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Greening the Financial Sector One Bond at a Time

Investigating the existence of a greenium in the market for bank-issued bonds and the effect of green policies in the European Union

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Abstract

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Key words: Greenium, Green bonds, Quantitative easing, Accounting policies, Yield to maturity

Purpose: This study aims to determine if a greenium exists for bank-issued green bonds compared to their brown counterparts and to examine the impact of green policies on the European bond market.

Methodology: This study takes on a deductive scientific approach along with an econometric approach for which OLS regression models are estimated. The regressions use yield to maturity (YTM) as the dependent variable, with proxy variables for green bonds, the ECB's APP as well as PEPP, the SFDR and the EU taxonomy as the main explanatory variables.

Theoretical perspectives: The theoretical perspective for this paper consists of the efficient market hypothesis (EMH), signaling theory and the concept of a greenium existing in the bond market. Additionally, the study incorporates theoretical frameworks related to quantitative easing policies and accounting standards.

Empirical foundation: The empirical foundation consists of 295 green bonds and 5904 brown bonds issued by the 25 largest listed banks in the EU between the years of 2013-2023. The total amount of observations is 6199.

Conclusions: Green bonds issued by banks in the EU generally exhibit a greenium, meaning that they have lower yields to maturity compared to brown bonds. The quantitative easing programs implemented by the ECB, the APP and PEPP, have a mixed impact on these yields. While both programmes generally reduce bond yields, their effects on green bonds are not as unequivocal compared to brown bonds. The accounting-based policies, the SFDR and EU taxonomy, show no significant direct impact on bond yields, except when accounting for delayed reactions to the implementation of each policy, at which point the EU taxonomy indicates a small greenium.

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John Hallros & Erik Lundström

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Abbreviations

ABSPP	-	Asset-Backed Securities Purchase Programme
APP	-	Asset Purchase Programme
BPS	-	Basis Points
CBPP3	-	Covered Bond Purchase Programme 3
CSPP	-	Corporate Sector Purchase Programme
CSR	-	Corporate Social Responsibility
DKK	-	Danish Crown
ECB	-	European Central Bank
EMH	-	Efficient Market Hypothesis
ESCAP	-	Economic and Social Commission for Asia and the Pacific
ESG	-	Environmental, Social and Governance
EU	-	European Union
FED	-	Federal Reserve
GREENIUM	-	Green Premium
ICMA	-	International Capital Market Association
OECD	-	The Organization for Economic Co-operation and Development
OLS	-	Ordinary Least Squares
PEPP	-	Pandemic Emergency Purchase Programme
PSPP	-	Public Sector Purchase Programme
QE	-	Quantitative Easing
SEC	-	Securities and Exchange Commission
SEK	-	Swedish Crown
SFDR	-	Sustainable Finance Disclosure Regulation
YTM	-	Yield to Maturity

1 Introduction

This chapter provides a background and problem discussion on the area of focus in this study. Based on this, the purpose of the study as well as its research questions are formulated. Thereafter, the main findings, contributions and limitations of this paper are briefly presented. Finally, the structure for the remainder of the paper is presented.

1.1 Background

Climate change represents a critical systemic risk, challenging the foundations of global economic growth and development (Dubiel-Teleszynski, Franch, Fukker, Miccio, Pellegrino & Sydow, n.d.). From a high-level of international engagements, such as the 2015 Paris Climate Change Conference, and a low interest rate environment, an unprecedented opportunity to invest in sustainable infrastructure has emerged, aligning with the Paris Agreement's goal to limit global warming to below 1.5 degrees Celsius (OECD, 2017). In this context, the financial sector has pivotal roles to play, particularly through the innovation and adoption of sustainable financial instruments. Among these, green bonds stand out as a crucial tool (BBVA, 2021). Defined as debt instruments exclusively aimed at financing projects with significant environmental benefits, green bonds offer a dual advantage as they support environmental projects while providing financial returns to investors (OECD, 2017; Flammer, 2021). Since the European Investment banks first green bond issuance in 2007, the market has expanded rapidly, complemented by social and sustainability bonds, becoming a market worth more than €2.2 trillion (Sertore, 2022) after seeing an average of 50% growth per year in the period 2015-2020 (European Council, 2024), underscoring the increasing acceptance and importance of green project and investment funding.

Focusing on the banking sector, banks are uniquely positioned to leverage green bonds not only for financing their direct environmental projects but also for extending green credit facilities, such as loans or mortgages to businesses and retail customers, to further promote environmental sustainability across the economic landscape (BBVA, 2021). This strategic utilization of green bonds by banks is further accentuated by the concept of "greenium"—a term denoting the potential yield differential where green bonds may command lower yields compared to brown bonds, reflecting the market's valuation of the environmental benefits they offer (Flammer, 2021).

In the broader economic context, the European Central Bank (ECB) and politicians have an important role to play. The joint financing of fiscal stimulus by the ECB underscores the potential for strategic financial policymaking to support sustainable investments. The current regulatory landscape in the EU provides a supportive backdrop for green bonds, highlighted by initiatives such as the Sustainable Finance Disclosure Regulation (SFDR) and the EU Taxonomy. These measures are designed to enhance transparency and boost investor confidence in green markets (Finansinspektionen, 2023; European Commission, n.d.c). Furthermore, the ECB (n.d.) engages in quantitative easing (QE) through policy frameworks like the Asset Purchase Programme (APP) and the Pandemic Emergency Purchase Programme (PEPP) that directly stimulate the securities market, including the market for green bonds. This regulatory support is expected to strengthen the market position of green bonds further, enhancing their appeal to investors and issuers alike (ECB, n.d.).

1.2 Problem Discussion

Research on green bonds has largely focused on their pricing compared to brown bonds, examining whether these instruments are priced differently despite having similar fundamental characteristics. As mentioned above, Flammer (2021) discusses the greenium concept, something that is supported by authors such as Hacıomeroğlu, Danışoğlu and Güner (2022) Gianfrate and Peri (2019) and Zerbib (2019). The attribution of the greenium, however, differs across the current academic landscape, with authors such as Li, Zhang and Wang (2022) and Bachelet, Becchetti and Manfredonia (2019) noting that only certified green bonds or entities with strong reputations may benefit from this premium. A universal green bond standard or certification in the EU was however not introduced until 2023 in a market that has existed for over a decade (European Commision, n.d.a). Furthermore, some studies challenge the universal existence of a greenium in the bond market. Larcker and Watts (2020) found no significant yield difference between green and brown bonds, suggesting that market pricing for green bonds might not always reflect a lower yield. Several studies however exclude actors such as banks and focus primarily on corporate issued green bonds from non-financial companies.

Banks play a pivotal role in the financial system, serving as intermediaries between savers and borrowers and significantly influencing the allocation of resources in the economy. There are several compelling reasons to investigate banks, particularly in the context of green bonds. Banks can raise funds specifically for environmentally sustainable projects by issuing green bonds, positioning them as key players in the transition to a green economy (BBVA, 2021). As mentioned above, several studies exclude financial institutions from their datasets, often focusing on non-financial corporate or sovereign issuers (Andrade, Breckenfelder, De Fiore, Karadi & Tristani, 2016; De Santis, 2020; Yeow & Ng, 2021). This exclusion overlooks the unique role banks play in both issuing green bonds and financing green projects, underscoring the need for focused research on banks to fully understand the dynamics of green bond markets. They are furthermore heavily regulated and thus provide a clear view of how green policies impact green bond issuance and performance (European Commision, n.d.b).

Green policies, particularly those implemented by the ECB, are crucial in influencing bond yields. QE policies, such as the APP and the PEPP, aim to stimulate economic activity and stabilize financial markets by purchasing a wide range of securities, including green bonds. Dedola, Georgiadis, Gräb and Mehl (2021) and De Santis (2020) found that the APP significantly lowered bond yields, suggesting that such policies enhance the attractiveness of bonds by reducing their yields. Conversely, Lewis and Roth (2019) noted that while QE supported economic activity and promoted bank lending, it also introduced financial stress and increased bond premiums, indicating a complex relationship between QE and bond yields. The existing literature does however not, except for De Santis (2020), investigate whether the effect of QE policies is universal on the bond market or if green and brown bonds respond differently. Moreover, accounting-based policies introduced in the EU, such as the SFDR and the EU taxonomy, are not heavily studied in regard to the green bonds market and can arguably have an impact. The SFDR, established to enhance transparency in the financial services sector regarding sustainability-related disclosures, mandates that financial market participants include detailed descriptions of how sustainability risks are integrated into their investment decisions. This regulation reduces information asymmetry, potentially influencing investor behavior and bond pricing by making sustainability-related information more readily available. The EU taxonomy, which provides a classification system for environmentally sustainable economic activities, aims to direct investments towards projects that are aligned with the EU's environmental objectives. This framework helps investors identify sustainable investments, which consequently could increase the attractiveness and marketability of green bonds.

1.3 Purpose and Research Question

The purpose of this study is to explore whether there is a greenium for bank-issued green bonds in relation to their brown counterpart with a further aim to investigate the effect of the evolving regulatory landscape of the EU's green policies on the bond market. The study spans over the years 2013-2023, a period affected by the global pandemic Covid-19. To this end, our research will focus on two primary research questions:

RQ1: Is there a difference in the Yield to maturity between bank-issued green bonds and brown bonds?

RQ2: How has the market for bank-issued bonds responded to the implementation and changes to green policies in the European Union?

1.4 Main Findings

The paper uses an extensive dataset of 295 green bonds and 5904 brown bonds issued between the years of 2013-2023 by the 25 largest banks in the EU. The results reveal a marginally significant negative premium of 18.8 bps for bank-issued green bonds, aligning with similar findings in the literature. This indicates that green bonds generally offer lower yields, reflecting a market trend where investors accept lower returns for environmentally beneficial investments. Furthermore, the thesis investigates the effects of QE policies on green and brown bond yields, uncovering that these policies generally reduce bond yields, with variations depending on the specific policy and bond type. The results suggest that QE policies implemented by the ECB stimulate economic activity and influence bond yields, although the impact differs between green and brown bonds. Finally, the research addresses the influence of accounting policies on bond yields, particularly the EU taxonomy indicates a delayed but significant effect on the greenium, which challenges the efficient market hypothesis.

1.5 Contributions

Our research makes several key contributions to the financial policy literature. We examine the effects of diverse policies, particularly accounting-based ones, which are less studied compared to QE policies like the APP and PEPP. Unlike most studies that focus on bonds in general when examining the effect of QE, we differentiate between green bonds and brown bonds, providing a nuanced analysis of policy impacts. We also focus on banks within the EU, addressing the gap left by studies that either exclude banks or do not concentrate on the EU. Additionally, we compare the effects of different time lags in policy implementation, offering insights into the temporal dimensions of policy impacts.

1.6 Limitations

The primary limitation of this study is related to the relatively new and developing market for bank-issued green bonds. This has resulted in limited access to comprehensive data due to a lack of transparency and the absence of complete bond data. Additionally, all bonds that had matured before the data extraction date were excluded since pricing data for matured bonds is not stored on Reuters Refinitiv Eikon. This exclusion reduced the sample size, potentially affecting the inference and reliability of the findings. Future studies may benefit from including these excluded observations. Moreover, there is currently no standardized green bond framework. Therefore, this study relied on Reuters Refinitiv Eikon's definition and selection of green bonds. As a result, the definition used by Reuters Refinitiv Eikon may differ from those of other frameworks.

