Global Bachelor's Degree in Business Management and Entrepreneurship

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"Green Bonds vs. Traditional Bonds: A Comparative Analysis of Bond Pricing and Macroeconomic Influences in the EU Bond Market."

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ABSTRACT

The relationship between traditional and green bonds has gained more attention in recent years. Nowadays sustainability becomes part of financial markets and green bonds seem to be used more often as an option to regular bonds. Both bond types raise money through debt, however they may have different prices and attract different investors. The theoretical foundation of this study is The Efficient Market Hypothesis (EMH) to check if features such as green bond labels and ESG scores affect how both bond types are priced.

The research investigates the price differences between green and regular bonds in 15 countries of the European Union. It uses data from 2020 to 2025 and statistical methods such as correlation and multiple linear regression to study how sustainability and macroeconomic factors affect bond coupon rates.

The results show that green bonds do not always have lower coupon rates than regular ones. However, bonds with higher credit ratings usually offer lower rates. ESG scores are weakly linked to lower costs in green bonds, which suggests that sustainability may slightly affect pricing.

KEYWORDS

Green Bonds; Bonds; Sustainable Finance; Bond Pricing; European Bond Market; Macroeconomic Factors; Regression Analysis

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INDEX OF ACRONYMS AND ABBREVIATIONS

Initials	English	Spanish
CAB	Climate Awareness Bond	Bono de Conciencia Climática
ECB	European Central Bank	Banco Central Europeo
EIB	European Investment Bank	Banco Europeo de Inversiones
EMH	Efficient Market Hypothesis	Hipótesis del Mercado Eficiente
ESG	Environmental, Social, and Governance	Ambiental, Social y Gobernanza
EU	European Union	Unión Europea
GDP	Gross Domestic Product	Producto Interno Bruto
IMF	International Monetary Fund	Fondo Monetario Internacional
OECD	Organisation for Economic Cooperation and Development	Organización para la Cooperación y el Desarrollo Económico
OLS	Ordinary Least Squares	Mínimos Cuadrados Ordinarios

R	R Programming Language	Lenguaje de Programación R
SDG	Sustainable Development Goal	Objetivo de Desarrollo Sostenible
UN	United Nations	Naciones Unidas

1. Introduction

1.1 Research Problem

Traditional bonds have been used for centuries as fixed-income tools that pay regular interest and return the full amount at maturity (Thau, 2010). However, green bonds are a newer type of bond. The first one, called the Climate Awareness Bond, was issued by the European Investment Bank in 2007 to support renewable energy and efficiency projects (European Investment Bank, 2022). Unlike regular bonds, green bonds are designed to finance environmental projects. They also support larger goals in sustainable finance and climate policy, like the European Green Deal (Sartzetakis, 2019). Both types of bonds are used by governments, cities, and companies to raise money (Thau, 2010).

In recent years, green bonds have become more popular as people worry more about climate change and its impact on the global economy. Because of these risks, many financial markets now follow Environmental, Social, and Governance (ESG) ideas to support more responsible investments (Friede, Busch, & Bassen, 2015). The Risk-Return Tradeoff Theory says that investors usually want higher returns for taking bigger risks (Sharpe, 1964). However, some research shows that green bonds sometimes pay lower yields than normal bonds, which may mean investors care about sustainability more than profit alone (Zerbib, 2019). As a result, green bonds are seen as a good choice for both big and small investors, letting them spread risk and support the environment.

Even though green bonds are becoming more important, their financial performance is still debated. According to the Efficient Market Hypothesis (EMH), asset prices already include all available information. This means that green and traditional bonds should have similar returns in an efficient market (Malkiel, 2003). However, if green bonds are influenced by ESG-focused investors or government policies, this could go against traditional market theories

(Friede, Busch, & Bassen, 2015). Green bonds might also react differently to changes in interest rates, inflation, or GDP growth, which are factors in bond pricing (Fabozzi, 2021).

The research aims to compare the financial performance of green bonds and traditional bonds, focusing on their stability, volatility, and how their pricing responds to macroeconomic factors.

1.2 Research Questions/Hypothesis

In formulating the research questions, this study is based on some basic ideas about how financial markets work and how investors think, especially in the area of sustainable finance. For many years, traditional bonds have been a popular way to raise money because they are seen as safe and give regular income (Thau, 2010). However now, green bonds are becoming more common. They are made to support projects that help the environment. It is also believed that investors are starting to care more about things that are not only financial. They pay attention to how a company's operations affect the environment or to its ESG score when they are about to choose where to invest (Friede, Busch, & Bassen, 2015).

Building on this, the study assumes that green bonds might have lower coupon rates compared to traditional bonds. This could be because more investors want them, there are policy benefits, and they match big goals like protecting the environment. At the same time, classic finance theory says that bond prices also depend on things like the country's economy and the type of issuer. The Efficient Market Hypothesis (Malkiel, 2003) says that all available information, including ESG data, should already be included in bond prices. Moreover, economic factors like inflation and GDP growth can change how people expect interest rates to move, which affects bond yields (Fabozzi, 2021). Based on these ideas, the main research questions were created:

RQ1: Are green bonds in the European Union priced differently from traditional bonds, as measured by their coupon rates?

RQ2: To what extent do ESG scores and macroeconomic indicators such as GDP growth and inflation influence bond pricing in the European Union?

The first question looks at whether green bonds are priced differently compared to traditional bonds, based on their coupon rates. The second question explores how much ESG scores and economic indicators like inflation and GDP growth affect bond pricing and whether they help explain the differences.

Other hypotheses based on the Efficient Market Hypothesis (EMH) argue that if markets work perfectly, green bonds and traditional bonds with the same level of risk should have the same price. In this case, features like green labels or ESG scores would already be included in the price, and there would be no big difference in yields (Malkiel, 2003; Fama, 1970). But some studies show that investors may choose green bonds because they care about sustainability. Furthemore, if not all information about environmental impact is shared, it may cause small changes in pricing. This is called the ‘greenium’, meaning that green bonds have slightly lower yields compared to yields of traditional bonds (Zerbib, 2019). Based on these ideas, the following hypothesis is formed:

H1: *Green bonds are associated with lower coupon rates than traditional bonds, and this relationship is influenced by ESG performance and macroeconomic indicators such as inflation and GDP growth.*

1.3 Objectives

1.3.1 General Objective

The main purpose of this research is to study how the pricing of green bonds is different from traditional bonds in the European Union between 2020 and 2025. To do this, the study applies correlation analysis and multiple linear regression to see how economic factors such as inflation and GDP growth affect the coupon rates of both types of bonds. It also includes other variables such as ESG scores, bond grade, the country where the bond was issued, and the year it was issued. These are used to check if green or sustainable features have a real effect on bond pricing. The methods and results are explained more in the next parts of the thesis.

1.3.2 Specific Objective

The first objective is to compare coupon rates between green bonds and traditional bonds issued in 15 member countries of the European Union from 2020 to 2025. This comparison will help determine whether green bonds are priced more favorably, which could make them a cheaper funding option for environmentally focused issuers.

The second objective is to study how macroeconomic factors such as inflation and GDP growth influence the pricing of both green and traditional bonds. This analysis helps to understand how broader economic changes shape investor expectations and affect bond yields.

The third objective is to test the idea that green bonds issued in countries with stronger ESG performance and more stable economies meaning low inflation and steady GDP growth are linked to lower coupon rates than traditional bonds. This will show whether both sustainability and national-level economic stability lead to better financing terms.

