M)/GDP	2.745	1.141
	(2.886)	(2.946)		(1.839)	(2.741)
Debt/GDP	1.684***	1.812***	Debt/GDP	-0.782	-1.085**
	(0.262)	(0.331)		(0.451)	(0.428)
ΔP/P	-1.181**	-1.250**	ΔP/P	0.441	0.868**
	(0.451)	(0.498)		(0.394)	(0.343)
ΔGDP/GDP	-0.117**	-0.0865	ΔGDP/GDP	0.0887	0.0402
	(0.0403)	(0.0480)		(0.150)	(0.169)
CA/GDP	-0.0107	-0.0116	CA/GDP	-0.468**	-0.283
	(0.0495)	(0.0495)		(0.182)	(0.203)
VSTOXX	0.411	0.550	VIX	-0.755	-0.134
	(0.297)	(0.325)		(0.642)	(0.888)
QE	0.158	0.0121	QE	7.147**	1.528

	(0.265)	(0.463)		(3.060)	(3.438)
qe×env		-0.612	qe×env		-2.067
		(0.554)			(3.990)
qe×soc		-0.471	qe×soc		-5.751
		(0.750)			(3.072)
qe×gov		-0.598	qe×gov		7.744
		(0.351)			(5.553)
qe×esg	-1.839***		qe×esg	-12.90**	
	(0.441)			(5.449)	
Constant	8.994	7.456	Constant	-96.80**	-24.87
	(10.75)	(10.54)		(37.09)	(46.53)
Observations	160	160	Observations	20	20
R-squared	0.59	0.59	Adjusted R-squared	0.810	0.780
Country Fixed effects	Yes	Yes	Country Fixed effects	No	No

Standard errors for Eurozone are clustered by country and reported in parentheses. For the time-series analysis, the standard errors are reported in paratheses. ***, **, * denotes p<0.01, p<0.05, p<0.1, respectively.

Table 7 - ESG factors and CDS spreads: macro variables effects

	EUR CDS spread 5YR			US CDS spread 5YR	
VARIABLES	Basic	Extended	VARIABLES	Basic	Extended
ESG (lagged)	2.386		ESG (lagged)	48.80	
	(6.387)			(128.9)	
ENV (lagged)		-1.451	ENV (lagged)		-5.865
		(4.949)			(0.908)
SOC (lagged)		-1.230	SOC (lagged)		5.672
		(6.940)			(2.298)
GOV (lagged)		2.558	GOV (lagged)		4.868
		(4.555)			(0.145)
(X+M)/GDP	-6.565***	-6.025***	(X+M)/GDP	3.402	4.081
	(1.057)	(1.220)		(4.115)	(3.179)
Debt/GDP	0.743**	0.829**	Debt/GDP	-0.398	-0.514
	(0.316)	(0.334)		(1.005)	(0.456)
ΔP/P	-0.472	-0.538	ΔP/P	0.287	0.368
	(0.320)	(0.334)		(0.923)	(0.300)
ΔGDP/GDP	-0.0304**	-0.0181	ΔGDP/GDP	0.124	-0.0443
	(0.0103)	(0.0118)		(0.303)	(0.145)
CA/GDP	-0.0428	-0.0482	CA/GDP	-0.439	-1.486
	(0.0285)	(0.0280)		(1.631)	(0.552)
VSTOXX	0.891***	1.001***	VIX	-0.0627	-2.940
	(0.167)	(0.160)		(2.582)	(0.167)

QE	-0.145	-0.275	QE	1.687	-0.429
	(0.252)	(0.298)		(5.941)	(1.992)
qe×env		0.0294	qe×env		0.422
		(0.411)			(2.948)
qe×soc		-0.0795	qe×soc		0.557
		(0.523)			(1.335)
qe×gov		-0.212	qe×gov		0.341
		(0.330)			(0.317)
qe×esg	-0.440		qe×esg	-3.154	
	(0.461)			(10.80)	
Constant	34.25***	33.16***	Constant	-35.57	-5.140
	(4.482)	(5.334)		(71.30)	(28.99)
Observations	90	90	Observations	12	12
R-squared	0.71	0.72	Adjusted R-squared	0.75	0.31
Country Fixed effects	Yes	Yes	Country Fixed effects	No	No

Standard errors for Eurozone are clustered by country and reported in parentheses. For the time-series analysis, the standard errors are reported in paratheses. ***, **, * denotes p<0.01, p<0.05, p<0.1, respectively.