1.7 Structure

The remainder of this paper is structured as follows. Section 2 provides a theoretical background on the concepts of this paper and section 3 presents empirical literature related to this field of study. Based on this, section 4 presents the hypotheses to be tested. Furthermore, section 5 presents the empirical methodology while section 6 describes the data sample. The results are then presented in section 7 and analyzed in section 8. Finally, section 9 provides the conclusions of the study as well as suggestions for future research.

2 Theoretical Background

This section aims to present the theoretical background of the study. Initially, definitions of ordinary bonds as well as green bonds are provided, and theories connected to bonds and their yield to maturity (YTM) are discussed. Ultimately, the different green bond policies examined in this study are presented.

2.1 Definition of Bonds and Green Bonds

2.1.1 Ordinary Bonds

The SEC (n.d.) defines corporate bonds as a debt instrument which companies can issue to attain external financing. Investors purchase these bonds, effectively lending money to the issuing company, in exchange for interest as well as repayment of the principal within a predefined period (Waschiczek, 2004 cited in Redak, Schuberth & Weber, 2004). Companies issue bonds for a variety of reasons, according to the SEC (n.d.), mainly to raise capital for investments or financing of the business. The rationale for banks issuing bonds is in essence the same, however banks also issue bonds to finance other companies' projects through, for example, loans (BBVA, 2021). The SEC (n.d.) also discusses various bond aspects, including bond maturity, credit ratings, and types of interest payments, all of which can affect bond pricing.

The United Nations ESCAP (2021) introduces the concept of thematic bonds. The authors explain that this could for example be green, social and sustainability bonds, that are issued on the condition that the funds are used to finance projects within the specific theme of the bond. Since funds raised through the issuance of these bonds are only allowed to be used to finance specific projects, they also require disclosure and reporting regarding the usage of the funds. While there are different kinds of thematic bonds, ordinary bonds, as described above, generally don't have any specific conditions in terms of usage of the funds and are commonly referred to as brown bonds.

2.1.2 Green Bonds

As mentioned above, green bonds are a form of thematic bonds, which are primarily used for the financing of green projects. This could for example be projects that are environmentally or climate friendly, such as green building projects or renewable energy according to Nordea (2023a). Additionally, Nordea (2023a) explains that green bonds can often provide financing for sustainability projects that would otherwise not receive financing. Green bonds are essentially priced the same way as brown bonds, however, from an issuer perspective, green bonds tend to be preferable, since they are higher priced and consequently have lower yields according to Agliardi and Agliardi (2019). While this should theoretically make green bonds less favorable to investors, both Agliardi and Agliardi (2019) and MacAskill et al. (2021) explain that investors are willing to accept a lower yield on green bonds based on the concept of a greenium in the bond market, which will be discussed in more detail below. This positive investor sentiment can also be seen from the growing popularity of the instrument, highlighted in several studies (Agliardi & Agliardi, 2019; Flammer, 2021; MacAskill, Roca, Liu, Stewart & Sahin, 2021) and referred to as the 'green bond boom'

The 'green bond boom' can be attributed to the growing focus on sustainability, which is becoming an increasingly important topic in the corporate world and society as a whole (Chollet & Sandwidi, 2018). This growing focus is conceptualized for corporations through the notion of corporate social responsibility (CSR). Chollet and Sandwidi (2018) explain that companies' CSR performance can be measured through an environmental, social and governance score (ESG score). The authors furthermore explain that companies that focus on improving their ESG score can reduce their financial risk as a result of the improved societal standing that an ESG focus leads to. Oikonomou, Brooks and Pavelin (2014) argue that good performance in terms of CSR can lead to lower cost of debt and yield spreads of corporate bonds, alluding to the possibility of CSR providing competitive advantages for firms. Neitzert and Petras (2021) examine CSR from a bank perspective and argue that banks are more susceptible to sustainability and ESG risks, since banks are exposed to both their own as well as their clients' ESG risks. The importance of CSR in the banking industry is furthermore highlighted by Ruiz and García (2021) who connects CSR to the reputation of banks, which is a factor that has become increasingly important, for banks in particular, since the financial crisis in 2008.

2.2 The Yield to Maturity of Bonds

The YTM is a crucial concept for both investors and issuers in the bond market according to Fernando (2024) as it represents the total return an investor can expect if they hold the bond until it matures, factoring in its current market price, coupon payments, and the time left until maturity. The author explains that while YTM represents the effective interest rate issuers are paying on the funds raised through issuing bonds, a higher YTM generally implies a better return for investors, but also often indicates higher risk. Conversely, he explains that from an issuer point of view, a lower YTM implies lower borrowing costs. A decreasing YTM may indicate improving investor confidence, while an increasing YTM might suggest deteriorating credit quality according to the author.

The YTM of bonds can also be viewed from an efficient market hypothesis perspective. Fama (1991) explains that the efficient market hypothesis argues that all information is fully always incorporated into the prices of securities, under the assumption of a perfect market. The author is thereby implying that there should not be any arbitrage opportunities since everything is fairly and accurately priced. If this is the case, markets are assumed to be efficient. The efficient market hypothesis does however have its critics who argue that markets are not perfectly efficient (Bernstein, 1999; Malkiel, 2005).

2.2.1 Greenium

Flammer (2021) argues that one rationale for issuing green bonds could be in the form of the cost of capital. If green bond investors are willing to accept a lower YTM due to the environmentally friendly aspect of the instrument, then it may represent a cheaper alternative of financing for issuers. This argument is more commonly referred to as the greenium concept. While the greenium concept could be a plausible explanation for corporations preferring to issue green bonds over brown bonds, there are conflicting findings in previous studies. Some studies have found that the YTM for green bonds tend to be slightly lower compared to that of brown bonds (Hacıomeroğlu, Danışoğlu & Güner, 2022; Gianfrate & Peri, 2019; Zerbib, 2019). However other studies found no negative premium for green bonds in relation to brown bonds (Larcker & Watts, 2020). Torvanger, Maltais and Marginean (2021) argues that the difference in findings could be a result of differences in the type of issuer or country being studied, implying that the presence of greenium in the bond market might be dependent on such underlying factors.

Flammer (2021) discusses the concept of a greenium when examining the rationales behind issuing green bonds. Despite the growing popularity of green bonds, the author argues that there still are several unknowns regarding this financial instrument. The author mentions that it’s slightly puzzling that companies would prefer to issue green bonds instead of brown bonds considering the fact that the funds received from issuing green bonds are restricted to green projects. Additionally, the author explains that there is a third-party verification process that must be completed for a bond to become a certified green bond. When considering bank-issued green bonds in particular, this verification process might be more complicated as the funds can be used for financing green projects undertaken by other companies instead of projects undertaken by the bank itself (Handelsbanken, 2023).

2.2.2 Signaling

Flammer (2021) also mentions the signaling theory as a rationale for issuing green bonds. According to Connelly, Certo, Ireland and Reutzel (2011) the signaling theory addresses how information asymmetries in markets and social phenomena are resolved through the communication of signals that carry costs for the signaler. The authors argue that the theory differentiates between high-quality and low-quality firms or individuals, noting that only high-quality entities can afford the cost of sending credible signals. According to the authors, the idea of costs and benefits in signaling theory revolves around the premise that entities send signals to convey information about their quality or attributes in situations where information asymmetry exists.

García, Herrero, Miralles-Quirós and Miralles-Quirós (2023) state that the signaling theory can be applied to the issuance of green bonds. When issuing green bonds, the authors explain that a company is effectively communicating to investors its intention to make investments promoting sustainable growth and environmental sustainability. The company reduces information asymmetries with investors, by signaling what the proceeds will be used for, and communicates its environmental policy aimed at implementing green projects (Flammer, 2021).

The ECB's purchase programs can also be seen from a signaling percpective. Lewis and Roth (2019) aruge that, as a central bank, the ECB has the power to influence the market's future inflation expectations. Andrade et al. (2016) support this view, stating that the ECB's choices regarding their purchase programs could serve as a signal to the market. Thus, making green policies an area of interest when examining green bond issuance

2.3 Green Bond Policies

Below will follow a presentation of the four policies that this paper will be focusing on in order to answer the second research question. Here, a distinction will be made between QE policies and policies oriented towards accounting practices.

2.3.1 ECB's Purchase Programmes - Quantitative Easing

The ECB engages in asset purchase programmes as a strategic monetary policy tool to stimulate economic activity across the Eurozone. This acts as a form of QE, whereby the ECB purchases bonds from corporations, effectively increasing the price of these bonds, which in turn injects additional money into the bond market. For banks, this process leads to a reduction in a wide range of interest rates, making loans more affordable. Consequently, both businesses and individuals benefit from lower borrowing costs, allowing them to spend less on debt repayment and more on consumption and investment. This surge in spending and investment not only bolsters economic growth but also aids in job creation. Through these measures, the ECB aims to foster a stable economic environment where consumption and investment can thrive, ultimately helping achieve a target inflation rate of 2% (ECB, n.d.).

2.3.1.1 Asset Purchase Programme (APP)

The ECB's APP is a monetary policy tool used to stimulate the economy when conventional monetary policy, such as lowering interest rates, has become ineffective. This typically occurs during periods of very low or negative interest rates. The APP involves the ECB buying financial assets, primarily government bonds, from banks and other financial institutions. Over the years, the ECB has recalibrated the APP multiple times, reflecting changes in economic conditions and policy objectives. The programme started with a purchase target of €60 billion per month in March 2015, peaking at €80 billion from April 2016 to March 2017, and then gradually tapering to no net purchases by 2023, shifting focus solely to reinvestments of principal payments from maturing securities. Notably, the programme saw a temporary expansion with an additional €120 billion envelope of net asset purchases from March to December 2020 (ECB, n.d.).

The APP consists of several different sub-programmes, however only four sub-programmes have been active during the timeframe of this study. The Covered Bond Purchase Programme 3 (CBPP3) was started in October 2014 and involved purchases of covered bonds issued by financial institutions within the Eurozone. The Asset-Backed Securities Purchase Programme (ABSPP) was launched in November 2014 and targeted the purchase of asset-backed securities to support liquidity in the financial markets for such instruments. The Public Sector Purchase Programme (PSPP) involves the purchase of public sector securities, including central government bonds, bonds issued by recognized agencies, regional and local governments, international organizations, and multilateral development banks located in the euro area. All three programmes gradually shifted focus to reinvestments and was completely phased out in July 2023 (ECB, n.d). The Corporate Sector Purchase Programme (CSPP) targets investment grade euro-denominated bonds issued by non-financial companies (ECB, 2016). Due to this study's focus on financial companies, the CSPP has been excluded from the study.

2.3.1.2 Pandemic Emergency Purchase Programme (PEPP)

The PEPP was initiated by the ECB in response to the unprecedented economic challenges posed by the coronavirus pandemic. Launched in March 2020, this programme was specifically aimed at mitigating the adverse effects of the crisis on the euro area economy. The initial allocation for the PEPP was €750 billion, which was increased by €600 billion in June 2020 and by another €500 billion in December 2020, bringing the total to €1.85 trillion. The ECB committed to conducting net asset purchases under the PEPP until at least the end of March 2022, or until the Governing Council deemed the crisis to be over. The primary goal of the PEPP was to bolster economic growth and steer inflation back towards the ECB's target of 2%, consistent with its mandate to ensure price stability (ECB, 2021). In this regard, the PEPP complemented other ECB monetary policy measures, including other asset purchase programmes to target lending operations.