2. Justification of the Research: Relevance to Sustainability, Finance, and Scientific Contribution to the Academic Knowledge

The research supports several of the United Nations Sustainable Development Goals (SDGs). It particularly connects to the following goals:

- SDG 7 (Affordable and Clean Energy) focuses on making sure everyone has access to clean and reliable energy. Green bonds help financially in supporting projects that produce renewable energy, like solar or wind power (Sustainable Development, n.d.).
- SDG 9 (Industry, Innovation and Infrastructure) aims to improve industry and build better infrastructure using clean technologies. Green bonds are used to fund low-carbon projects in the EU (Sustainable Development, n.d.).
- SDG 11 (Sustainable Cities and Communities) is about making cities safer, greener, and more sustainable. Green financial tools fund eco-friendly transport, housing, and urban planning (Sustainable Development, n.d.).
- SDG 13 (Climate Action) encourages countries to take action against climate change. Green bonds as a tool support the EU reach its climate targets and become carbon-neutral (Sustainable Development, n.d.).

2.1 Literature Review

Sustainable finance becomes more important not only in Europe, but also in global scale. Many researchers have studied whether green bonds, behave differently from traditional bonds in terms of risk and return.

Gianfrate and Peri (2019) found that green bonds are sometimes priced with slightly lower yields than traditional ones. This may happen because some investors accept lower returns in exchange for supporting the environment. Fatica, Panzica, and Rancan (2021) also studied green bond prices in the primary market. They found that green bonds may be financially undervalued but socially overvalued, which means investors care about more than

just profit. They support the idea of existence of a ‘greenium’, which is the small price discount investors accept when choosing green bonds instead of traditional bonds.

Other studies have explored the performance of government bonds across Europe. For example, Vuković et al. (2021) studied what affects the yield to maturity of government bonds in Europe. They found that both the features of the bond and the country that issues it can change how much return investors get. Therefore, it is important to look at both risk and return when comparing how bonds perform. In a similar way, Flammer (2021) found that portfolios with corporate green bonds have less risk. This means that green bonds can help make investments more stable. Therefore, green bonds are not only good for the environment but might also have lower financial risk.

Baker et al. (2018) also added to this topic by showing that green bonds often have lower yields than similar traditional bonds, even when maturity, rating, and issuer type are the same. Therefore, investor interest in sustainable investments may affect how bonds are priced. Fatica, Panzica, and Rancan (2021) found similar results. They explained that factors such as external certification and the reputation of the issuer can also change how green bonds are priced in the European Union, where rules about sustainable finance are always changing.

Furthermore, in relation to macroeconomic factors and how they affect bond pricing, Ehrmann et al. (2007) studied bond yield changes in eurozone countries. They found that investor behavior is influenced by inflation expectations and announcements from central banks. Their study also showed that these effects are stronger in countries with less trust in national monetary policies. However, the effect depends on how much people trust their country’s monetary policy. Bernoth, von Hagen, and Schuknecht (2012) also talked about the importance of fiscal strength and trust in national institutions. Countries with better financial situations and stable governments usually pay lower interest on their bonds, while countries with high debt or weaker institutions often have higher borrowing costs.

Canova and Pappa (2020) used econometric models to study how bond prices react to changes in interest rates, inflation, and GDP growth in eurozone countries. Their results show that different countries respond in different ways to global economic events like the COVID-19 crisis, and this can affect how bonds perform. These findings support using macroeconomic indicators in this study, as they may help explain why bond yields may be different or not across EU member states.

Even though more research is being done on this topic, there are still some gaps in the literature. First, many studies have looked at yield differences between green and traditional bonds (Baker et al., 2018; Zerbib, 2019), however fewer have used correlation and multiple linear regression models, especially working with data from the EU. Second, while macroeconomic factors like inflation and GDP have been studied in relation to traditional bonds (Ehrmann et al., 2007; Canova & Pappa, 2020), their effect on green bond pricing is still not well understood. Third, much of the research is based on data from before 2020, missing important changes caused by the COVID-19 pandemic and the European Green Deal, which have made investors more focused on ESG factors.

Therefore, this study tries to close these gaps by comparing green and traditional bonds and looking at how macroeconomic factors like inflation and GDP affect their prices. It uses recent data from the EU (2020–2025) and adds new ideas to the topic of sustainable finance in the European area. It is also based on traditional bond pricing theories (Fabozzi, 2021) and shows the need to look at both financial data and what investors care about, like the environment.

2.2 Theoretical Framework

The paper focuses on several well-known financial theories. One of them is the Efficient Market Hypothesis (EMH), which says that all available information is already included in market prices. This means it is hard to get better results than the market (Fama, 1970). If investors care about sustainability, it should also be shown in bond prices.

The research also uses bond pricing models and the risk-return tradeoff theory, which explains that investors want higher returns when taking more risk (Sharpe, 1964). These models describe why factors like credit rating, interest rates, and bond maturity influence coupon rates. Green bonds may offer different yields if investors believe they are more or less risky or if they accept lower returns to support sustainable projects (Zerbib, 2019).

Furtermore, the paper also includes ideas from sustainable finance, which look at how Environmental, Social, and Governance (ESG) performance can influence investor preferences and where money is invested (Friede, Busch, & Bassen, 2015; Flammer, 2021). Investors who care about sustainability may be willing to accept lower returns known as the "greenium" in exchange for positive environmental impact.

Finally, macroeconomic theory also contributes to this study. Economic indicators such as GDP growth and inflation influence bond yields because they affect investor expectations and central bank decisions (Mishkin, 1989). This is needs to be especially taken into account as countries in the European Union have different economic conditions that impact bond pricing.

The following sections explain each of these theories in more detail and show how they support the choice of variables used in the regression models.

2.2.1 Efficient Market Hypothesis

The Efficient Market Hypothesis (EMH), introduced by Fama (1970), says that all available information is already included in the prices of financial assets. This means that investors cannot regularly earn higher returns than the market by picking stocks or trying to time the market, because prices change quickly when new information comes out. From this view, the price of a traditional bond, including green bond, should reflect its risk and expected return. Therefore, if a green bond and a traditional bond have similar financial features, their prices should also be similar, assuming the market sees them the same way.

However, the EMH is often debated. Some experts say that markets are not always fully efficient. For example, Malkiel (2003) agrees that markets are mostly efficient, however sometimes prices behave strangely. Behavioral economists argue that investors do not always make rational decisions. Furthemore, studies by Shleifer and Summers (1990) and Sewell (2011) show that emotions can lead to wrong prices in the market for a short time. This means that investors do not always behave logically or rationally, and this can cause asset prices to be too high or too low for a while. This applies to green bonds, where some investors may buy them for ethical or environmental reasons, even if the returns are lower (Baker et al., 2018). Such behavior of choosing a lower return for a positive impact is known as the ‘greenium’ (Gianfrate & Peri, 2019), and it goes against the main idea of EMH. The Adaptive Market Hypothesis (AMH) introduced by Lo (2004) helps to explain it better.

According to the Adaptive Market Hypothesis (AMH), market efficiency can change depending on the situation, how investors learn, and how they adjust over time. Since ESG data and sustainability rules are not yet fully consistent, investors might price green bonds in different ways. However, as ESG reporting gets better and more investors join the market, prices may become more accurate.

In summary, the Efficient Market Hypothesis (EMH) is a good starting point for understanding how traditional bonds are priced. However, it may not fully explain how green bonds are priced. Investor preferences, growing interest in ESG, and changing regulations can cause short-term price differences that EMH alone cannot explain.

Table 1 *Efficient Market Hypothesis vs. Green Bond Market Realities*

EMH Assumptions	Observations in Green Bond Market
All information is instantly priced	ESG factors are still inconsistently reflected in bond prices
Investors care only about financial returns	Investors also value environmental and social impact
No persistent mispricing	The presence of 'greenium' suggests some mispricing persists
Markets behave rationally	Behavioral biases such as ethics, reputation influence decisions

Note. Own Elaboration.

2.2.2 Bond Pricing Theory

Bond prices are based on the present value of future cash flows. These include regular coupon payments and the amount paid back at the end of the bond's life. To find the bond's value, these payments are discounted using the market interest rate or the return expected by investors. This rate depends on the bond's risk, such as credit risk and the overall economic situation. As Fabozzi (2021) explains, bond prices and interest rates move in opposite directions: when interest rates go up, bond prices go down; and when interest rates go down, bond prices go up. This rule applies to both green and traditional bonds.