6.3 Monetary Policy

The results for sovereign bond yields are presented in Table 8 and the credit spreads are in Table 9. Firstly, for Eurozone countries, the results are still robust with the introduction of the new interest rate variable. The coefficients of the ESG indicators are negative, but only the global score seems to influence the sovereign bond yields. Also, the effect of GDP seems to start to contribute. When the economy is growing, there is a reduction of perceived default risk by the market, reducing the bond yields by 0.12% and by 0.10%, for ESG and dimensions, respectively. Nonetheless, it seems that the value of interest rate does not explain the variation in the sovereign bond yields in both regressions. On the contrary, the interaction term is significant, suggesting that the relationship between bond yield and ESG is conditional on the value of the short-term interest rate. Specifically, an increase in ESG has a higher effect on reducing bond yields, when the interest rates are increasing, compared to when they are decreasing. The same applies to the significant result with environmental factors. The relation between the two variables may be driven by underlying economic factors captured by ESG and conventional monetary policy variables. This finding suggests that the European market is considering more the ESG impact in a controversial financial environment.

Analyzing the European CDS market, the social pillar becomes significant, decreasing the spread by 211 basis points. Unexpectedly, the ESG lost its power to explain the variation in CDS spreads and the value of the trade openness has a positive coefficient. Moreover, changes

in conventional monetary policy contribute to a positive effect on the spread rising. Therefore, an increase in EONIA makes CDS rise by 288 basis points and by 403 basis points when accounting for dimensions together. Thus, a possible country default could arrive, if the country does not manage well the higher borrowing costs, increasing the spreads. Also, this could lead to an appreciation of foreign currency, potentially creating challenges for governments in servicing their foreign-denominated debt. Consequently, it increases default risk and rising spreads. Lastly, an increase in the social factor, and in the environmental one, despite the non-significance by itself, has a weaker effect on reducing the spread when the value of EONIA is increasing, compared to when decreasing. Contrary to the bond yields, innovation, demography, gender equality and employment might not be factors that governments are prioritizing in this analysis.

Similar to Europe, the results are robust to the Federal Fund Effective rate, significant positive ESG and social dimension. As expected, an increase in this interest rate upsurges the American government bond yield by 151 basis points. Furthermore, the joint effect seems the opposite as found in the European market. The effect of ESG on bond yields is mitigated by higher values of FFER. These results suggest that the impact of monetary policy and quantitative easing is perceived in a similar way. For the US CDS market, the results are not statistically significant, not possible to make a comparison.

The differences between the two markets might not be that straightforward when targeting these policies. Accordingly, markets might face different constraints periods to increased interest rates. In Europe, countries are still managing their regulations and politics toward the ESG indicators. Whereas, in the US, as they are still maturing on this matter, gender equality, energy use, and freedom of expression are not government priorities during these periods.