2.3.2 Accounting Policies

2.3.2.1 Sustainable Finance Disclosure Regulation (SFDR)

The SFDR (Regulation 2019/2088), was established by the European Parliament and the Council to enhance transparency in the financial services sector regarding sustainability-related disclosures and came into effect on the 10th of March 2021. This regulation mandates that financial market participants and financial advisers include descriptions in their pre-contractual disclosures on how sustainability risks are integrated into their investment decisions (Regulation 2019/2088). The SFDR aims to reduce information asymmetries by requiring ongoing disclosures about the integration of sustainability risks and the consideration of adverse sustainability impacts. The regulation also addresses the promotion of environmental or social characteristics and sustainable investments, ensuring that financial market participants make these factors clear to end investors (Regulation 2019/2088). This includes making sustainability-related information readily available concerning financial products. The SFDR mandates that all asset managers, regardless of whether they have a specific focus on ESG or sustainability, must provide detailed, prescriptive, and standardized disclosures at both the entity and product levels (KPMG, 2021).

2.3.2.2 The EU Taxonomy

The EU taxonomy, which entered into force on 12 July 2020, plays a major part in EU's sustainable finance framework and is an important market transparency tool (European Commission, n.d.c). It aims to increase direct investments to the economic activities most needed for the green transition, in line with the European Green Deal objectives (European Commission, n.d.c). The taxonomy is a classification system that defines criteria for economic activities that are aligned with a net zero trajectory by 2050 and the broader environmental goals other than climate (European commission, n.d.c). It allows financial and non-financial companies to share a common definition of economic activities that can be considered environmentally sustainable by setting out the 4 overarching conditions that an economic activity has to meet in order to qualify as environmentally sustainable (European commission, n.d.c).Several frameworks are also being developed around the EU taxonomy, such as the soft regulation EU green bond standard which was approved in late 2023 (European Commission, n.d.a). This new standard aims to create a more uniform requirement, consistency and comparability and will allow issuers that choose to adopt it to denominate their green bonds as European Green Bonds (EuGB) if they adhere to the standard (European Council, 2023). This is the first standard on a European level and the effects remain to be seen. Currently there are several different policies such as the ICMA Green Bond policy that issuers can follow, however not all issuers follow the same framework and differences in definitions of what a green bond is between issuers may vary (ICMA, n.d).

The EU taxonomy itself provides a framework to classify economic activities as green or sustainable within the EU. Prior to this, there was no definitive criterion for what constituted a sustainable activity (Doyle, 2021). The taxonomy specifically outlines what makes a business operation sustainable or environmentally friendly, encouraging investments in companies that adhere to these standards (European Commission, n.d.d). The taxonomy emphasizes six environmental objectives: climate change mitigation, climate change adaptation, sustainable water and marine resource use, circular economy transition, pollution prevention and biodiversity and ecosystem protection (Doyle, 2021). For an economic activity to be deemed sustainable under the EU taxonomy, it must contribute to at least one of these environmental objectives without significantly harming any of the others, adhere to minimum safeguards like the UN Guiding Principles on Business and Human Rights to avoid negative social impacts, and comply with specific technical screening criteria set by the EU Technical Expert Group. Initial technical criteria for climate change mitigation and adaptation were released in April 2021, with further details on the remaining objectives expected to follow (European Commission, n.d.d).

3 Literature review

This chapter aims to lay a foundation for the existing literature surrounding the research questions presented in the first chapter by first presenting the current academic landscape for the existence of a greenium in the green bond market, followed by how the market was affected during the Covid-19 pandemic and lastly the effects of QE policies on the bond market.

3.1 Existence of a Greenium for Green Bonds

The concept of a greenium existing in the bond market was presented in section 2.3 and several studies have explored whether there is a greenium when comparing green bonds with brown bonds. A majority of previous studies seems to identify a negative premium, meaning that the yields of green bonds are lower than the yields of brown bonds, thus indicating an existence of greenium in the bond market (Gianfrate & Peri, 2019; Agnese & Giacomini, 2023; Hacıomeroğlu, Danışoğlu & Güner, 2022; Li, Zhang & Wang, 2022; Zerbib, 2019). Meanwhile, Bachelet, Becchetti and Manfredonia (2019) identified both positive and negative premiums, while Larcker and Watts (2020) found no premium when comparing green bonds to brown bonds.

Gainfrate and Peri (2019) studied bonds issued by both corporate and non-corporate European issuers between 2007 and 2017, rendering a data sample of 121 green bonds and 3,055 bonds in total. The authors found that for both corporate and non-corporate issuers, green bonds are the cheaper option compared to brown bonds and this is the case even after accounting for the cost of green certification. Additionally, the authors found that the cost of issuing green bonds is lower for corporate issuers compared to non-corporate issuers. This can be contrasted to Bachelet, Becchetti and Manfredonia's (2019) study, who compare private and institutional issuers. The data consisted of 89 bond couples (consisting of one green bond and its closest non-green bond match) issued between 2013 and 2017. Initially, the authors noted overall higher yields for green bonds compared to brown bonds. However, a further analysis by the authors revealed a negative premium for institutional issuers and a positive premium for private issuers, thus somewhat contradicting Gianfrate and Peri (2019). Ultimately, Bachelet, Becchetti and Manfredonia (2019) suggests the existence of a negative premium for green bonds under the requirements of either a strong reputation of the issuer or green certification.
Along the same lines of Gainfrate and Peri (2019) and Bachelet, Becchetti and Manfredonia (2019), Li, Zhang and Wang (2022) also underscore the importance of certification. Their study

examined the green bond market in China from 2016 to 2020 and collected 3,438 bonds. The authors identified a negative premium for green bonds (8.4 bps) but also highlighted the fact that the bonds must be labeled as green to reduce the yield spread by a significant amount (12 bps). Zerbib (2019) looked at the global issuance of bonds from 2013 until 2017, resulting in a sample of 110 green bonds. The author also found a negative premium for green bonds, however the premium was rather small at merely 2 bps.

Agnese and Giacomini (2023) focus on the primary market for bank bonds within the EU. They analyze a significant dataset comprising 19,106 fixed-rate senior bonds issued by 63 EU banks from 2006 to 2021. Specifically, they find that a one-point increase in the ESG score leads to a 5 bps (basis points) reduction in the bond yield, suggesting a strong financial incentive for banks to enhance their sustainability practices, particularly in governance (Agnese & Giacomini, 2023).

Contrary to what most of the studies discussed above, Larcker and Watts (2020) discovered that when comparing green securities to nearly identical non-green securities, investors seem unwilling to accept lower returns purely for the sake of investing in environmentally sustainable securities. Thereby, the authors, whose sample consisted of 640 matched pairs of green and brown bonds issued by US municipal issuers between the years 2013-2018, found no pricing differential and thus no premium for green bonds.

3.2 Market Dynamics of Green Bonds During Covid-19

The Covid-19 pandemic quickly became a global crisis, affecting public health, economies, and societies. It triggered lockdowns, travel restrictions, and shifts in consumer and business activities, straining healthcare systems and causing economic disruptions. Governments and organizations' response measures became critical to study in order to understand the effects on global and local markets. Despite having heavily impacted the market, the research field for the effect of green bonds during the Covid-19 pandemic is not studied extensively, however Hacıomeroğlu, Danışoğlu and Güner (2022) and Perote, Vicente-Lorente and Zuñiga-Vicente (2023) provide some insight on the area.

Hacıomeroğlu, Danışoğlu and Güner (2022) specifically examine the performance of green versus brown bonds during the pandemic. Their study includes a comprehensive dataset of bonds issued both in the primary and secondary markets, covering a diverse range of issuers. Their findings indicate that both green and brown bonds experienced declines in primary market yields post-pandemic, with green bonds showing a notably larger decrease—32 bps lower on average than brown bonds. This suggests a stronger market demand for green bonds during the pandemic, supported further by secondary market analysis where brown bonds' returns decreased by 45 bps more than those of green bonds. The research highlights a differential impact of the pandemic on green versus brown bonds, with green bonds potentially viewed as safer or more attractive investments during times of crisis (Hacıomeroğlu, Danışoğlu & Güner, 2022). Perote, Vicente-Lorente and Zuñiga-Vicente (2023) extend this analysis by examining the US green bonds and ESG stock markets' responses to various pandemic phases and containment measures. Their study uses a non-linear approach to understand market dynamics, noting that green bonds and ESG stocks initially react positively to moderate increases in Covid-19 cases, which markets interpret as manageable situations promising long-term gains from sustainable investments. However, this response shifts to a sharp negative when case numbers surge dramatically, indicating heightened uncertainty and risk. The research also notes that while stringent lockdowns and swift vaccination rollouts individually boost market returns, their concurrent implementation is perceived negatively, suggesting that a multifaceted approach to containment might be interpreted as a sign of a worse-than-expected situation (Perote, Vicente-Lorente & Zuñiga-Vicente, 2023).

3.3 Effect of ECB's Quantitative Easing Policies on Bonds

While there is a lack of studies examining the effect of accounting-based policies, the effect of programmes implemented as a QE measure by the ECB, such as the APP for example, has been examined to a greater extent in previous studies. For starters, Cortes, Gao, Silva and Song (2022) as well as Dedola et al. (2021) look at the ECB's and the Federal Reserves' (FED) QE efforts from an overarching point of view. Cortes et al. (2022) compared the effectiveness of FED's QE efforts during the subprime and Covid-19 crises. The authors conclude that QE policies influence tail risk events, otherwise known as events that are extreme but also very rare, thus identifying an indirect effect of QE policies on bonds. Meanwhile, Dedola et al. (2021) examine the stock- and bond market reactions to both the ECB's and FED's QE announcements between 2008 and 2019 and find that both have a direct effect on bond market rates, measured as the 10-year bond rate. Regarding the ECB in particular, the authors find that the initial announcement of the APP as well as the announcement of further APP details had a negative effect on bond rates by 8 bps and 4 bps, respectively. Conversely, the authors found that the first announcement of an extension of the APP in 2016 had a positive effect of 3 bps, although the second such announcement in 2017 again had a negative effect of 6 bps. The authors also examined some announcements regarding the sub-programmes of the APP. For the initial announcement as well as the announcement of the details of the ABSPP and CBPP3, the authors found only positive effects on bond rates by 2 bps and 1 bp, respectively. Finally, the authors explored the effect of an increase in the issue limit of the PSPP and again found a negative effect of 7 bps. Based on the study performed by Dedola et al. (2021) it can be argued that there is no clear consensus on whether the effect of QE policies on bond YTM is positive or negative.

A couple of studies examine the effect of the APP on government and sovereign bonds (Andrade et al., 2016; De Santis, 2020). While these types of bonds differ somewhat from the bank bonds that are the focus of this study, the results of these studies could provide useful insights. Andrade et al. (2016) examined a total of 171 different publicly listed European banks and their sovereign bond holdings. The authors find that the yield of the sovereign bonds, since the announcement of the APP in 2015, have reduced significantly and this reduction has also been persistent. Ultimately, the authors conclude that the impact of the APP from a macroeconomic perspective can be expected to be large. These results are in line with the results obtained by De Santis (2020) who found that the effect of the APP on 10-year euro area sovereign yield was minus 72 bps.