Traditional bond pricing models say that bonds with similar features such as maturity, type of issuer, and credit quality should have the same price. However some studies suggest this may not be true for green bonds. Research shows that green bonds often offer lower yields than traditional bonds with similar characteristics. This is called the 'greenium', and it means

that some investors may accept lower returns in order to support environmentally friendly projects (Baker et al., 2018; Karpf & Mandel, 2018; Zerbib, 2019).

As a result, traditional models for pricing bonds may need to be updated to include non-financial factors like ESG performance, transparency, and third-party certification (Flammer, 2021). These sustainability factors can affect investor choices, especially for those who follow strong ESG guidelines.

Credit ratings are still one of the most important traditional factors in bond pricing. Issuers with high credit ratings usually have lower borrowing costs because they are seen as less risky (Hull, 2018). This matters for green bonds as well, since they are often issued by governments or large international organizations that have strong credit scores. Therefore, it is important to look at both financial and green finance factors together to understand how bonds are priced today.

Table 2 *Main Pricing Differences Between Traditional and Green Bonds*

Pricing Factor	Traditional Bonds	Green Bonds
Cash Flows	Periodic coupon payments face value at maturity	Same structure as traditional bonds
Discount Rate	Determined by credit risk, maturity, market interest rate	May be lower due to investor demand for sustainable investments
Coupon Rate	Reflects the conventional risk-return trade-off	May include a yield discount 'greenium' due to ESG-related preferences
Investor Motivation	Primarily focused on financial returns	Financial return Environmental impact
Market Assumptions	Assumes all risk-return factors are efficiently priced	May be affected by non-financial motives, challenging Efficient Market Hypothesis
Transparency and Reporting	Standard financial disclosures	Enhanced reporting obligations on use of proceeds and environmental outcomes

Note. Own Elaboration.

2.2.3 ESG and Sustainable Finance Theories

In recent years, Environmental, Social, and Governance (ESG) factors have become more relevant in investment decisions when it comes to bond markets. ESG and sustainable finance theories question the traditional idea that making a profit is the only goal of investing. Instead, they suggest that non-financial factors such as environmental risks, social impact, and good company management can also affect how well financial assets perform and how risky they are (Friede, Busch, & Bassen, 2015; Flammer, 2021). Furthemore, more studies show that using ESG criteria might improve long-term performance, or at least not hurt returns. This has encouraged many investors and institutions to consider ESG when building their portfolios (Fatemi et al., 2015).

Green bonds usually require more transparency, such as clear information on how the money will be used and regular updates on the progress of the project that is meant to address environmental issues. The idea behind why green bonds might offer lower returns, known as the ‘greenium’ is that many investors care about sustainability and are willing to accept slightly lower profits (Zerbib, 2019; Bachelet, Becchetti, & Manfredonia, 2019). This is explained by the theory of socially responsible investing, which says that investors also get personal satisfaction from knowing their money supports ethical or environmental goals (Heinkel, Kraus, & Zechner, 2001).

Furthermore, the concept of double materiality, introduced by the European Commission (2019), adds more to the concepts of financial reporting and ESG performance. It says that companies and financial tools should be judged not only by how ESG factors affect them financially, however also by how their actions impact the environment and society. For green bonds, this means that both the environmental effect of the funded projects and the overall ESG score of the issuer could affect the bond’s price. Therefore, this study includes ESG scores as a variable to see if ESG performance is linked to lower borrowing costs, especially for green bonds compared to regular ones.

Table 3 *ESG and Sustainable Finance Theories in the Context of Green Bonds*

Concept	Traditional Finance View	Sustainable Finance Perspective
Investment Objective	Maximize risk-adjusted financial return	Financial return with positive environmental impact
Investor Motivation	Financial return only	Focus on ESG, and non-financial considerations
Pricing Mechanism	Based on financial risk and time value of money	Financially reflects investor preferences for sustainability preferences
Utility Theory	Utility derived from monetary gains	Includes non-monetary utility from supporting socially responsible initiatives
Disclosure Requirements	Standardized financial disclosures	Enhanced reporting on use of proceeds and environmental outcomes

Note. Own Elaboration.

2.2.4 Risk-Return Tradeoff in Fixed Income Markets

The risk–return tradeoff means that higher returns usually come with higher risk. In bond markets, this tradeoff shows up in bond yields and coupon rates, which give investors extra return for taking on different types of risk such as credit risk, interest rate risk, or inflation risk. Sharpe (1964), through the Capital Asset Pricing Model (CAPM), explained that expected returns are connected to overall market risk. When it comes to bonds, investors usually want higher coupon rates for riskier bonds, especially those with lower credit ratings, longer time to maturity, or exposure to uncertain economic conditions (Fabozzi, 2021).

This idea is especially important when comparing green bonds to traditional bonds. Some green bonds are seen as less risky because of strong ESG performance, more transparency, or support from governments. In these cases, the risk–return theory would suggest that green bonds should have lower yields. However, studies like Zerbib (2019) and

Flammer (2021) show that green bonds often give slightly lower returns even though they do not carry higher risk. This goes against traditional finance theory and suggests that some investors are willing to accept lower returns in exchange for helping the environment or society, which once again is called ‘greenium’.

People see risk differently depending on who issues the bond and what kind of project it funds. Green bonds from supranational institutions or strong governments are usually seen as low-risk. On the other hand, green bonds from companies may seem riskier, especially if the company does not clearly share ESG information or lacks third-party certification (Gianfrate & Peri, 2019). In recent years, ESG-related problems such as pollution, weak management, or climate change have started to be seen as financial risks too (OECD, 2020). This shows that including ESG in financial analysis may help investors spot risks that are not part of traditional models, which can lead to better risk-adjusted performance (Friede et al., 2015).

In summary, the risk–return tradeoff is a helpful way to understand the regression results in this thesis. If green bonds have lower coupon rates, even after accounting for common risk factors such as economic conditions, it could mean that investors see them as less risky or that they are willing to accept lower returns in exchange for supporting sustainability.

Table 4 *Risk-Return Tradeoff Across Bond Types*

Bond Type	Perceived Risk	Expected Return	Influencing Factors
Traditional Government Bond	Low	Low	Credit rating, fiscal stability, central bank credibility
Traditional Corporate Bond	Medium to High	Higher	Creditworthiness, market exposure, macroeconomic sensitivity
Green Government Bond	Very Low	Slightly Lower	ESG preferences, transparency, reputational signaling
Green Corporate Bond	Low to Medium	Moderate	ESG disclosure quality, project verification, issuer reputation

Note. Own Elaboration.

2.2.5 Macroeconomic Influences on Bond Markets

Macroeconomic factors shape what investors expect, how they view risk, and how bonds are priced. Two of the most important economic indicators are inflation and gross domestic product (GDP) growth. These factors influence the overall economy by affecting interest rates and borrowing costs. When inflation is expected to increase, investors usually want higher yields to protect their real returns. This leads to higher coupon rates on new bonds (Mishkin, 1989). In the same way, when GDP growth is strong, the need for capital goes up, and central banks may raise interest rates. On the other hand, when the economy slows down, interest rates often fall because central banks want to support spending and investment (Fabozzi, 2021).

In the European Union (EU), macroeconomic trends are connected to the actions of the European Central Bank (ECB). Ehrmann et al. (2007) showed that inflation expectations and how the central bank communicates can have impact on bond yields across eurozone countries.

Canova and Pappa (2020) also found that GDP growth affects bond markets in different ways across EU countries. This is because each country has different levels of debt, trust in their fiscal policies, and how investors feel about their economies.