Table 8 - ESG factors and bond yields: macro variables effects

	EUR Sovereign bond yield 10YR	
VARIABLES	Basic	Extended
ESG	-8.323**	
	(2.641)	
ENV		-1.528
		(1.520)
SOC		-3.838
		(2.295)
GOV		-1.362
		(3.237)
Trade	-3.066**	-3.615***

	US Sovereign bond yield 10YR	
VARIABLES	Basic	Extended
ESG	18.42***	
	(4.048)	
ENV		3.353
		(2.458)
SOC		7.490**
		(2.642)
GOV		5.592
		(4.662)
Trade	0.859	-0.598

	(1.155)	(0.792)		(1.357)	(1.941)
Debt	-0.00726	0.0198	Debt	-1.463***	-1.106**
	(0.212)	(0.192)		(0.286)	(0.386)
Inflation	0.217***	0.224***	Inflation	1.116***	0.958***
	(0.0506)	(0.0504)		(0.204)	(0.237)
GDP	-0.123***	-0.104**	GDP	0.371***	0.249*
	(0.0364)	(0.0445)		(0.0990)	(0.119)
CAC	0.0265	0.0351	CAC	-0.116	-0.0132
	(0.0219)	(0.0222)		(0.145)	(0.275)
VSTOXX	0.677***	0.757***	VIX	0.171	-0.0613
	(0.132)	(0.153)		(0.493)	(0.682)
eonia	-0.0789	-0.199	ffer	1.508*	0.701
	(0.203)	(0.255)		(0.701)	(1.831)
eonia×env		1.024*	ffer×env		0.605
		(0.467)			(2.445)
eonia×soc		0.567	ffer×soc		-0.580
		(0.346)			(1.187)
eonia×gov		0.119	ffer×gov		-1.463
		(0.216)			(2.950)
eonia×esg	1.451***		ffer×esg	-2.185*	
	(0.359)			(1.134)	
Constant	17.55***	18.91***	Constant	-11.48*	-4.093
	(4.669)	(3.098)		(6.096)	(6.478)
Observations	230	230	Observations	23	23
R-squared	0.632	0.619	Adjusted R-squared	0.850	0.843
Country Fixed effects	Yes	Yes	Country Fixed effects	No	No

Standard errors for Eurozone are clustered by country and reported in parentheses. For the time-series analysis, the standard errors are reported in paratheses. ***, **, * denotes p<0.01, p<0.05, p<0.1, respectively.

Table 9 - ESG factors and CDS spreads: macro variables effects

	EUR CDS spread 5YR			US CDS spread 5YR	
VARIABLES	Basic	Extended	VARIABLES	Basic	Extended
ESG	-2.479		ESG	4.124	
	(1.689)			(5.932)	
ENV		0.199	ENV		-0.640
		(0.879)			(2.438)
SOC		-2.109*	SOC		5.374
		(1.135)			(2.466)
GOV		0.491	GOV		-0.563
		(1.119)			(4.537)
Trade	1.615**	1.993**	Trade	5.413*	4.396
	(0.709)	(0.636)		(2.249)	(2.192)
Debt	0.0739	0.0881	Debt	-1.761*	0.193
	(0.0565)	(0.0637)		(0.687)	(0.726)
Inflation	-0.000166	-0.00129	Inflation	1.697*	-0.097
	(0.0163)	(0.0215)		(0.677)	(0.510)

GDP	-0.0284	-0.0218*	GDP	0.284*	0.214
	(0.0156)	(0.0112)		(0.128)	(0.164)
CAC	0.0185	0.0217	CAC	0.755	1.141
	(0.0147)	(0.0150)		(1.057)	(1.448)
VSTOXX	-0.130	-0.0770	VIX	2.571	2.399
	(0.114)	(0.112)		(1.690)	(2.313)
eonia	2.882***	4.027***	ffer	-14.42	-1.906
	(0.392)	(0.353)		(8.239)	(4.562)
eonia×env		-2.735***	ffer×env		5.196
		(0.423)			(3.504)
eonia×soc		-1.583**	ffer×soc		-1.709
		(0.666)			(5.209
eonia×gov		0.0492	ffer×gov		-6.532
		(0.284)			(9.009)
eonia×esg	-1.913*		ffer×esg	28.49	
	(0.896)			(16.32)	
Constant	-2.105	-4.530	Constant	-23.68**	-18.692
	(3.156)	(2.510)		(7.727)	(6.727)
Observations	140	140	Observations	14	14
R-squared	0.700	0.728	Adjusted R-squared	0.6777	0.702
Country Fixed effects	Yes	Yes	Country Fixed effects	No	No

Standard errors for Eurozone are clustered by country and reported in parentheses. For the time-series analysis, the standard errors are reported in paratheses. ***, **, * denotes p<0.01, p<0.05, p<0.1, respectively.