Lewis and Roth (2019) explored the effect of the APP on the financial markets in Germany between 2009 until 2017. The authors note positive effects of the APP on German economic activity as well as prices, but also signs of increasing financial stress through higher volatility and liquidity risk. Furthermore, the authors discovered that the APP promoted bank lending but along with that also discovered that lending rates did not decrease, and bond premiums increased, indicating that lending overall became riskier and by extension more expensive through higher yields.

Aloui, Benkraiem, Guesmi and Vigne (2023) explores the impact of the ECB's green QE through the green monetary programme. The authors theorize that green QE would increase the price of green bonds and subsequently lower the yields since the aim of the programme is to purchase green bonds from sustainable companies. By looking at European green bond indices between 2015 and 2021, the authors were able to confirm this theory. Thus, the authors conclude that the ECB’s green QE effectively incentivizes investors to make green investments, although green QE sees a reduced effect during crisis periods, such as the Covid-19 pandemic.

4 Hypothesis Development

When examining the yield behavior of green bonds compared to traditional brown bonds, the existing academic landscape offers diverse findings. Several researchers find evidence of a negative green bond premium (Zerbib, 2019; Hacıomeroğlu, Danışoğlu & Güner, 2022; Gianfrate & Peri, 2019; Li, Zhang & Wang, 2022), indicating that green bonds often have lower yields in comparison to their brown counterparts. Contrastingly, Larcker and Watts (2020) find no discernible premium associated with green bonds. Their results indicate that, in some contexts, the market prices green and brown bonds similarly. Adding another layer to the discussion, Bachelet, Becchetti and Manfredonia (2019) report a positive premium on green bonds issued by private entities and a negative premium for green bonds issued by institutional entities, with banks considered private entities, thus presenting differing results to what some of the previously mentioned authors have found. On the backdrop of this previous literature, it can be hypothesized that the market for bank-issued bonds will exhibit a greenium in YTM in relation to brown bonds.

H1: Bank-issued green bonds will have a significant YTM greenium in relation to brown bonds.

While there is considerable research on QE, accounting-based policies, which govern financial reporting and disclosures, have not been studied as extensively. However, they likely influence market dynamics and investor behavior indirectly, following the arguments in chapter 2.3.2. Empirical studies such as those by Cortes et al. (2022) and Dedola et al. (2021) have explored the effects of QE implemented by the ECB and the FED, revealing that these policies can significantly impact bond market rates. Dedola et al. (2021) found a mostly negative impact on bond rates following certain QE announcements, such as the initiation and detailing of the ECB's APP. Additional research by Andrade et al. (2016) and De Santis (2020) focused on the APP's effects on government and sovereign bonds, noting a substantial and persistent reduction in yields post-announcement. Similarly, Lewis and Roth (2019) observed that while QE in Germany supported economic activity and promoted bank lending, it also introduced increased financial stress, which combined should lead to a reduction in bond yields.

Given this background, the hypothesis rests on the documented effects of QE, which tend to lower bond yields following their announcements, in accordance with chapter 2.3, with the expectation that accounting-based policies similarly impact yields negatively.

H2: Both QE policies and accounting-based policies will have a significant negative effect on bank-issued bond yields.

When assessing the effects of significant monetary policies and accounting standards, the use of lagged variables in econometric models is something that needs to be considered. It might help capture the nuanced and often delayed impacts of such policies on the economy. This approach contrasts sharply with the expectations of the EMH, which according to Fama (1991), states that a perfect market is presumed to efficiently and immediately reflect all available information in asset prices. Under this hypothesis, any policy announcements or changes in accounting standards should theoretically be reflected without delay in financial markets. This implies an immediate adjustment of asset prices in response to new data, assuming markets have full and immediate access to all pertinent information. However, if markets are not fully efficient, the effects of monetary policies and accounting changes might not be instantly observable in market prices. In accordance with the EMH it can be hypothesized that there would not be any significant changes to the results when assuming delayed effects.

H3: Delaying the effect of the QE- and accounting policies will not incur significantly different results compared to assuming immediate effects

5 Methodology

This chapter introduces the methodological approach of the study, presenting both the scientific- and econometric approach. Pre-regression statistical tests are also discussed as well as efforts taken to improve the robustness of the results.

5.1 Scientific Approach

The scientific approach of this study is based on the deductive approach, in which hypotheses are created based on previous studies and theory and then tested to either confirm or reject the hypotheses. Based on the above presented review of previous literature and different theories on the subject, research gaps emerged in the form of a lack of studies examining the effect of QE policies and particularly accounting policies on the potential existence of a greenium in the European market for bank-issued bonds. The hypotheses presented above were formulated with this research gap in mind and with the aim of exploring whether or not a greenium exists in the bank-issued bond market and how it would be affected by QE- and accounting policies. In order to either confirm or reject this study's hypotheses, ordinary least squares (OLS) regression models will be performed, which will be presented below. The decision to use OLS regressions was based on the fact that, while this study's dataset is structured as panel data, the dataset is unbalanced which means that using pooled OLS regressions or fixed effects models could potentially lead to inaccurate results. Furthermore, the methodology of this study is influenced by Agnese and Giacomini (2023), who also utilize OLS regressions in their study.

5.2 Econometric Approach

The aim of this study is to investigate the potential existence of a greenium in the bank-issued bond market and how this existence is affected by the implementation of different accounting- and QE policies. To this end, the econometric approach of this study is to base the multivariate analysis on OLS regression models, as mentioned above. The OLS method is a commonly used statistical method, used to estimate the relationship between a dependent variable and one or more independent variables (Woolridge, 2019). There are some assumptions that must be considered, for the results of OLS regressions to be reliable, these assumptions will be further discussed as the paper progresses.

This study's first hypothesis (*H1*) is to be tested through estimating regression model 1, as can be seen below. *YTM* is set as the dependent variable, with *Green bonds* as the sole main explanatory variable for this regression. Additionally, several control variables are included in the regression model. The control variables are *Amount issued*, *Years until maturity, Short-term*, *Medium-term*, *Long-term*, *Investment grade*, *Unsecured*, *Underwritten*, *Publicly traded*, *Callable*, *Senior* and *Covered*. All variables presented in this section, as well as the variables used to test the second and third hypotheses presented below, are discussed in further detail in section 6.

$$YTM = \beta_0 + \beta_1 Green\ bonds + \beta_2 Controls + \mu \quad (1)$$

In order to test the study's second hypothesis (*H2*), four different regression models will be estimated, all of which are presented below (regression models 2-5). *YTM* is used as the dependent variable for all four regression models. The variable *Green bonds* is one of the main explanatory variables and the control variables presented above are also all included. The ECB's APP is tested in regression model 2, hence the inclusion of the variable *APP* as one of the main explanatory variables. Regression model 3 tests the ECB's other QE programme, namely *PEPP,* which is included as a main explanatory variable. Moving on to regression model 4, the variable *SFDR* is included as an explanatory variable to test its effect on bond YTM. Finally, regression model 5 is estimated with the variable *EU taxonomy* as an explanatory variable. Each model also includes an interaction term as an explanatory variable, which consists of the policy variable multiplied with the variable *Green bonds*.

$$YTM = \beta_0 + \beta_1 Green\ bonds + \beta_2 APP + \beta_3 APP\ x\ Green\ bonds + \beta_4 Controls + \mu \quad (2)$$

$$YTM = \beta_0 + \beta_1 Green\ bonds + \beta_2 PEPP + \beta_3 PEPP\ x\ Green\ bonds + \beta_4 Controls + \mu \quad (3)$$

$$YTM = \beta_0 + \beta_1 Green\ bonds + \beta_2 SFDR + \beta_3 SFDR\ x\ Green\ bonds + \beta_4 Controls + \mu \quad (4)$$

$$YTM = \beta_0 + \beta_1 Green\ bonds + \beta_2 EU\ Taxonomy + \beta_3 EU\ Taxonomy\ x\ Green\ bonds + \beta_4 Controls + \mu \quad (5)$$

The third hypothesis (*H3*) is essentially tested through the same regression models used to test the second hypothesis (regression models 2-5). However, the difference is that, to test the third hypothesis, the variables *APP, PEPP, SFDR* and *EU taxonomy* are lagged by one week as well as one month. This also affects the interaction term between the respective policies and *Green bonds*. The lagging of the four variables representing the policies studied in this paper is explained in further detail below.

5.3 Pre-Regression Statistical Tests

In order to assess the presence of heteroskedasticity, white tests have been conducted. Heteroskedasticity, or non-constant variance in the error terms, breaches the fifth assumption of multiple linear regression. This results in the ordinary least squares (OLS) estimator not being the best linear unbiased estimator, compromising the reliability of standard errors and, consequently, the validity of t-statistics and p-values. A p-value below 0.050 signifies significant heteroskedasticity, necessitating the use of either clustered or robust standard errors. From table 2, models 1-5 all have a p-value of 0, implying that the null hypothesis of homoskedasticity needs to be rejected. To deal with the apparent heteroskedasticity in the sample, robust standard errors have been implemented throughout all regression models.

5.4 Robustness

To enhance the robustness of our regression models, we have implemented robust standard errors, year effects, and lag effects. Robust standard errors, as explained above, adjust for heteroskedasticity - non-constant variance in error terms, a condition confirmed by the White test conducted on our models (table 2). This adjustment maintains the validity of statistical inferences despite these violations. Additionally, incorporating year effects allows us to control for annual variability, thereby isolating the influence of key variables by accounting for temporal dynamics. Finally, lag effects are also applied for regression models 2-5 to test if the results hold when applying a lag to some of the main explanatory variables, thereby assuming non-efficient markets.

6 Data and Sample Description

The data chapter describes the data sample and provides definitions for all variables included in the study. Additionally, summary statistics and correlation tables are presented and discussed.

6.1 Sample Description

This study examines bonds issued by banks between the 1st of January 2013 and the 31st of December 2023. The bonds are issued by 25 of the largest public banks, as well as their subsidiaries, headquartered in countries that are part of the EU. This limitation was implemented to comply with the main idea of this paper to focus solely on banks that could have been affected by the policies included in the study. The initial choice of having the 1st of January 2013 as the start date for this study was based on it being the first year that one of the banks in the sample issued a green bond, according to Reuters Refinitiv Eikon's database. Due to limited resources when downloading the data and problems accessing data for already matured bonds, the first green bond in this study's data sample was issued in 2018, as can be seen in figure 1. The start date was however maintained to be able to include a period without policy interference for the APP, which was implemented in October 2014. The data sample originally included 87,078 bonds, however a majority of these were excluded due to missing data on the YTM of the bonds (79,749). Additionally, bonds issued in 2024 (980), missing data in terms of amount issued (41), no information on seniority (1) and bonds for which Reuters Refinitiv Eikon had calculated unreasonably high YTM's (106) were also excluded from the sample, ultimately resulting in a total of 6,199 bonds. Of the 6,199 bonds, 295 are labeled as green bonds by Reuters Refinitiv Eikon, while the remaining 5,904 bonds are considered brown bonds.

For each bond in the sample, data was gathered from Reuters Refinitiv Eikon for most of the variables as well as the ECB (n.d.), Finansinspektionen (2023) and the European Commission (n.d.c) for data concerning the different green policies studied in this paper. All variables will be discussed in further detail below and can also be found in table 1.