The relationship between macroeconomic factors and green bonds can be more complicated than with traditional bonds. Green bonds are often affected by demand from ESG-focused investors, which can change based on the economic situation. For example, when interest rates are low, green bonds may seem more attractive because they are seen as stable and support long-term sustainability goals. On the other hand, when inflation is high, investors may care more about getting higher returns and less about environmental impact. This can lower the demand for green bonds and reduce the "greenium" (Zerbib, 2019).

Furthermore, international institutions like the European Central Bank (ECB) and the International Monetary Fund (IMF) have started to include climate risks in their economic models and financial stress tests. This shows a growing trend toward adding ESG (Environmental, Social, and Governance) factors into economic and financial planning (ECB, 2021; IMF, 2022). In the European Union, this means that the line between financial and environmental issues is becoming less clear.

As a result, the study uses inflation and GDP growth as variables in the regression model. Including these macroeconomic variables gives a more complete and accurate picture of how both sustainability and economic conditions affect bond pricing in the EU.

Table 5 *Summary of Macroeconomic Effects on Bond Pricing and Green Bond Insights*

Macroeconomic Factor	Effect on Bond Pricing	Green Bond Specific Impact
Inflation	↑ Inflation → ↑ Coupon rates to offset purchasing power loss	May reduce green bond demand if investors prioritize fixed return over ESG alignment
GDP Growth	↑ GDP growth → ↑ Interest rates due to higher demand	Economic expansion can strengthen demand for sustainable investments, especially EU-labeled green bonds
Fiscal Credibility	↑ Credibility → ↓ Risk premium → ↓ Yields	Green bonds from fiscally stable issuers are perceived as less risky, enhancing their attractiveness
Central Bank Policy	Policy shifts affect interest rate and bond spreads	ECB integration of ESG considerations can increase green bond credibility and spread effects

Note. Own Elaboration.

3. Methodology

The main objective is to investigate whether green bonds have different coupon rates compared to traditional bonds, and if these differences can be explained by certain factors. These include the ESG score, green bond label, bond grade, issuing country, and year of issuance.

To reflect the wider economic context, the study also includes two key macroeconomic indicators: GDP growth and inflation rate. These variables are useful in capturing both micro-level sustainability factors and macro-level financial trends that may influence investor decisions and bond pricing (Fabozzi, 2013).

The goal is to assess whether sustainability features and national economic conditions have a statistically significant impact on bond yields. To investigate this, a multiple linear regression model is applied. This method is often used in financial research to estimate how different independent variables affect a dependent variable. In this research it is the coupon rate of traditional bonds and green bonds (Wooldridge, 2020). The follwing sections explain each of these variables in more detail.

3.1 Research Design

This research uses a quantitative design, based on secondary data and statistical methods, to examine how selected variables influence bond pricing. A quantitative approach is for identifying patterns, testing hypotheses, and exploring cause-and-effect relationships in financial studies (Creswell & Creswell, 2018). In this analysis, the coupon rate stands for the dependent variable, representing the cost of borrowing for the bond issuer. The independent variables include green bond status (categorical), ESG score (continuous), bond grade (categorical), GDP growth and inflation (continuous), and the issuing country (categorical).

The explanatory research strategy is applied to understand what factors affect differences in coupon rates between green and traditional bonds within the European Union

(Casula et al., 2020). A deductive approach is followed, starting with economic theory and past research to formulate hypotheses Bhattacherjee (2012). The attention is given to sustainability-related variables such as ESG performance and green bond labeling, while also controlling for macroeconomic conditions.

A multiple linear regression model is applied, estimated using the Ordinary Least Squares (OLS) method. This model is used to determine how each independent variable contributes to explaining variations in the coupon rate. The tools used for evaluating the model include p-values (for testing statistical significance), Adjusted R-squared (to assess model fit), and diagnostic tests (to detect issues like heteroskedasticity). This enables a comparison between green and traditional bonds to later assess whether sustainability features or economic conditions have a stronger influence on bond pricing.

This type of regression-based analysis is widely used in sustainable finance research to investigate the impact of ESG factors and to identify the presence of a ‘greenium’ the lower yields sometimes associated with green bonds (Zerbib, 2019; Fatica & Panzica, 2021).

3.2 Data and Variables

This research originally aimed to include all European Union countries. However, due to limited data availability, the sample was narrowed down to 15 EU countries. This smaller sample still allows for answering the research questions and testing the hypothesis.

The dataset used in this study comes from two main sources. Bond-specific data including coupon rates, bond grade, issuance year, green bond classification, and ESG scores that was collected from the Refinitiv Eikon platform, a widely used financial database in academic and professional finance (Refinitiv, 2023). Macroeconomic indicators, such as annual GDP growth and inflation rates, were retrieved from the World Bank database, which provides reliable cross-country economic data (World Bank, 2024).

The sample includes bonds issued between 2020 and 2025, covering a mix of green and traditional bonds. This time frame ensures that the data reflects recent market developments and allows for a fair comparison across different types of bonds issued under similar economic conditions.

The dependent variable in the regression analysis is the coupon rate, which represents the fixed interest payment made to bondholders. The main independent variable is the green bond label, a binary indicator that shows whether a bond is classified as green or not. Other independent variables include the ESG score of the issuing entity, the bond grade (credit quality), the country of issue, and the year of issuance. Additionally, GDP growth and inflation rate are included as control variables to account for the broader macroeconomic environment during the bond issuance period.

The table below provides a summary of all the variables included in the regression models.

Table 6 *Overview of Variables Used in Regression Models*

Variable Name	Type	Description
Coupon Rate	Continuous	Fixed interest rate paid annually by the bond issuer to the investor
Green Bond	Categorical	Indicates whether the bond is green or traditional
ESG Score	Continuous	Environmental, Social, and Governance score of the issuing entity
Bond Grade	Categorical	Credit rating classification of the bond
Country of Issue	Categorical	Country where the bond is issued
Year	Categorical	Year of bond issuance
GDP Growth	Continuous	Annual GDP growth rate of the issuing country
Inflation Rate	Continuous	Annual inflation rate of the issuing country

Note. Own Elaboration.

Dependent variable

Coupon Rate

The coupon rate is the fixed annual interest payment that a bond issuer pays to the bondholder, usually expressed as a percentage of the bond's face value. It reflects the cost of borrowing for the issuer and the return required by investors (Fabozzi, 2021). In sustainable finance, green bonds may sometimes offer lower coupon rates if investors are willing to accept lower returns for environmental impact, a trend known as the "greenium" (Zerbib, 2019).

Independent variables

Green Bond

The green bond label is a binary variable showing whether a bond is classified as green. Green bonds are used to finance projects that have environmental benefits, such as renewable energy or energy-efficient buildings. This variable is used to test whether green bonds are priced differently from traditional bonds. Some studies suggest that green bonds may have lower yields due to stronger demand from ESG-focused investors (Gianfrate & Peri, 2019; Zerbib, 2019).

ESG Score

The *ESG score* is a measure of a company's performance in environmental, social, and governance areas. A higher score means the company follows more sustainable practices. Investors may see these companies as more responsible and less risky, which can affect bond pricing (Friede, Busch, & Bassen, 2015; Flammer, 2021). In this study, the ESG score is used to see if sustainability performance, beyond just having a green label, has an influence on the coupon rate.

Bond Grade

The bond grade shows the creditworthiness of the issuer. Bonds with higher ratings like AAA or AA are considered less risky and usually offer lower coupon rates. This factor is essential in bond pricing, including for green bonds, as many institutional investors prefer highly rated assets (Hull, 2018).

Year and Country of Issuance

The year of issuance controls for time-related effects, such as changes in interest rates or economic conditions. The country of issuance helps account for national differences, such as economic policies, financial stability, or investor confidence. These controls ensure the analysis reflects variations across time and geography (Bernoth et al., 2012).

GDP Growth and Inflation

GDP growth and inflation are important macroeconomic indicators. When GDP grows, bond yields may rise due to stronger demand for capital. Higher inflation often leads investors to ask for higher yields to keep up with the loss in purchasing power (Mishkin, 2016). Including these variables helps to reflect the broader economic environment that could affect bond pricing (Canova & Pappa, 2020; Ehrmann et al., 2007).