VII. Conclusion

This dissertation aims to assess the relationship between the Environmental, Social, and Governance (ESG) score of a country and its default risk. Specifically, I investigate the impact of the global ESG score and its pillars on measures of sovereign credit risk, namely, sovereign bond yields and credit default swaps mid spreads. I compare the results for the European market and the US market. Investors are sensitive to the ESG performance of a country because it signals a country's capacity to cope with climate, social and governance shocks. Also, it indicates the long-term commitment to its debt obligations as ESG is future oriented. Countries with good ESG performance have a buffer against shocks. This makes investors more likely to accept lower risk premiums for high ESG-performing countries, due to the increased creditworthiness. An enhanced judicial system; a government that is led by fair values and focuses on providing good public services; policies to promote employment, equality and education; measures that could combat toxic emissions and promote renewable energy use; and conscientious resources use are sources through countries could impact their default risk.

Following this relationship, I develop a sustainability index that counts on diversified indicators to account for the following sub-dimensions, environment, society, and governance. I include the ESG score and separately the sub-dimensions to explain sovereign bond yields and sovereign credit default swap spreads. I rely on panel data with ten European developed countries and the United States of America for the period of 1999 to 2022 and from 2008 to 2022 for the spreads. In addition, I include control variables to encompass the macroeconomic conditions associated with fixed-income instruments.

By comparing the two markets, I find that ESG performance influences sovereign credit risk to distinct levels. Firstly, there is evidence of a negative relationship between the overall ESG performance and European yields (9.89%) and spreads (393 bp). Therefore, above-average ESG performance is related to lower perceived default risk, and, consequently, decreased sovereign bond yields and CDS spreads. Secondly, the financial impact of social indicators is the most pronounced when compared to environmental and governance factors. Then, social factors can act as a buffer against shocks. In contrast, for the American market, ESG scores increase sovereign default risk, by increasing 15% bond yields and spread by 1113 basis points. But the social pillar continues the one that explains both measures. Thus, for the US, ESG improvements do not act as a mitigating factor for perceived default risk. These results are kept still for the US when checking for non-conventional monetary policies and for regular policies. Furthermore, the relationship between ESG and sovereign yields/ spreads is stronger in less volatile times, in non-crisis periods, for Eurozone countries.

In fact, these findings demonstrate the complexity and fluctuating nature of the economic effects of ESG performance on sovereign risk. In general, these results show that social factors are priced by sovereign bond and credit default swap markets. One possible explanation for this distinct behavior is the political party running the US State. Also, the market might see investments in ESG indicators, not only government extra—spending, but also a rise of regulations and policies to industries, diminishing corporate profitability. Whereas for the European countries, policies regarding sustainability issues have been considered earlier. The 'Green Laws' introduced by Germany in the '70s or the European Union´s Circular Economy Action Plan (CEAP) in 2015 is an example of that. This illustrates the greater government involvement in environmental and social issues.

These findings are interesting from a government and policymakers' perspective. Especially for the understanding of which are the factors affecting the cost of a country´s debt and the

spread associated. It also has relevance for socially responsible investors and asset managers who evaluate investment opportunities based on environmental, social and governance criteria. Indeed, ESG assessments can assist investors in achieving a balance in the risk-return profile by facilitating investment decisions (Connolly, 2007; Drut, 2010). The decision to where to invest, when considering ESG performance, must be well thought out, regarding sovereign credit risk effects.