6.2 Variable Definition

Table 1: Variable list along with definitions.

VARIABLE	DEFINITION	Sources
DEPENDENT VARIABLE		
YTM	Yield to maturity in percentage – calculated by Refinitv Eikon	(a)
MAIN EXPLANATORY VARIABLES		
GREEN BONDS	Dummy variable equals to 1 for bonds with a “Thomson Reuters Green Flag”, and 0 otherwise	(a)
APP	Value of the programme at the issuance date of a Bond, value in trillion euros	(b)
PEPP	Value of the programme at the issuance date of a Bond, value in trillion euros	(b)
SFDR	Dummy variable equals 1 if the issue is equal to or past the implementation date of the policy, and 0 otherwise	(c)
EU TAXONOMY	Dummy variable equals 1 if the issue is equal to or past the implementation date of the policy, and 0 otherwise	(d)
APP X GREEN BONDS	Interaction term between *APP* and *Green bonds*	(a), (b)
PEPP X GREEN BONDS	Interaction term between *PEPP* and *Green bonds*	(a), (b)
SFDR X GREEN BONDS	Interaction term between *SFDR* and *Green bonds*	(a), (c)
EU TAXONOMY X GREEN BONDS	Interaction term between *Eu taxonomy* and *Green bonds*	(a), (d)
CONTROL VARIABLES		
AMOUNT ISSUED	Amount issued in billion euros	(a)
COVERED	Dummy variable equals to 1 if the issue is Covered, and 0 otherwise	(a)
UNDERWRITER	Dummy variable equals to 1 if the issue is underwritten, and 0 otherwise	(a)
CALLABLE	Dummy variable equals to 1 if the bond is callable, and 0 otherwise	(a)
INVESTMENT GRADE	Dummy variable equals to 1 if the bond’s rating is “Investment Grade”, and 0 otherwise	(a)
PUBLICLY TRADED	Dummy variable equals to 1 if the issued bond is traded on an exchange, and 0 otherwise	(a)
YEARS UNTIL MATURITY	Time until maturity from issue date until maturity date in years	(a)
SHORT-TERM	Dummy variable equals to 1 if the bond’s original time to maturity is shorter than 5 years and 0 otherwise	(a)
MID-TERM	Dummy variable equals to 1 if the bond’s original time to maturity is longer than 5 years and shorter than or equal to 10 years, and 0 otherwise	(a)
LONG-TERM	Dummy variable equals to 1 if the bond’s original time to maturity is longer than 10 years, and 0 otherwise	(a)
SENIOR	Dummy variable equals to 1 if the issue is considered as senior in case of liquidation, and 0 otherwise	(a)
UNSECURED	Dummy variable equals to 1 if the issue is not collateralized, and 0 otherwise	(a)
Source: (a) Reuters Refinitiv Eikon; (b) ECB (n.d); (c); Finansinspektionen (2023); (d); European Commission (n.d.c) *Period: 2013-01-01 to 2023-12-31*		

6.2.1 Yield to Maturity of Bonds

In order to test how the YTM of bonds have been affected by the implementation of different policies, this paper will use the *YTM (%)* of bonds as a dependent variable. As explained above, the YTM of bonds can be used as a way of measuring the cost of issuing bonds. This choice of variable is furthermore in line with studies carried out by Agnese and Giacomini (2023), Hacıömeroğlu, Danışoğlu and Güner (2022) as well as Baker, Bergstrasser, Serafeim and Wurgler (2022). However, Li, Zhang and Wang (2022) and Painter (2020) utilize a slightly different dependent variable by examining yield spreads instead of the YTM. The rationale for choosing YTM as the dependent variable in this study, however, is that it provides a more direct, comprehensive and sensitive measure of the total return expectations and market dynamics for bonds. The YTM of the bonds was gathered from Reuters Refinitiv Eikon and are therefore based on the calculations of the database.

6.2.2 Main Explanatory Variables

This study focuses on five different explanatory variables to test the research questions. The first explanatory variable is *Green bond*, taking the value of 1 for all of the green bonds in the data sample and 0 otherwise (Hacıömeroğlu, Danışoğlu & Güner, 2022; Li, Zhang & Wang, 2022). This variable was derived from the Reuters Refinitiv Eikon database and as mentioned above, therefore depends on the databases' definition of a green bond.

Since this study aims to explore the effect of different policies on the issuance cost of green and brown bonds, variables were created for each policy. When creating these variables, the aim was to accurately match the starting point of each policy to bonds issued at or after this date. This meant that for the EU taxonomy and the SFDR, which are accounting policies, dummy variables were created. These dummy variables were given a value of 1 for any bonds issued on or after the implementation date of the respective policies and 0 for any bonds issued at a date preceding the implementation date. The implementation date of the EU taxonomy (12 July 2020) was retrieved from the European Commission (n.d.c), while the implementation date of the SFDR (10 March 2021) was retrieved from Finansinspektionen (2023).

While the same strategy could have been applied when creating the variables for the APP and PEPP, the ECB (n.d.) records the daily holdings of each programme. The choice was therefore made to create continuous variables instead of dummy variables for these two policies. This enables us to incorporate the effects of the different stages of growth and decline of the two programmes, from their respective start dates until their end dates, at which point no new purchases are made. As a result, both the APP (excluding the CSPP) and PEPP are measured in trillions of euros.

In addition to the above mentioned variables, this study also makes use of interaction terms as explanatory variables. For each policy, an interaction term was created between each policy's respective variable and the green bond dummy variable. This is done to be able to test the effect of each policy on green bonds specifically and is similar to a variable used by Hacıömeroğlu, Danışoğlu and Güner (2022), focusing on green bonds issued during the Covid-19 pandemic.

As explained towards the end of section 5.2, models 2-5 will also be tested with lags for the variables acting as proxies for the APP, PEPP, SFDR and the EU taxonomy. These variables will be lagged by one week and one month. Estimating the regression models without any lag to these variables essentially assumes efficient markets. However, as mentioned above the efficient market hypothesis does have its critics, who believe that markets are not always efficient. Lagging the policy variables will furthermore act as a robustness test, as established above, checking if the results hold when lagging the variables by one week and one month.

6.2.3 Control Variables

As a means to improve the robustness of our findings, this study also employs several control variables which are commonly used in the literature on this field. The control variables for this study are *Amount issued*, *Years until maturity*, *Short-term, Medium-term, Long-term, Investment grade, Unsecured, Underwritten*, *Publicly traded*, *Callable*, *Senior* and *Covered*. These are based on control variables included in studies performed by Agnese and Giacomini (2023), Hacıömeroğlu, Danışoğlu and Güner (2022) as well as Li, Zhang and Wang (2022). In addition to these control variables, the regressions also include a control for year effects, which was included by creating dummy variables for each year of the sample period.

As explained above, data for these variables was gathered from Reuters Refinitiv Eikon. The amount issued for some bonds were originally denominated in currencies other than euro, such as SEK or DKK. In order to achieve a unified denomination in terms of currency, all bonds that were not originally denominated in euros were converted into euros through the Reuters Refinitiv Eikon database. The fact that the ECB mainly purchases euro denominated bonds furthermore speaks for a unified currency for this study. Meanwhile, the maturity variables were based on each bond's time to maturity and divided into short-, medium- and long-term based on if the time to maturity was below 5 years, between 5 to 10 years or above 10 years, respectively. The remaining dummy variables were created in a straightforward way, based on the data gathered from Reuters Refinitiv Eikon.

6.3 Summary Statistics

Table 3 presents summary statistics for the variables in this study. *YTM* and *Amount issued* have been winsorized on the 1st and 99th percentile to deal with the prevalence of extreme outliers.

As seen from table 3, the dependent variable *YTM* shows both a mean and median centered around 5%, suggesting that, on average, the bonds in the dataset offer a yield of 5% if held until maturity. This consistency between mean and median indicates a relatively stable yield environment, although the wide range from 1% to 18% highlights that some bonds come with significantly higher yields, possibly due to greater risks or longer maturities. Concerning the *Green Bonds* dummy, we observe a mean of 0.048, which highlights that green bonds are relatively rare within this dataset. As presented in the data section of this report, there are 295 green bonds out of a total of 6199 in the dataset, justifying the presented mean.
Considering the policy variables, the *APP* presents a distribution where the median (€2.665 trillion) exceeds the mean (€2.325 trillion), suggesting a slight skew to the left. The APP programme does not span across the entire dataset, as it was implemented in September of 2014. Thus, skewing the summary statistics somewhat. The high standard deviation and a range extending from zero to nearly €3 trillion further indicate significant differences in the holdings of the programme. The variable *PEPP* reveals a mean slightly higher than the median, with a substantial standard deviation nearly as large as these values. The range from zero to over €1.7 trillion indicates variable levels of holdings in this programme. This variability can be traced to the differences in eligibility of the programme, due to the programme starting in March 2020 while the dataset encompasses bonds issued from 2013. The mean for the variable *SFDR* at 0.483 suggests that just below half of the observations were issued during the timeframe under which this policy is active. The variable *EU*

taxonomy has a mean of 0.548, suggesting that slightly more than half of the dataset falls under the EU taxonomy policy.

The variable *Amount issued*, denominated in billions of euros, has an average value of €0.428 billion, with a minimum value of €0.0003 billion and a maximum of €3.25 billions, indicating a fairly large difference in issuance amounts. While one could argue for transforming this variable with the natural logarithm, we follow the methodology of previous studies (Bachelet, Becchetti & Manfredonia, 2019; Larcker & Watts, 2020; Li, Zhang & Wang, 2020), who do not transform this variable. The variable *Covered* indicates that approximately 19.2% of the observations are covered bonds, as suggested by the mean. Meanwhile, the variable *Underwriter* has a mean value of 0.145 indicating that underwritten issues are relatively uncommon. The dummy variable *Investment grade* indicates that over half of the dataset (mean of 0.532) consists of investment grade bonds. Bonds with a call option appear to be less common, as indicated by the mean of the variable *Callable* at 0.244. Conversely, a majority of the bonds appear to be traded on public markets, which is established based on a mean of 0.812 for the variable *Publicly traded*.

The variable *Years until maturity* gives insight on the average lifespan of the bonds in the dataset with the mean being nearly 8.5 years. The standard deviation of roughly 6 years indicates a wide range of maturities, from short-term to long-term bonds. Delving deeper into the different maturities, the inclusion of the dummy variables *Short-term*, *Mid-term* and *Long-term* shows the distribution between the maturities. Short-term bonds constitute 25% of the entries, indicating a minority presence of short-term maturities. Mid-term bonds, with a mean of 0.4, have a larger presence, reflective of medium-term financial planning. Long-term bonds, indicated by a mean of 0.35, suggest that long-term bonds are relatively common. Finally, the dummy variables *Senior* and *Unsecured* both represent a majority of the data sample with senior bonds representing a large majority of roughly 88.2% and unsecured bonds just having the majority over secured bonds, at 50.2% of the observations.