4. Analysis

Inferential statistics are used to test the hypotheses and understand bond pricing in the European Union. By applying both correlation and regression analysis there is a possibility of finding out whether there are relationships between the coupon rate of bonds and above-described variables. Correlation analysis is used to identify if two variables tend to move together in the same direction or in opposite directions. However, it is important to remember that correlation does not mean causation. Even if two variables are related, it does not always mean that one causes changes in the other (Marshall & Jonker, 2011; Schumacker, 2017).

Furthermore, to examine possible cause-and-effect relationships, multiple linear regression analysis is used. This method allows for estimating how much the coupon rate, which is the dependent variable in this research, is influenced by other independent variables like green bond label, ESG performance, bond grade, and macroeconomic conditions. The analysis is performed in RStudio, a statistical software used for econometric analysis also commonly used in both academic research and professional finance (Kabacoff, 2015).

In the next sections, the initial model is presented and discussed together with correlation matrix. The aim is to check for multicollinearity and improve the initial model if needed. Lastly, the results and interpation is presented including separate models for green bonds and traditional bonds for better understanding the difference in pricing between them.

4.1 Initial Model

An initial model is created with dependent variable ‘Coupon rate’ and above-mentioned independent variables (see Figure 1).

Figure 1 *Initial Multiple Regression Model*

```
Call:
lm(formula = Coupon ~ `Green Bond` + `ESG Score` + `Bond Grade` +
    GDP_Growth + Inflation_Rate + `Country of Issue` + Year,
    data = data)

Residuals:
    Min      1Q  Median      3Q     Max
-3.6424 -0.7008 -0.2131  0.5052 10.0695

Coefficients:
                                Estimate Std. Error t value Pr(>|t|)
(Intercept)                    2.5839566  0.3566625   7.245 7.20e-13 ***
`Green Bond`1                  0.4552781  0.1277359   3.564 0.000377 ***
`ESG Score`                    0.0008858  0.0030897   0.287 0.774378
`Bond Grade`Investment Grade  -2.2923348  0.1912897 -11.984  < 2e-16 ***
GDP_Growth                    -0.0653335  0.0261796  -2.496 0.012692 *
Inflation_Rate                -0.0139476  0.0417369  -0.334 0.738296
`Country of Issue`Belgium      0.3512104  0.1926587   1.823 0.068526 .
`Country of Issue`Finland     -0.1857847  0.4145219  -0.448 0.654087
`Country of Issue`France       0.3941649  0.1389961   2.836 0.004638 **
`Country of Issue`Germany     -0.0555472  0.1345523  -0.413 0.679796
`Country of Issue`Italy        0.3833018  0.1686894   2.272 0.023227 *
`Country of Issue`Netherlands -0.6550729  0.3227825  -2.029 0.042605 *
`Country of Issue`Portugal    -0.0499695  0.3048904  -0.164 0.869839
`Country of Issue`Slovakia    -0.0808124  0.3075323  -0.263 0.792762
`Country of Issue`Spain        0.6082186  0.1789532   3.399 0.000696 ***
Year2021                       0.8223368  0.3526237   2.332 0.019842 *
Year2022                       2.3913576  0.3748231   6.380 2.42e-10 ***
Year2023                       3.3790111  0.2931869  11.525  < 2e-16 ***
Year2024                       2.9744709  0.2334058  12.744  < 2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.188 on 1370 degrees of freedom
Multiple R-squared:  0.5408,    Adjusted R-squared:  0.5348
F-statistic: 89.63 on 18 and 1370 DF,  p-value: < 2.2e-16


        studentized Breusch-Pagan test

data:  model
BP = 23.362, df = 18, p-value = 0.1771
```

Note. Own Elaboration using RStudio software.

To evaluate the performance of the regression model, two key statistics are considered. One of these is the Adjusted R-squared, which measures how well the model fits the data overall. This value tells what percentage of the variation in the dependent variable (coupon rate) can be explained by the independent variables included in the model (Miles, 2005). In the case of the model presented in figure 1, the Adjusted R-squared is 0.5348, meaning that approximately 53.5% of the changes in coupon rates can be explained by the selected explanatory variables. In general, the higher this value is, the better the model fits, as it shows a larger proportion of explained variation.

However, it is important to note that the Adjusted R-squared does not indicate whether each individual variable in the model is statistically significant. To evaluate the relevance of each independent variable, p-values need to be considered. A p-value tells how likely it is that the effect of a variable happened by chance. It is compared to a significance level, usually 0.05 (5%). If the p-value is equal to or below 0.05, the variable is considered statistically significant, meaning it is likely to be useful in explaining the dependent variable (Marshall & Jonker, 2011). Variables with p-values between 0.05 and 0.10 may still be considered weakly significant, while those above 0.10 are often considered statistically insignificant and may be removed from the model, depending on the research goal.

Moreover, the Breusch-Pagan test was conducted to check for heteroskedasticity. The aim is to check that the assumptions of the regression model are met. The test returned a p-value of 0.1771, which is higher than the conventional 0.05 threshold. This suggests that the variance of the residuals is constant, and therefore, the assumption of homoskedasticity holds for this model (Wooldridge, 2020). As a result, the OLS regression estimates can be considered reliable and unbiased in terms of error variance.

By looking at the model (see Figure 1), some variables do stand out. The Bond Grade is highly significant and shows a strong negative relationship with the coupon rate, confirming

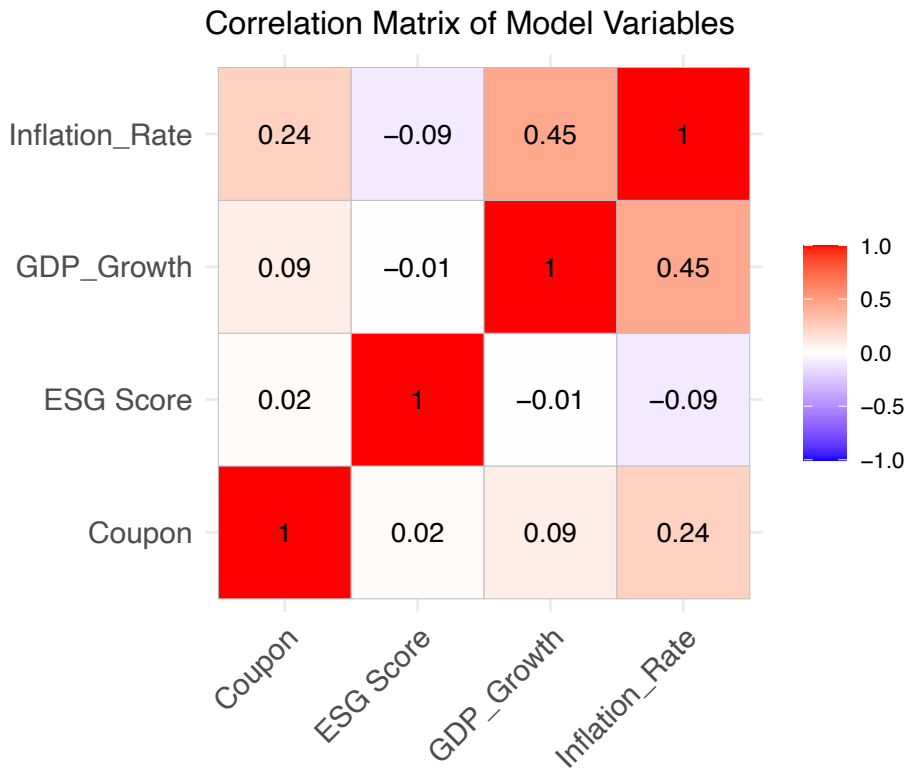
that investment-grade bonds tend to offer lower yields. The Green Bond label is also statistically significant. However, it shows a positive effect on the coupon rate. This suggests that green bonds in this sample are not associated with a pricing benefit, but rather might offer slightly higher yields. On the other hand, the ESG Score is not significant, indicating that it does not appear to affect pricing in this model. Among the macroeconomic variables, GDP growth is weakly significant, while Inflation is not. Additionally, some countries of issue and all post-2020 years show strong significance, reflecting market shifts and monetary policy changes over time.