My analysis is subject to limitations arising from data availability. This is related to the accuracy and consistency of the variables used to proxy ESG indicators. ESG scores are not publicly available for all dimensions, as they are for corporations. And with all the different rating agencies, come different methodologies to account for ESG (Refinitiv is one of them). Besides the fact that only a sample of countries is included in the coverage. Therefore, it will be worthwhile to examine more countries as could enhance the accuracy of the estimation. Additionally, different data frequencies and alternative methodologies could be considered when evaluating ESG performance. From a methodological standpoint, an event study could be applied to each dimension to isolate the potential impact of ESG news on sovereign credit spread and yields. Finally, it would also be interesting to explore the impact of ESG factors on different debt and spread maturities. Unfortunately, not all eurozone countries have historical data for that analysis.

In fact, it is expected to see global progress in the improvement of the implementation of the United Nations´ Sustainable Development Goals by governments, corporations, society, and policymakers. Therefore, there will be more data to consider. As well as more enthusiasts to address challenges that come with these Goals, leading to economic growth and positive synergies in various areas.

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Appendix

Appendix I (Table 10) - Definition of ESG indicators

ESG	Categories	Themes	Data points	Definitions	Source
E	Resource Use	Water efficiency	Level of water stress	Freshwater withdrawal (% of available freshwater resources)	World Bank
E	Resource Use	Natural resources	Adjusted saving natural resources	Natural resource depletion (sum of net forest depletion, energy depletion, and mineral depletion) as % of GNI	World Bank
E	Emissions	Air quality	CO2	CO2 emissions (metric tons per capita)	World Bank
E	Emissions	Temperature	Annual change in temperature	Annual surface temperature change measured with respect to a baseline climatology	United Nations
E	Renewable sources	Renewable energy	Renewable energy consumption	Renewables energy (% of total final energy consumption)	World Bank
E	Renewable sources	Biodiversity	Forest area	Natural or planted stands of trees (% of land area)	World Bank
S	Gender equality	Education	Secondary rate of school	Gender parity index for gross enrollment ratio in primary and secondary education is the ratio of girls to boys enrolled at primary and secondary levels in public and private schools.	World Bank
S	Gender equality	Workforce	Ratio female/ male labor	Ratio of female-to-male labor force participation rate (%)	World Bank
S	Demography	Community	Life expectancy	Number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life	World Bank
S	Demography	Population	Fertility rate	Number of children that would be born to a woman if she were to live to the end of her childbearing years and bear children in accordance with age-specific fertility rates of the specified year.	World Bank
S	Employment	Employment	Unemployment rate	Share of the labor force that is without work but available for and seeking employment (% of total labor force)	World Bank
S	Innovation	Innovation	Patents	Patent applications filed through the Patent Cooperation Treaty procedure or with a national patent office for exclusive rights for an invention	OECD
G	Regulation	Society confidence	Rule of Law	Captures perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence	World Governance Indicators

G	Regulation	Sector development	Regulatory capital	Captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development	World Governance Indicators
G	Management	Freedom	Voice and accountability	Captures perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and free media.	World Governance Indicators
G	Management	Control of corruption	Corruption Level	Captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as 'capture' of the state by elites and private interest	World Governance Indicators
G	Management	Political stability	Political stability and violence	Measures perceptions of the likelihood of political instability and/or politically motivated violence, including terrorism.	World Governance Indicators
G	Management	Quality of services/policies	Government effectiveness	Captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies	World Governance Indicators