6.4 Correlation

Table 4 shows the correlation matrix for the variables included in this study. As can be seen in the table, all variables, except *Green bond*, are significantly correlated with the dependent variable *YTM*. Some interesting correlations to make note of are the correlations of the four policy variables (*APP*, *PEPP*, *SFDR* and *EU taxonomy*) with the dependent variable *YTM*. According to the correlation table, all policy variables are positively correlated with *YTM*, meaning that since the implementation of each policy the *YTM* of bonds have increased. It is also interesting to make note of the difference in correlation between *YTM* and the *Short-*, *Medium* and *Long-term* maturity variables. All three are significantly correlated with the dependent variable, however the economic relationships differ, with *Short-term* being positively correlated and *Medium-* and *Long-term* being negatively correlated with *YTM*. Thus, short-term bonds appear to receive higher YTM:s while medium- and long-term bonds receive lower YTM:s. Finally, one can also make special note of the correlation between *YTM* and *Amount issued*. The correlation is negative, indicating that higher issue size bonds give lower yields compared to lower issue size bonds. Beyond the above-mentioned correlations, we can also see that *Covered*, *Investment grade*, *Publicly traded*, *Years until maturity* and *Senior* are negatively correlated with YTM. On the other hand, *Underwriter*, *Callable* and *Unsecured* are positively correlated with YTM.

Woolridge (2019) explains that if two variables are very highly correlated with each other, it could result in an issue of multicollinearity. However, Woolridge (2019) also proclaims that it is difficult to set an exact correlation amount between two variables that should be considered too high. With that in mind, there are three correlations in table 4 which could be considered too high. Those are the correlations between *SFDR* and *PEPP* (0.961), *EU taxonomy* and *PEPP* (0.938) as well as *EU taxonomy* and *SFDR* (0.878). However, these three variables are never present at the same time in any of the regression models estimated in this study. This means that the correlation between these variables is not cause for concern regarding the risk of multicollinearity in any of the regression models.

7 Empirical Results

This chapter aims to present the results from the regressions used throughout the study as well as test the previously mentioned hypotheses. Firstly, the regression results for hypothesis 1 is presented followed by hypothesis 2 and lastly hypothesis 3.

7.1. Greenium in the Bond Market - Hypothesis 1

7.1.1 Main Explanatory Variable and Hypothesis Testing

The first hypothesis is tested based on the results from model 1 in table 5:

H1: Bank-issued green bonds will have a significant YTM greenium in relation to brown bonds.

The variable *Green bonds* feature a coefficient of -0.188 with a p-value of 0.093, which, while not being able to be considered a strong statistical significance, does support the hypothesis at the 10% level. The negative coefficient clearly indicates that green bonds, on average, tend to have a lower YTM of 18,8 bps compared to their brown counterparts. The null hypothesis of green bonds not having any greenium in relation to their brown counterparts can therefore be rejected on a 10% significance level, indicating that a greenium exists for bank-issued green bonds.

7.1.2 Control Variables

As for the control variables included in the regression model, we find that all variables showcase significance varying between 1% and 5%. Furthermore, the control variables affect the YTM of bonds in different ways, some indicating a positive relationship and some a negative one. The control variable *Short-term* was omitted due to multicollinearity in the results of this regression, as well as all of the following regression results. The omission of the short-term dummy implies that it is used as the baseline category. All effects of the mid-term and long-term variables are thus interpreted relative to short-term bonds.

For the variables with a positive coefficient, we find that an increase in the issuance amount by €1 billion results in a 9.3 bps increase in YTM at a 1% significance level. Bonds purchased by underwriters are associated with a 19.3 bps higher YTM at a 5% significance level. Meanwhile we find that bonds with call options in general see a 38.9 bps higher YTM at a 1% significance level. Additionally, the variable *Years until maturity* is statistically significant at the 1% level, indicating a positive effect on YTM by 2.3 bps. Lastly, unsecured bonds have a higher YTM by 28.8 bps at a 1% significance level.

On the other hand, when analyzing the control variables that effectively lower the YTM of issued bonds we find that the variable *Covered* significantly lowers YTM by 104.6 bps at a 1% significance level. Investment grade bonds also show a lower YTM by 67.4 bps at a 1% significance level. Publicly traded bonds in general have a 24.1 bps lower YTM at a 5% significance. Both the *Mid-term* as well as the *Long-term* variables are statistically significant at the 1% level and indicate a negative effect on bond YTM by 80.4 bps and 138.1 bps, respectively. Lastly, senior bonds show a significant reduction in YTM by 87.5 bps at a 1% significance level.

7.2 Policy Effect on Bond YTM and Greenium - Hypothesis 2

This study's second hypothesis claims that:

H2: Both QE policies and accounting-based policies will have a significant negative effect on bank-issued bond yields.

To test this hypothesis regression models 2-5, which were presented in section 5.2, were estimated. The results from these regression models can be seen in table 6.

7.2.1 Main Explanatory Variables

Starting with model 2, which showcases the results when incorporating the APP into the regression, we see that all three explanatory variables are statistically significant. The variable *Green bonds* as well as the interaction term *APP x Green bonds* are both statistically significant at the 5% level, while the variable *APP* is statistically significant at the 10% level. We furthermore see that the coefficient for the variable *Green bonds* is -4.315, indicating that green bonds seem to have lower YTM by 431.5 bps, reflecting a greenium. However, when incorporating the interaction term into the interpretation, we see that the APP reduces the greenium by 148.6 bps. A one unit increase of the *APP* thereby reduces the observed greenium to 282.9 bps. When combining the interaction term with the final main explanatory variable, *APP*, we see a similar effect. By itself, the variable *APP* indicates that an increase in the holdings of the programme leads to lower yields for brown bonds by 52.4 bps. When combining the variable *APP* with the interaction term, we see that an increase of the APP by €1 trillion results in an increase in YTM for green bonds by 96.2 bps (-0.524+1.486=0.962).

Model 3 in table 6 tested the impact of the PEPP and found that all three main explanatory variables are statistically significant at the 5% level. The variable *Green bonds* indicate a negative relationship with bond YTM, with a coefficient of -0.795, thus implying a greenium of 79.5 bps. However, the coefficient for the interaction term *PEPP x Green bonds* indicates that a one unit increase of the *PEPP* reduces the greenium effect by 46.1 bps, to an observable greenium of 33.4 bps. Looking at the variable *PEPP*, we see that an increase by €1 trillion in the holdings of the PEPP reduces the yields of brown bonds by 60.1 bps, which is a slightly larger effect compared to the APP. However, contrary to the APP, the regression results from model 3 indicates that a €1 trillion increase of the PEPP results in a reduction of the YTM of green bonds by 14 bps (-0.601+0.461=-0.14).

Moving on to the results of models 4 and 5 in table 6, we see that the variable *Green bonds* is statistically significant at a 5% and 10% level, respectively. However, neither the *SFDR* and *SFDR x Green bonds* nor the *EU taxonomy* and *EU taxonomy x Green bonds* variables are statistically significant, making it difficult to make any conclusions based on these results.

7.2.2 Control Variables

As for the control variables included in the regression models, we see that all variables remain at the same significance level throughout all four regressions. All control variables are statistically significant at the 1% level, except for the variables *Underwriter* and *Publicly traded*, which are statistically significant at the 5% level. From the coefficients we can see that having an underwriter purchase a bond has an increasing effect on YTM by between 19.5 to 19.7 bps for all four regression models. Conversely, publicly traded bonds appear to have lower yields by between 23.4 to 24.3 bps, compared to bonds that are not publicly traded.

As for the variables significant at a 1% level, we find that the variables *Covered, Investment grade, Mid-term, Long-term* and *Senior* have negative relationships with bond YTM. Covered bonds seem to receive lower yields by between 104 to 105.2 bps while bonds that are investment grade appear to have lower yields by between 66.4 to 67.2 bps. Similarly, bonds with mid-term maturity have lower yields on average by between 80.4 to 80.8 bps and long-term maturity bonds by between 137.8 to 138.6 bps. Finally, senior bonds appear to have lower yields by between 86.6 to 87 bps. Moving on to the variables with a positive relationship with bond YTM, we find the variables *Amount issued, Callable, Years until maturity* and *Unsecured*. The results indicate that increasing the amount issued of a bond increases the yield by between 8.8 to 9.3 bps. Bonds which possess a call option appear to have higher yields by between 39.1 to 39.5 bps. Increasing the years until maturity of a bond by one year increases the yield on average by between 2.2 to 2.3 bps. Finally, we find that unsecured bonds have yields that are between 29 to 29.5 bps higher than secured bonds.

7.2.3 Hypothesis Testing

Based on the regression results in table 6 we cannot accept this study's second hypothesis. While the results indicate that both QE programmes, the APP and the PEPP, do have a negative effect on brown bond yields, we cannot make the same conclusion regarding the accounting policies. Furthermore, when focusing specifically on green bonds in relation to the QE programmes, we see differing results, with the APP having an increasing effect on the yields of green bonds while the PEPP has a reducing effect. It is however worth noting that, while both QE programmes reduce the greenium effect, the results still indicate a greenium presence in the market for bank-issued bonds.

7.3 Delaying the Effect of the Policies - Hypothesis 3

To test the study's third hypothesis, models 6-9 and 10-13 were estimated and the results can be seen in tables 7 and 8.

H3: Delaying the effect of the QE- and accounting policies will not incur significantly different results compared to assuming immediate effects.

Compared to the results presented in section 7.2, the significance level of the control variables does not change. Additionally, the coefficients of the control variables only see minimal to no changes, as a result, the control variables will not be discussed further in this section.

7.3.1 Comparison of Main Explanatory Variables

When looking at the results in tables 7 and 8 concerning the QE programmes and comparing those to the results presented in section 7.2, we find that the variable *Green bonds* does not change in significance level or the direction of the coefficient for either the APP or the PEPP, when delaying the effects of the policies by one week as well as one month. What we do find however is that the value of the coefficients marginally changes. The variable *APP* shows no change in significance level or coefficient direction, but a marginal change in the coefficient value, when assuming a delay. *PEPP* however demonstrates a change in the significance level, from 5% when assuming an instant reaction compared to a 1% level when delaying the effects of the implementation by both one week and one month. Although, there are no changes in the direction of the coefficient and only marginal changes to its value. Considering the interaction terms of the two QE programmes we find that the significance level of the *APP x Green bonds* variable is lowered from a 5% level to a 10% level when introducing a delay of one week and one month. *PEPP x Green bonds,* on the other hand, show no changes in the significance level and only marginal changes to the coefficient value for either of the interaction terms when implementing a delay.

Moving on to the accounting policies, the most notable change can be seen in the interaction term *EU taxonomy x Green bonds*. It went from not being significant when assuming an instant reaction to the implementation of the EU taxonomy or when assuming a delay of one week, to becoming significant at a 5% level when assuming a delay of one month in the reaction to the implementation. Furthermore, the coefficient indicates a positive relationship with bond YTM by 83.3 bps. Thus, we can conclude that the implementation of the EU taxonomy greatly reduces the observed greenium by 83.3 bps, resulting in a greenium of 9.3 bps (-0.926+0.833=-0.093). We can also highlight the changes to the significance level of the *Green bonds* variable for both accounting policies. For the SFDR, the variable changes from a 5% significance level, when assuming no delay as well as a one-week delay to the reaction of the implementation, to a 10% significance level when assuming a delay by one month. Meanwhile, the exact opposite is observed for the EU taxonomy, going from a 10% significance level to a 5% level. Additionally, the coefficient of the *Green bonds* variable changes by close to 30 bps from models 5 and 9 to model 13, most likely being a result of the interaction term becoming statistically significant. The remaining variables, *SFDR, SFDR x Green bonds* and *EU* *taxonomy*, are still not statistically significant after introducing both a one week and one month delay to the reactions of the two accounting policies.