These results raise the question of whether sustainability characteristics matter at all in pricing bonds. It is also important to remember that adding more variables does not always improve the quality of a model. In fact, too many variables can sometimes reduce clarity (Wooldridge, 2020).

Previous literature supports these mixed outcomes. For example, Zerbib (2019) found only small pricing differences in green bonds, while Fatica et al. (2021) reported that sustainability effects can depend on bond type and issuer. The findings in this model are more in line with research suggesting that ESG and green labels have limited impact. To explore these relationships further, a correlation matrix is used in the next section to examine variable relationships and potential overlaps.

4.2 Correlation Matrix and Improved Models

Figure 2 *Correlation Matrix of Variables*



Note. Own Elaboration using Rstudio software.

A correlation matrix is used to examine how the numerical variables in the model relate to one another. In Figure 2, the matrix shows the relationships between coupon rate (the dependent variable), ESG score, GDP growth, and inflation rate. The color scale helps visualize the strength and direction of each correlation: red values indicate positive correlations, while blue values represent negative ones. Values closer to 1 or −1 reflect stronger relationships, while those near 0 suggest weak or no correlation between the variables (Schober, Boer, & Schwarte, 2018).

Looking at the matrix, the coupon rate shows a positive correlation with inflation rate ($r = 0.24$), suggesting that bonds tend to offer higher coupon rates in periods of higher inflation. There is also a very weak positive correlation between coupon rate and GDP growth ($r = 0.09$),

and nearly no correlation with ESG score (r = 0.02). These patterns are consistent with the results from the regression model, where the ESG score was not statistically significant. The strongest correlation observed is between GDP growth and inflation (r = 0.45), which aligns with common macroeconomic trends.

Since none of the variables show very strong correlations (above 0.8), multicollinearity does not appear to be a concern. Therefore, all variables can be retained in the model. The next part of the analysis explores whether the relationship between coupon rates and explanatory variables changes when bond types are analyzed separately. Therefore, two separate regression models are created: one focusing only on green bonds and the other on traditional bonds.

Figure 3 *Model Representing The Effect Of Sustainability And Macroeconomic Factors On Coupon Rates Of Green Bonds.*

```
Call:
lm(formula = Coupon ~ `ESG Score` + `Bond Grade` + GDP_Growth + 
    Inflation_Rate + `Country of Issue` + Year, data = green_bonds)

Residuals:
    Min      1Q  Median      3Q     Max 
-2.7495 -0.6389 -0.1054  0.4932  2.6244 

Coefficients:
                              Estimate Std. Error t value Pr(>|t|)    
(Intercept)                    5.22552    1.65458   3.158 0.002231 ** 
`ESG Score`                   -0.02692    0.01554  -1.732 0.087098 .  
`Bond Grade`Investment Grade -1.84704    0.53121  -3.477 0.000818 ***
GDP_Growth                     0.02994    0.12050   0.248 0.804396    
Inflation_Rate                 0.16414    0.15540   1.056 0.294002    
`Country of Issue`Belgium     -0.73099    0.73608  -0.993 0.323621    
`Country of Issue`France       0.11928    0.54974   0.217 0.828774    
`Country of Issue`Germany     -0.03395    0.58645  -0.058 0.953975    
`Country of Issue`Italy       -0.14746    0.79981  -0.184 0.854188    
`Country of Issue`Slovakia     0.85984    0.76142   1.129 0.262121    
`Country of Issue`Spain        1.40186    0.77737   1.803 0.075055 .  
Year2021                      -1.16766    1.78488  -0.654 0.514841    
Year2022                       0.63494    1.80462   0.352 0.725870    
Year2023                       2.30309    1.40188   1.643 0.104289    
Year2024                       2.19186    1.17904   1.859 0.066657 .  
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.175 on 81 degrees of freedom
Multiple R-squared:  0.7157,    Adjusted R-squared:  0.6666 
F-statistic: 14.57 on 14 and 81 DF,  p-value: < 2.2e-16


        studentized Breusch-Pagan test

data:  model_green
BP = 29.512, df = 14, p-value = 0.008904
```

Note. Own Elaboration using Rstudio software.

Figure 3 presents the multiple linear regression results for green bonds, aiming to evaluate how both sustainability and macroeconomic factors influence coupon rates. The model shows a relatively strong fit, with an Adjusted R-squared of 0.6666, which means that approximately 67% of the variation in coupon rates is explained by the included variables. This is a solid result for a financial model, indicating that the chosen factors capture a substantial portion of the pricing behavior in the green bond segment. The overall model is statistically significant, as shown by the F-statistic p-value < 0.001, meaning it is unlikely that the results occurred by chance.

Among the variables, Bond Grade is the most statistically significant ($p < 0.001$), showing a strong negative relationship with coupon rate. This confirms that green bonds with higher credit quality offer lower returns, which aligns with general bond pricing logic. The ESG Score, while not strongly significant ($p = 0.087$), shows a negative coefficient, suggesting that higher ESG performance may be associated with slightly lower coupon rates. Although not conclusive, this supports the theory that investors may accept lower returns in exchange for sustainable impact. Several variables, such as Year 2024 ($p \approx 0.066$) and Spain ($p \approx 0.075$), approach conventional significance thresholds, hinting that temporal and country-specific factors may influence green bond pricing as well. Overall, this model suggests that sustainability characteristics could play a role in investor decision-making.

Furthermore to interpreting coefficients, the Breusch-Pagan test was applied to check for heteroskedasticity in the model. The result (p-value = 0.0089) shows that the variance of the residuals is not constant, which violates one of the classical linear regression assumptions. This suggests that the standard errors might be biased, and caution is needed when interpreting the significance of individual variables. Future research could apply robust standard errors to improve the reliability of the estimates.

Figure 4 *Model Representing The Effect Of Sustainability And Macroeconomic Factors On Coupon Rates Of Traditional Bonds.*

```
Call:
lm(formula = Coupon ~ `ESG Score` + `Bond Grade` + GDP_Growth + 
    Inflation_Rate + `Country of Issue` + Year, data = traditional_bonds)

Residuals:
    Min      1Q  Median      3Q     Max 
-3.6611 -0.7033 -0.1882  0.5089 10.0508 

Coefficients:
                                Estimate Std. Error t value Pr(>|t|)    
(Intercept)                     2.644414   0.370147   7.144 1.52e-12 ***
`ESG Score`                     0.002190   0.003162   0.693  0.48863    
`Bond Grade`Investment Grade   -2.345141   0.204102 -11.490  < 2e-16 ***
GDP_Growth                     -0.052718   0.027047  -1.949  0.05150 .  
Inflation_Rate                 -0.036698   0.043209  -0.849  0.39586    
`Country of Issue`Belgium       0.451619   0.198691   2.273  0.02319 *  
`Country of Issue`Finland      -0.140202   0.411359  -0.341  0.73329    
`Country of Issue`France        0.418512   0.142876   2.929  0.00346 ** 
`Country of Issue`Germany      -0.035844   0.137568  -0.261  0.79448    
`Country of Issue`Italy         0.409886   0.171553   2.389  0.01703 *  
`Country of Issue`Netherlands -0.623651   0.320242  -1.947  0.05170 .  
`Country of Issue`Portugal     -0.058947   0.303670  -0.194  0.84612    
`Country of Issue`Slovakia     -0.538342   0.346868  -1.552  0.12091    
`Country of Issue`Spain         0.519826   0.183417   2.834  0.00467 ** 
Year2021                        0.748568   0.360283   2.078  0.03793 *  
Year2022                        2.365206   0.382449   6.184 8.38e-10 ***
Year2023                        3.351074   0.299245  11.198  < 2e-16 ***
Year2024                        2.872085   0.237834  12.076  < 2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.175 on 1275 degrees of freedom
Multiple R-squared:  0.533,     Adjusted R-squared:  0.5268 
F-statistic: 85.62 on 17 and 1275 DF,  p-value: < 2.2e-16


        studentized Breusch-Pagan test

data:  model_green
BP = 29.512, df = 14, p-value = 0.008904
```

Note. Own Elaboration using Rstudio software.