Appendix II (Table 11) - Variables descriptions

Variables	**Definitions**	**Code**	**Sources**
GDP	Annual percentage growth rate of GDP at market prices	ΔGDP/GDP	World Bank
Trade openness	Sum of exports and imports of goods and services in relation to gross domestic product	(X+M)/GDP	World Bank
Debt	Liabilities that require payment or payments of interest and/or principal by the debtor to the creditor at a date or dates in the future in relation to gross domestic product	Debt/GDP	World Bank
Current account	Country´s international trade in goods and services, as well as types of income flows, such as investment income and remittances in relation to gross domestic product	CA/GDP	International Monetary Fund
Inflation	Percentage change of the average consumer price index	ΔP/P	International Monetary Fund
Uncertainty - US	Chicago Board Options Exchange Volatility Index	VIX	Federal Bank St. Louis
Uncertainty - EUR	Euro Stoxx 50 options Volatility Index	VSTOXX	DataStream

Appendix III (Table 12) - Pearson correlation between Bond yields, ESG ratings and macroeconomic variables and CDS spreads for Eurozone

		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	CDS
1.	**Bond yield**	1											
2.	**ESG**	-.340**	1										
3.	**Env**	-.143*	.406**	1									
4.	**Soc**	-.245**	.643**	-.261**	1								
5.	**Gov**	-.197**	.826**	.235**	.345**	1							
6.	**(X+M)/GDP**	-.193**	.295**	-.253**	.226**	.516**	1						
7.	**Debt/GDP**	-.152*	-.462**	0.024	-.298**	-.543**	-.180*	1					
8.	**ΔP/P**	-.180**	-0.016	0.001	-0.012	0.005	0.063	-.176**	1				
9.	**ΔGDP/GDP**	-0.034	0.005	-.236**	0.069	0.126	.317*	-.260**	.225**	1			
10.	**CA/GDP**	-.261**	.489**	-.251**	-.265**	-.442**	-.257*	-0.029	-0.068	0.084	1		
11.	**VSTOXX**	.278**	-0.017	-0.028	-0.007	-0.005	-0.088	-0.053	-0.012	-0.096	-0.054	1	
	CDS		-.419**	-.207*	-.275**	-.301**	-0.081	0.221	-0.014	-0.151	-.307**	.167*	1

CDS spreads, trade openness, government debt and VSTOXX are in natural logarithm. ** Correlation is significant at the 1% level. * Correlation is significant at the 5% level.

Appendix IV (Table 13) - Pearson correlation between Bond yields, ESG ratings and macroeconomic variables and CDS spreads for US

		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	CDS
1.	**Bond yield**	1											
2.	**ESG**	.704**	1										
3.	**Env**	0.279	0.373	1									