7.3.2 Hypothesis Testing

To sum up the results from tables 7 and 8 compared to table 6, we find that delaying the effects of the QE programmes does have somewhat of an effect on the significance levels and the coefficients in some instances. However, the overall effect does not appear to be very dissimilar from the results identified in section 7.2, since the reduction of the negative variables, *Green bonds, APP* and *PEPP*, are essentially neutralized by a reduction of the positive interaction term coefficients. However, for the accounting policies we do find some
rather large changes due to the introduction of delays in the reaction to specifically the implementation of the EU taxonomy. The interaction term goes from not being statistically significant to reaching a significance level of 5% with a one-month delay. Based on this, we cannot fully accept the study's third hypothesis.

8 Analysis & Discussion

This chapter aims to analyze and discuss the results in relation to the presented theories and literature in chapters 2 and 3. Firstly, the greenium of bank-issued green bonds is discussed. Secondly, an analysis of green policy effects on bond yields will be performed, including an analysis when assuming delayed reactions by the market.

8.1 The Greenium of Bank-Issued Green Bonds

The regression results from model 1 confirms that there is a marginally significant negative premium for bank-issued green bonds by 18.8 bps, suggesting that they generally have lower yields compared to their brown counterparts. This finding aligns with the results of Zerbib (2019) who identifies a slight greenium on green bonds by 2 bps as well as Li, Zhang and Wang (2022) who found a greenium of 12 bps. This observation is further corroborated by Hacıomeroğlu, Danışoğlu and Güner (2022), Gianfrate and Peri, (2019), all noting similar findings of lower yields for green bonds, which underscores a general market trend where investors are seemingly willing to accept lower returns on investments deemed environmentally beneficial. Contrastingly, Larcker and Watts (2020), whose study focused on municipal bonds in the US between 2013-2018, found no discernible premium associated with green bonds, suggesting that in some markets or conditions, green and brown bonds are priced similarly. This points to the possibility that the greenium may not be universally observed across all markets and could depend on factors like geographical region, temporal factors or types of issuers, consistent with conclusions made by Torvanger, Maltais and Marginean (2021).

Bachelet, Becchetti and Manfredonia (2019) on the other hand notes an initially observed positive premium for green bonds issued by private entities, which contradicts the results of this paper. The researchers offer a clarifying perspective by suggesting that a negative premium for green bonds tends to materialize under specific conditions, notably when issuers have a strong reputation or when the bonds are accompanied by credible green certifications. Furthermore, Li, Zhang and Wang (2022) emphasize the importance of green labeling in reducing the yield significantly, arguing that the label or certification acts as a crucial signal to the market. The signal thus attests to the bond's genuine environmental benefits and that this certification process is vital in reducing information asymmetry between issuers and investors. Linking this observation to the signaling theory, the issuance of certified green bonds could possibly serve as a credible signal of an issuer's commitment to environmental standards. This aligns with Agnese and Giacomini (2023), who finds that higher ESG score, acting as a signal, is linked with a negative bond premium for banks. Combining these arguments with the results of this study suggests that European banks either have a strong reputation or credible green certification for issued green bonds. However, it's important to note that the current landscape for green bond certification, especially in the EU, is still evolving (European Commission, n.d.a). The recent introduction of the EU Green Bond Standard, which aims to provide a clear and rigorous framework for what constitutes a green bond, has not yet been fully implemented (Nordea, 2023b). This evolving regulatory context provides ground for future research where it will be particularly interesting to see if the enhanced transparency and rigor of the new standards amplify the signaling effects, leading to a more pronounced negative premium as the market gains further confidence in the environmental integrity of these financial instruments.

8.2 Policy Effects on Greenium and Bond Yields

From the regressions results (table 6) we were able to confirm that the QE policies do influence bond yields, in line with Cortes et al. 's (2022) conclusion. However, we were not able to confirm this for the accounting policies, except when assuming a delay in the reaction to the implementation of the EU taxonomy. Consistent with the discovery of a greenium for bonds issued by European banks confirmed in section 8.1, green bonds were also observed to have lower yields compared to brown bonds when incorporating the effects of both QE policies. The greenium observed in table 6 ranged from 282.9 bps for the APP to 33.4 bps for the PEPP. This can be compared to the 18.8 bps greenium found in model 1 as well as the results obtained by Li, Zhang and Wang (2022) and Zerbib (2019) who found negative premiums for labeled green bonds of 12 and 2 bps, respectively. A potential explanation for the differing results between model 1 and models 2-3 could be that the two QE policies have a significant effect on the greenium in the market for bank-issued bonds. However, while the greenium observed in conjunction with the PEPP is reasonable, the greenium observed when taking the APP into account can be argued to be unreasonably high. One explanation for the larger effect of the APP could be that the APP was implemented shortly after the first green bond issuance by banks in the EU. Thus, the effect of the APP could be expected to be larger since it affected the entire green bond sample examined in this study, including the early stages of the green bond market. A further cause for this could be due to the nature of this study's data sample and the limitations that were imposed. Mainly the limitation which caused a loss of observations for both green and brown bonds, which were issued after the study's start date, but had matured before collecting the data, thus being excluded. Ultimately, an interpretation could be that APP amplifies the effect of the greenium, however due to the abnormal nature of the coefficient we cannot make a realistic assessment of the economic impact.

In addition to the effect of QE policies on the existence of a greenium in the European market for bank-issued bonds, we also found differences in the policies' effects on green and brown bonds, respectively. We found that a €1 trillion increase in the holdings of the APP reduces the yield of brown bonds by 52.4 bps while it conversely increases the yield of green bonds by 96.2 bps. Concerning the PEPP, we found that a €1 trillion increase resulted in lower yields of brown and green bonds by 60.1 and 14 bps, respectively. This finding matches Hacıomeroğlu, Danışoğlu and Güner (2022) who found that the post-pandemic reduction of brown bond yields was larger compared to the decrease of green bond yields, in the secondary market. Thus, we find a predominately negative relationship between QE policies and bond YTM, consistent with studies performed by Andrade et al. (2016), De Santis (2020) as well as Lewis and Roth (2019). This would suggest that the QE policies implemented by the ECB are successful in their aim to stimulate economic activity for banks across the Eurozone, driving up prices and thereby lowering bond yields. However, we did also find somewhat contradictory results, since the APP appears to have an increasing effect on the yields of green bonds issued by banks. These contradictory results can be compared to the results of Dedola et al. (2021), who found both positive and negative effects of announcements related to the APP as well as some of its sub-programmes. The results of this study, as well as some previous studies, therefore indicate differing effects for different QE policies on green and brown bond yields. This could be dependent on several factors, such as the period under which the QE policy has existed as well as the scope and aim of each respective QE policy. As explained above, there is a relatively large gap in time between implementation of the APP and the PEPP. Furthermore, the PEPP was intended specifically for the Covid-19 pandemic which could be part of the reason why the greenium observed during the PEPP is lower than that of the APP. This reasoning would also be in line with Aloui et al. (2023), who argue that green QE experiences lower effects during times of crisis, such as the Covid-19 pandemic. Additionally, there are differences in the amount of holdings as well as purchases made for each policy, and to some extent the instruments permitted to be bought according to the guidelines of the APP and the PEPP.

As mentioned above, the accounting policies did not have an observable effect on bond yields, except when assuming a delay of one month in the reaction to the implementation of the EU taxonomy. The greenium discovered once accounting for the one month delayed effect of the EU taxonomy was 9.3 bps, which is close to results of Li, Zhang and Wang (2022) and Zerbib (2019). This finding could perhaps suggest that the signaling effect, to the market for bank-issued bonds, of implementing accounting policies is in some cases delayed, which would challenge the efficient market hypothesis. The reasoning behind that argument would be that accounting policies, like the EU taxonomy, have a delayed effect due to a gradual implementation and need for market adaptation. In contrast, QE policies prompt immediate reactions in the bond market as a result of a more predictable implementation. Furthermore, given the fact that the SFDR did not provide support for any effect on bond yields, regardless of delay to the reaction, one could argue that accounting-oriented policies in some cases don't have any effect on bond yields. The contrasting results between the SFDR and the EU taxonomy could also be explained by the fact that the SFDR, in its role as a transparency and disclosure regulation, does not directly alter the financial fundamentals of bond issuers. The EU taxonomy, on the other hand, can directly influence investor behavior and capital allocation since it provides a clear framework for sustainable investments, potentially leading to increased demand and lower yields for bonds.

9 Conclusion

The ever-accelerating threat of climate change positions financial intermediaries in an increasingly urgent situation to commit towards the climate transition. The emerging tool of green bonds has become a significant instrument that these intermediaries can utilize to align their investments with the net zero emission goal. This paper examines the issuance of green and brown bonds between the years of 2013-2023 by the 25 largest banks in the EU. In terms of this study's first research question, the results reveal a marginally significant greenium of 18.8 bps for bank-issued green bonds in the EU, aligning with similar findings in the literature. This indicates that green bonds generally offer lower yields, reflecting a market trend where investors accept lower returns for environmentally beneficial investments. Furthermore, the thesis' second research question aims to investigate the effects of green policies on green and brown bond yields. The results uncover that QE policies generally reduce bond yields, with variations depending on the specific policy and bond type. The results suggest that QE policies implemented by the ECB stimulate economic activity and influence bond yields, although the impact differs between green and brown bonds. Finally, the research addresses the influence of accounting policies on bond yields, particularly the EU taxonomy indicates a delayed but significant effect on the existence of a greenium, challenging the efficient market hypothesis.

Our research makes several key contributions to the financial policy literature. We examine the effects of diverse policies, particularly accounting-based ones, which are less studied compared to QE policies like the APP and PEPP. Unlike most studies that focus on bonds in general when examining the effect of QE, we differentiate between green bonds and brown bonds, providing a nuanced analysis of policy impacts. We also focus on banks within the EU, addressing the gap left by studies that either exclude banks or do not concentrate on the EU. Additionally, we compare the effects of different time lags in policy implementation, offering insights into the temporal dimensions of policy impacts.

The primary limitation of this study is related to the relatively new and developing market for bank-issued green bonds. This has resulted in limited access to comprehensive data due to a lack of transparency and the absence of complete bond data. Additionally, all bonds that had matured before the data extraction date were excluded since pricing data for matured bonds is not stored on Reuters Refinitiv Eikon. This exclusion reduced the sample size, potentially affecting the inference and reliability of the findings. Future studies may benefit from including these excluded observations. Moreover, there is currently no standardized green bond framework, therefore this study relied on Reuters Refinitiv Eikon's definition and selection of green bonds. As a result, the definition used by Reuters Refinitiv Eikon may differ from those of other frameworks.

Another suggestion for future studies to consider is the recent introduction of the EU Green Bond Standard, which aims to provide a clear and rigorous framework for what constitutes a green bond but has not yet been fully implemented. This evolving regulatory context provides ground for future research where it will be particularly interesting to see if the enhanced transparency and rigor of the new standards amplify the signaling effects, as previous studies have shown, leading to a more pronounced negative premium as the market gains further confidence in the environmental integrity of these financial instruments. Building on this, seeing as the EuGBs is considered as an amendment to the EU taxonomy, questions can be raised whether different amendments to these accounting policies have different effects on the green bond market and if the effects change over time as the policies become more clearly defined.