Figure 4 shows the regression results for traditional bonds. The Adjusted R-squared is 0.5268, meaning that about 52.7% of the variation in coupon rates is explained by the model. Although slightly lower than the green bond model, this still reflects a strong fit. The model is also statistically significant overall, as shown by the F-statistic with a p-value below 0.001.

Similar to the green bond model, Bond Grade remains highly significant ($p < 0.001$), confirming that investment-grade bonds consistently offer lower coupon rates due to lower risk. In contrast to green bonds, the ESG Score shows no statistical significance in this model ($p = 0.489$), indicating that sustainability ratings have little to no influence on coupon pricing in traditional bond markets. Macroeconomic variables such as GDP growth ($p = 0.051$) and Inflation Rate ($p = 0.396$) also have weak or no influence. However, several issuer countries, including Belgium, France, Italy, and Spain, are statistically significant, suggesting that national factors may play a larger role in the pricing of traditional bonds. Overall, this model suggests that traditional bond pricing is still primarily driven by bond grade and market conditions, with little evidence that sustainability factors impact investor expectations in this segment.

4.3 Results and Interpretation

The regression models provide insights into the factors that influence both traditional and green bond pricing in the European market. In every model, the bond grade is very important. This means that the credit quality of a bond strongly affects the coupon rate. Investment-grade bonds typically come with lower coupon rates, which reflects investors' preference for lower-risk assets.

When the models for green bonds and traditional bonds are compared, some differences some differences can be noticed. In the green bond model, the ESG score has a small negative link with the coupon rate. This suggests that better environmental, social, and governance (ESG) performance might slightly reduce the cost of borrowing. Although this result is not

highly significant, it implies that ESG performance may play a growing role in influencing green bond pricing. In the traditional bond model, the ESG score does not affect the coupon rate, This outcome supports the notion that ESG factors are more influential in the context of green bonds than traditional ones.

Macroeconomic indicators such as GDP growth and inflation were found to have limited influence on bond pricing in both models. A modest positive association between inflation and coupon rates was observed in the correlation analysis.

These results agree with past research (e.g., Fatica et al., 2021; Zerbib, 2019), which indicated that green bonds may be priced more favorably in some cases, though the results vary across studies and conditions.

To evaluate whether the variance in the traditional bond model remained stable, the Breusch-Pagan test was applied. A p-value of 0.2585 suggests that the null hypothesis of constant variance cannot be rejected. This indicates the model does not exhibit heteroskedasticity, and the regression estimates can be considered dependable.

5. Conclusion

5.1 Summary of Key Findings

The main objective of this study was to explore whether green bonds are priced differently from traditional bonds in the European Union, and to assess how sustainability factors and macroeconomic conditions influence bond coupon rates. Using a dataset of bonds issued between 2020 and 2025, three regression models were created: a full model including all bonds, and two separate models: one for green bonds and one for traditional bonds.

The findings revealed that bond credit rating (Bond Grade) is the most significant factor influencing coupon rates in all models. Bonds with investment-grade ratings were consistently associated with lower coupon rates, which confirms that credit risk is a key driver of pricing in both green and traditional bond markets.

The Green Bond label was statistically significant in the full model, but it showed a positive effect on coupon rates. In this dataset, green bonds did not appear to be more affordable than traditional ones; rather, they carried slightly higher yields. However, when analyzing green bonds separately, the ESG score showed a weak negative relationship with the coupon rate. This suggests that better ESG performance might be associated with lower borrowing costs in the green bond segment, though the effect is not strong enough to be conclusive.

Regarding macroeconomic indicators, GDP growth had weak significance in the full model, while inflation rate did not show a consistent impact in any model. The correlation matrix supported these findings by showing only modest relationships between coupon rate and inflation, and nearly none with ESG score.

Additionally, issuer country and year of issuance played a role in pricing, especially in the traditional bond model. Some countries such as Spain, France and years 2023 and 2024 had a significant impact on coupon rates, possibly reflecting changing market conditions, investor sentiment, or central bank policy.

To ensure the reliability of the regression results, Breusch-Pagan tests were performed to assess heteroskedasticity in the models. The results showed no evidence of heteroskedasticity in the full model and the traditional bond model (p-values = 0.1771 and 0.2585, respectively), confirming that the assumption of constant variance in errors is valid. However, the green bond model indicated the presence of heteroskedasticity (p-value = 0.0089), suggesting that the error variance may not be stable across all observations in that subset. Although the results remain valid, interpretations of the green bond model require cautious analysis due to this issue. Future research could apply robust standard errors or alternative regression techniques to further validate these results.

The study addressed all three specific objectives. First, it confirmed that green bonds in this sample were not consistently cheaper than traditional bonds, as they exhibited slightly higher coupon rates. Second, macroeconomic factors such as inflation and GDP growth showed weak and inconsistent influence on bond pricing, indicating that traditional pricing factors remain dominant. Third, the analysis suggested a modest trend toward lower coupon rates in green bonds issued by countries with higher ESG scores and economic stability, though this trend was not statistically significant. These insights reinforce the idea that while sustainability-related features are beginning to influence pricing, the green bond market still heavily relies on conventional financial risk factors.

In summary, while sustainability-related variables like green bond status and ESG scores do play a role within the green bond segment, the strongest influence on pricing still comes from traditional financial indicators such as credit rating and country risk. These findings align with existing literature suggesting that the green bond market is still evolving and may not yet fully reflect sustainability premiums.

5.2 Limitations to the Study and Future Research

First, the dataset used in the analysis includes bonds issued between 2020 and 2025, which is a relatively short and specific time period. This timeframe overlaps with economic disruptions caused by the COVID-19 pandemic and recovery efforts, which may have influenced bond markets in ways that are not typical. Therefore, these findings might not be entirely applicable to different time periods or more stable economic environments.

Second, the models focus only on a limited set of variables, including ESG scores, bond grade, country of issue, and selected macroeconomic indicators such as inflation and GDP growth. While these are important factors, other variables such as interest rate expectations, central bank policies, investor demand, or bond maturity were not included due to data availability. Such factors could also play a role in bond pricing and may enhance model precision if included in future analyses.

Third, the ESG score in this study is treated as a single numeric value, but ESG is a broad concept made up of environmental, social, and governance components. Future studies could examine these dimensions separately to see if specific aspects of ESG performance have stronger impacts on bond yields.

Lastly, while the analysis distinguishes between green and traditional bonds, it does not examine sector-specific effects like corporate vs. sovereign issuers, or renewable energy vs. infrastructure projects. Such variations could impact how investors perceive risk and affect bond pricing decisions.

For future research, it would be useful to explore larger datasets that include bonds from more years and different regions. Researchers could also apply more advanced modeling techniques, such as fixed effects models or interaction terms, to better capture relationships between variables. Additionally, more work is needed to understand investor behavior in green

finance and whether non-financial motivations such as impact investing affect pricing differently than purely financial decisions.

5.3 Addressing Research Questions and Hypothesis

RQ1: Are green bonds in the European Union priced differently from traditional bonds, as measured by their coupon rates?

The regression results show that green bonds are not always cheaper than traditional bonds. In fact, in the full model, the Green Bond variable was statistically significant and had a positive effect on coupon rates. Thus, green bonds in this dataset had slightly higher yields. This result does not support the idea of a strong 'greenium'. However, when the models were split into green and traditional bonds, there were clear differences in how ESG scores and macroeconomic factors affected pricing. This suggests that bond type does influence how investors look at risk and return.