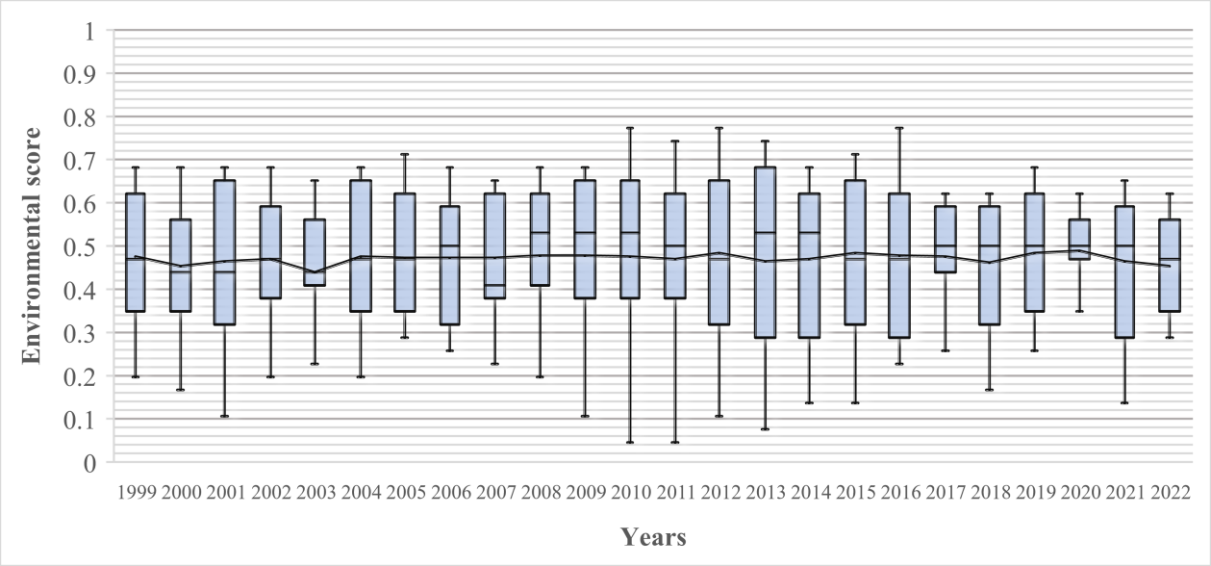
4.	**Soc**	.730**	.933**	0.084	1							
5.	**Gov**	0.360	.672**	0.116	.589**	1						
6.	**(X+M)/GDP**	-.507*	-0.319	-0.101	-0.384	-0.073	1					
7.	**Debt/GDP**	.819**	.853**	0.177	.892**	.559**	.454*	1				
8.	**ΔP/P**	-0.157	-0.160	-0.227	-0.020	-0.353	-0.012	-0.007	1			
9.	**ΔGDP/GDP**	0.298	0.196	0.102	0.230	0.094	0.021	0.206	-0.322	1		
10.	**CA/GDP**	-.494*	-0.345	-0.035	-.508*	-0.072	-0.317	-.646**	.454*	-0.182	1	
11.	**VIX**	0.080	0.164	0.140	0.235	0.199	0.353	0.164	0.096	-.463*	-0.080	1
	CDS		.635*	0.179	.606*	.691**	.574*	-.827**	0.048	-0.248	-0.326	0.351

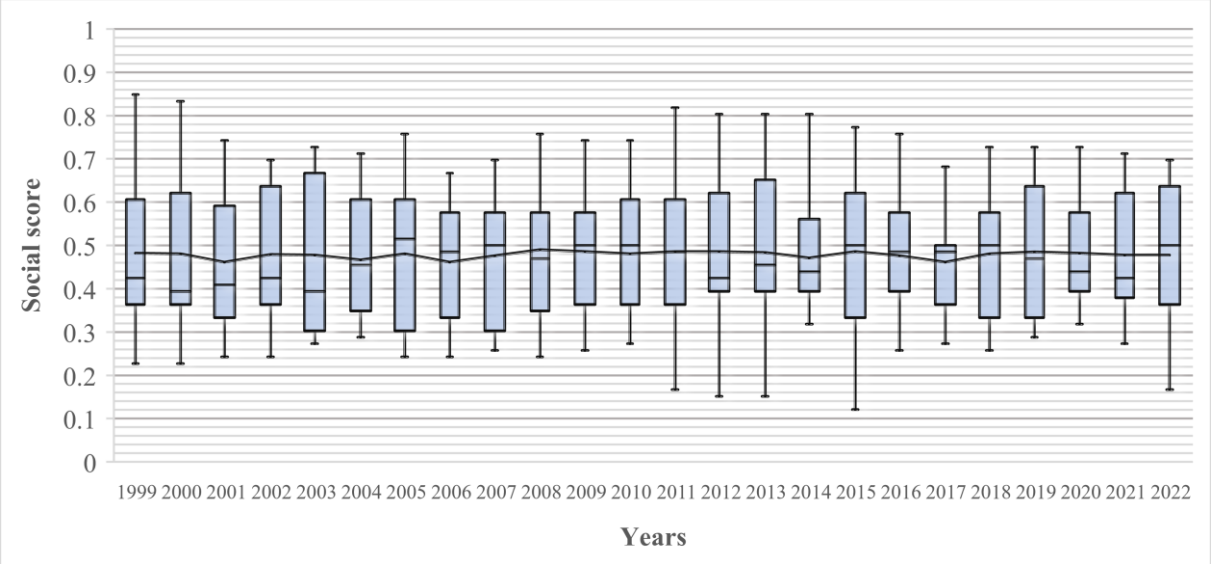
CDS spreads, trade openness, government debt and VIX are in natural logarithm. ** Correlation is significant at the 1% level. * Correlation is significant at the 5% level.

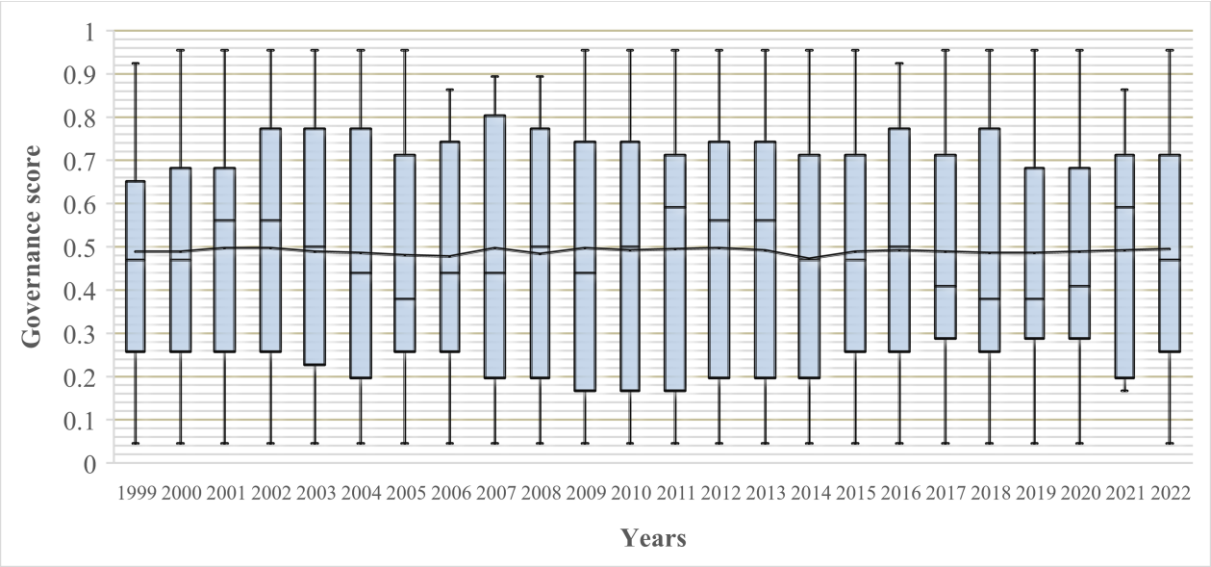
Appendix V (Table 14) – Variance Inflation Factors

	EUR	VIF	Tolerance		US	VIF	Tolerance
3.	**Env**	1.800	0.554	**3.**	**Env**	1.150	0.866
4.	**Soc**	1.480	0.677	**4.**	**Soc**	3.260	0.174
5.	**Gov**	3.070	0.325	**5.**	**Gov**	3.850	0.259
6.	**(X+M)/GDP**	1.980	0.506	**6.**	**(X+M)/GDP**	1.720	0.581
7.	**Debt/GDP**	1.850	0.539	**7.**	**Debt/GDP**	2.750	0.364
8.	**ΔP/P**	1.100	0.908	**8.**	**ΔP/P**	3.270	0.306
9.	**ΔGDP/GDP**	1.320	0.755	**9.**	**ΔGDP/GDP**	1.970	0.507
10.	**CA/GDP**	1.530	0.654	**10.**	**CA/GDP**	3.110	0.322
11.	**VSTOXX**	1.030	0.969	**11.**	**VIX**	1.910	0.523

Appendix VI (Figure 3) – Distribution of the individual pillar scores throughout the years






Governance score
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022
Years