RQ2: To what extent do ESG scores and macroeconomic indicators such as GDP growth and inflation influence bond pricing in the European Union?

The models showed that ESG scores had only a small effect on bond pricing. In the full model and the traditional bond model, ESG was not statistically significant. But in the green bond model, the ESG score had a weak negative link to coupon rates. This suggests some investors may accept slightly lower returns for bonds with better ESG scores. Among macroeconomic indicators, GDP growth had weak significance in the full model, and inflation had little effect in any model. These results show that while ESG and economic factors may matter, they are less important than traditional factors like credit rating and year of issue.

H1: Green bonds are associated with lower coupon rates than traditional bonds, and this relationship is influenced by ESG performance and macroeconomic indicators such as inflation and GDP growth.

Based on the regression analysis, this hypothesis is only partly supported. Green bonds did not show lower coupon rates in the full model. ESG scores had a weak effect only in the green bond model, and macroeconomic factors were not consistently significant. So while ESG and economic conditions may influence green bond pricing to a small extent, they are not strong predictors when comparing green and traditional bonds directly. Overall, bond pricing is still mostly shaped by credit quality and market conditions.

5.4 Final Concluding Thoughts

This thesis aimed to find out whether green bonds in the European Union are priced differently from traditional bonds, and how much sustainability and economic factors influence their coupon rates. By using multiple linear regression models and analyzing green and traditional bonds separately, the study adds to current research on sustainable finance.

The results show that green bonds do not always have lower coupon rates than traditional ones. However, they may react differently to sustainability-related factors. In the green bond model, there was a weak negative relationship between ESG scores and coupon rates. This means investors might accept slightly lower returns for bonds that support environmental or social goals. This pattern was not seen in the traditional bond model, where pricing was more influenced by credit rating and country of issue.

Overall, this study shows that while sustainability is becoming more important, its effect on bond pricing is still small and depends on the type of bond. The price of green bonds seems to be shaped by both traditional financial factors and growing interest in ESG. As the green

finance market develops, future research will be important to understand how and when sustainability factors become more influential.

In conclusion, even though the hypothesis was only partly supported, this research gives useful insights into how sustainability connects with bond pricing. It also opens the door for future studies to look deeper into the financial risks and benefits of green bonds, especially as the market grows and new policies are introduced.

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7. Annexes

Annex A: Raw database

	A	B	C	D	E	F	G	H	I	J
1	Coupon	Maturity	Issue Date	Country of Issue	Coupon Type	Amount Issued (EUR)	Bond Grade	ESG Score	Country of Incorporation	Green Bond
2	0	2025-03-28 00:00:21	2020-04-28 00:00:21	Germany	Zero Coupon	1609221,434		79,7029	Germany	0
3	0	2025-03-28 00:00:21	2020-04-28 00:00:21	Germany	Zero Coupon	603458,2703		79,7029	Germany	0
4	0	2025-03-28 00:00:21	2020-04-28 00:00:21	Germany	Zero Coupon	704034,0286		79,7029	Germany	0
5	3.883	2025-03-31 00:00:21	2020-03-02 00:00:21	Austria	Fixed Margin over Index	5028818,609		72,4048	Austria	0
6	0	2025-03-31 00:00:21	2020-03-31 00:00:21	Austria	Zero Coupon	20133783,56		72,4048	Austria	0
7	1	2025-04-01 00:00:21	2020-03-30 00:00:21	France	Plain Vanilla Fixed Coupon	1003625769	Investment Grade	86,071	France	0
8	0	2025-04-03 00:00:21	2020-04-03 00:00:21	Austria	Zero Coupon	97265244,18		72,4048	Austria	0
9	0	2025-04-03 00:00:21	2020-03-27 00:00:21	Spain	Other / Complex Floating Rate	23946334,81		78,8857	Spain	0
10	3	2025-04-07 00:00:21	2020-04-06 00:00:21	Austria	Plain Vanilla Fixed Coupon	100576384,3		72,4048	Austria	0
11	1.125	2025-04-07 00:00:21	2020-04-06 00:00:21	France	Plain Vanilla Fixed Coupon	1003625769	Investment Grade	66,6939	France	0
12	3	2025-04-08 00:00:21	2020-04-06 00:00:21	Austria	Plain Vanilla Fixed Coupon	100576384,3		72,4048	Austria	0
13	0	2025-04-09 00:00:21	2020-03-31 00:00:21	Spain	Other / Complex Floating Rate	1205352,18		78,8857	Spain	0
14	3	2025-04-09 00:00:21	2020-04-06 00:00:21	Austria	Plain Vanilla Fixed Coupon	100576384,3		72,4048	Austria	0
15	0	2025-04-09 00:00:21	2020-04-08 00:00:21	Austria	Zero Coupon	100744158,7		72,4048	Austria	0
16	2.125	2025-04-09 00:00:21	2020-04-09 00:00:21	France	Plain Vanilla Fixed Coupon	602175460,8	Investment Grade	89,3664	France	0
17	0	2025-04-15 00:00:21	2020-04-14 00:00:21	Austria	Zero Coupon	97265244,18		72,4048	Austria	0
18	0	2025-04-15 00:00:21	2020-04-14 00:00:21	Austria	Zero Coupon	97265244,18		72,4048	Austria	0
19	0	2025-04-15 00:00:21	2020-04-14 00:00:21	Austria	Zero Coupon	97265244,18		72,4048	Austria	0
20	2.968	2025-04-17 00:00:21	2020-04-17 00:00:21	Austria	Fixed Margin over Index	752719326,1	Investment Grade	79,7029	Austria	0
21	2	2025-04-22 00:00:21	2020-04-15 00:00:21	Germany	Plain Vanilla Fixed Coupon	148809,6		79,7029	Germany	0
22	0	2025-04-22 00:00:21	2020-04-21 00:00:21	Austria	Zero Coupon	101181461,8		72,4048	Austria	0
23	0.52600000000000002	2025-04-24 00:00:21	2020-04-24 00:00:21	France	Plain Vanilla Fixed Coupon	501812884,3	Investment Grade	64,0224	France	0
24	0	2025-04-24 00:00:21	2020-04-24 00:00:21	Austria	Zero Coupon	2777159,16		72,4048	Austria	0
25	0	2025-04-25 00:00:21	2020-03-27 00:00:21	Austria	Zero Coupon	150543865,2		74,0382	Austria	0
26	0	2025-04-30 00:00:21	2020-04-24 00:00:21	Finland		50181287,78		67,1335	Denmark	0
27	0	2025-04-30 00:00:21	2020-04-30 00:00:21	Austria	Other / Complex Floating Rate	20225730,22		72,4048	Austria	0
28	0	2025-05-06 00:00:21	2020-05-04 00:00:21	Austria	Zero Coupon	100744158,7		72,4048	Austria	0
29	2	2025-05-07 00:00:21	2020-05-07 00:00:21	Germany	Fixed then Floating	1003625769		81,1669	Germany	0
30	0	2025-05-09 00:00:21	2020-06-09 00:00:21	Germany	Zero Coupon	579350,185		79,7029	Germany	0
31	0	2025-05-09 00:00:21	2020-06-09 00:00:21	Germany	Zero Coupon	1806526,223		79,7029	Germany	0
32	0	2025-05-09 00:00:21	2020-06-10 00:00:21	Germany	Zero Coupon	3707750,224		79,7029	Germany	0
33	0	2025-05-12 00:00:21	2020-05-12 00:00:21	Austria	Zero Coupon	100576384,3		72,4048	Austria	0
34	0	2025-05-12 00:00:21	2020-05-12 00:00:21	Austria	Zero Coupon	100576384,3		72,4048	Austria	0

Note. This image of a table contains raw data exported from Refinitiv in excel and used in R studio for regression analysis.