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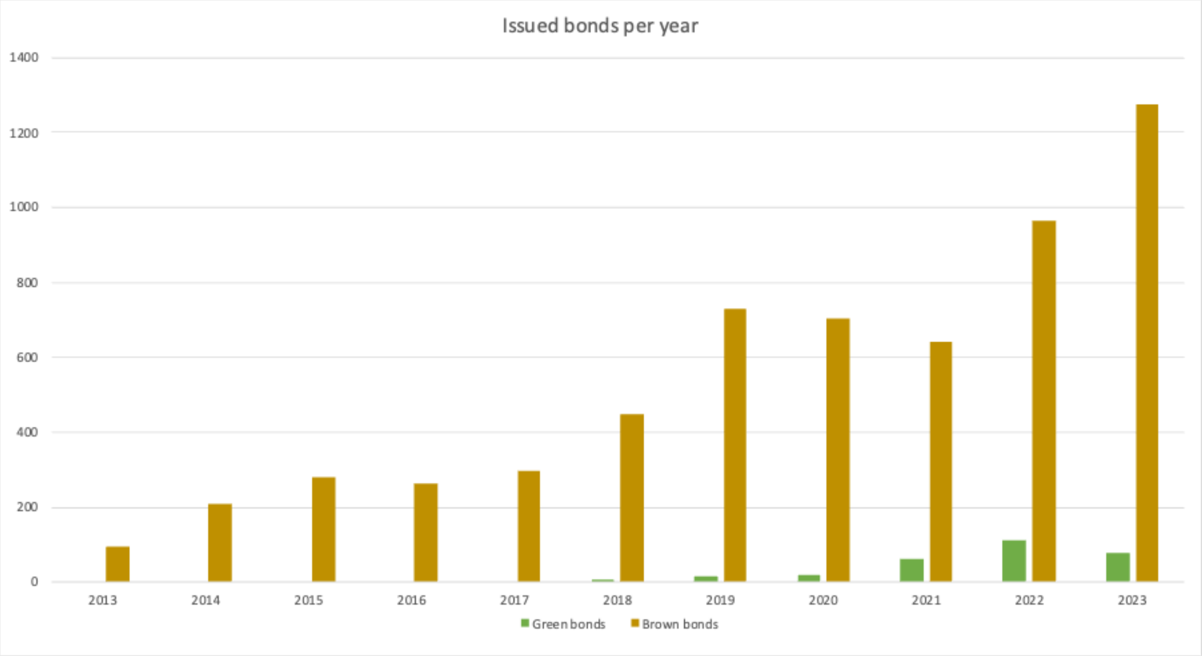
Figures

FIGURE 1: AMOUNT OF GREEN AND BROWN BONDS ISSUED, BY YEAR, IN THE DATA SAMPLE



Note: (Authors' own illustration)

Tables

Table 2: Heteroskedasticity test

Test: White test	Model	H0	Test statistics	P-Value	Decision	Heteroskedacity?
Stata test (Chi-squared)	1	Homoskadasticity	1378,42	0	Reject	Yes
Stata test (Chi-squared)	2	Homoskadasticity	1467,23	0	Reject	Yes
Stata test (Chi-squared)	3	Homoskadasticity	1428,49	0	Reject	Yes
Stata test (Chi-squared)	4	Homoskadasticity	1467,84	0	Reject	Yes
Stata test (Chi-squared)	5	Homoskadasticity	1431,08	0	Reject	Yes

Table 3: Summary statistics

Summary statistics

	Mean	Median	SD	Min	Max	N
YTM	5.144	4.549	2.477	.771	17.529	6199
Green bonds	.048	0	0.213	0	1	6199
APP	2.325	2.665	0.819	0	2.921	6199
PEPP	.82	.781	0.777	0	1.701	6199
SFDR	.483	0	0.500	0	1	6199
EU taxonomy	.548	1	0.498	0	1	6199
Amount Issued	.428	.100	0.609	.0003	3.25	6199
Covered	.192	0	0.394	0	1	6199
Underwriter	.145	0	0.352	0	1	6199
Investment grade	.532	1	0.499	0	1	6199
Callable	.244	0	0.429	0	1	6199
Publicly traded	.812	1	0.391	0	1	6199
Years until maturity	8.446	7.005	6.117	.416	40.027	6199
Short-term	.251	0	0.434	0	1	6199
Mid-term	.402	0	0.490	0	1	6199
Long-term	.347	0	0.476	0	1	6199
Senior	.882	1	0.322	0	1	6199
Unsecured	.502	1	0.500	0	1	6199

Notes: The variables included in the table are: ***Yield to maturity (%)*** *(winsorized on the 1st and 99th percentile);* ***Green bonds*** *(Dummy variable equals to 1 for bonds with a "Thomson Reuters Green Flag", and 0 otherwise);* ***APP (tnEUR)*** *(Value of the programme at the issuance date of a Bond, value in trillion euros);* ***PEPP (tnEUR)*** *(Value of the programme at the issuance date of a Bond, value in trillion euros);* ***SFDR*** *(Dummy variable equals 1 if the issue is equal to or past the implementation date of the policy, and 0 otherwise);* ***EU Taxonomy*** *(Dummy variable equals 1 if the issue is equal to or past the implementation date of the policy, and 0 otherwise);* ***Amount issued (bnEUR)*** *(winsorized on the 1st and 99th percentile);* ***Covered*** *(Dummy variable equals to 1 if the issue is Covered, and 0 otherwise);* ***Underwriter*** *(Dummy variable equals to 1 if the issue is underwritten, and 0 otherwise);* ***Investment grade*** *(Dummy variable equals to 1 if the bond is callable, and 0 otherwise);* ***Callable*** *(Dummy variable equals to 1 if the bond's rating is "Investment Grade", and 0 otherwise);* ***Publicly traded*** *(Dummy variable equals to 1 if the issued bond is traded on an exchange, and 0 otherwise);* ***Years until maturity*** *(h);* ***Short-term*** *(Dummy variable equals to 1 if the bond's original time to maturity is shorter than 5 years, and 0 otherwise);* ***Mid-term (****Dummy variable equals to 1 if the bond's original time to maturity is longer than 5 years and shorter than or equal to 10 years, and 0 otherwise);* ***Long-term (****Dummy variable equals to 1 if the bond's original time to maturity is longer than 10 years, and 0 otherwise);* ***Senior (****Dummy variable equals to 1 if the issue is considered as senior in case of liquidation, and 0 otherwise);* ***Unsecured*** *(Dummy variable equals to 1 if the issue is not collateralized, and 0 otherwise)*

Table 4: Parwise Correlation table

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
(1) YTM	1.000																	
(2) Green bonds	-0.018	1.000																
(3) APP	0.021*	0.126***	1.000															
(4) PEPP	0.049***	0.154***	0.645***	1.000														
(5) SFDR	0.048***	0.158***	0.600***	0.961***	1.000													
(6) EU taxonomy	0.048***	0.148***	0.652***	0.938***	0.878***	1.000												
(7) Amount Issued	-0.120***	0.036***	0.050***	0.005	0.001	0.019	1.000											
(8) Covered	-0.268***	-0.047***	-0.091***	-0.092***	-0.082***	-0.099***	0.414***	1.000										
(9) Underwritten	0.028**	-0.043***	-0.119***	-0.077***	-0.072***	-0.074***	-0.102***	-0.067***	1.000									
(10) Investment grade	-0.195***	0.015	-0.048***	-0.065***	-0.056***	-0.051***	0.398***	0.283***	0.060***	1.000								
(11) Callable	0.080***	0.044***	0.034***	0.088***	0.081***	0.124***	0.107***	-0.071***	0.082***	0.163***	1.000							
(12) Publicly traded	-0.127***	0.096***	-0.003	-0.039***	-0.041***	-0.008	0.203***	0.217***	-0.074***	0.248***	0.007	1.000						
(13) Years until maturity	-0.050***	-0.089***	-0.389***	-0.364***	-0.352***	-0.309***	0.082***	0.191***	0.076***	0.113***	0.409***	0.113***	1.000					
(14) Short-term	0.184***	0.033***	0.311***	0.479***	0.459***	0.406***	-0.065***	-0.117***	-0.042***	-0.161***	-0.054***	-0.125***	-0.416***	1.000				
(15) Mid-term	-0.068***	0.078***	0.210***	-0.065***	-0.069***	-0.023*	0.071***	-0.020	-0.050***	0.026**	-0.155***	0.053***	-0.285***	-0.474***	1.000			
(16) Long-term	-0.098***	-0.111***	-0.499***	-0.370***	-0.346***	-0.345***	-0.014	0.127***	0.090***	0.121***	0.209***	0.060***	0.672***	-0.422***	-0.598***	1.000		
(17) Senior	-0.166***	0.058***	0.087***	0.074***	0.074***	0.068***	-0.048***	0.157***	0.055***	-0.100***	-0.186***	0.028**	-0.128***	-0.066***	0.198***	-0.144***	1.000	
(18) Unsecured	0.226***	-0.124***	-0.189***	-0.156***	-0.152***	-0.160***	-0.344***	-0.489***	0.073***	-0.279***	0.093***	-0.129***	0.060***	0.021*	-0.145***	0.130***	-0.348***	1.000

Notes: The variables included in the table are: ***Yield to maturity (%)*** *(winsorized on the* 1^{st} *and* 99^{th} *percentile);* ***Green bonds*** *(Dummy variable equals to 1 for bonds with a "Thomson Reuters Green Flag", and 0 otherwise);* ***APP (tnEUR)*** *(Value of the programme at the issuance date of a Bond, value in trillion euros);* ***PEPP (tnEUR)*** *(Value of the programme at the issuance date of a Bond, value in trillion euros);* ***SFDR*** *(Dummy variable equals 1 if the issue is equal to or past the implementation date of the policy, and 0 otherwise);* ***EU Taxonomy*** *(Dummy variable equals 1 if the issue is equal to or past the implementation date of the policy, and 0 otherwise);* ***Amount issued (bnEUR)*** *(winsorized on the* 1^{st} *and* 99^{th} *percentile;* ***Covered*** *(Dummy variable equals to 1 if the issue is Covered, and 0 otherwise);* ***Underwriter*** *(Dummy variable equals to 1 if the issue is underwritten, and 0 otherwise);* ***Investment grade*** *(Dummy variable equals to 1 if the bond is callable, and 0 otherwise);* ***Callable*** *(Dummy variable equals to 1 if the bond's rating is "Investment Grade", and 0 otherwise);* ***Publicly traded*** *(Dummy variable equals to 1 if the issued bond is traded on an exchange, and 0 otherwise);* ***Years until maturity*** *(h);* ***Short-term*** *(Dummy variable equals to 1 if the bond's original time to maturity is shorter than 5 years, and 0 otherwise);* ***Mid-term (****Dummy variable equals to 1 if the bond's original time to maturity is longer than 5 years and shorter than or equal to 10 years, and 0 otherwise);* ***Long-term (****Dummy variable equals to 1 if the bond's original time to maturity is longer than 10 years, and 0 otherwise);* ***Senior (****Dummy variable equals to 1 if the issue is considerd as senior in case of liquidation, and 0 otherwise);* ***Unsecured*** *(Dummy variable equals to 1 if the issue is not collateralized, and 0 otherwise).*

***** *p<0.01,* *** *p<0.05,* * *p<0.1*

Table 5: Regression Results Model 1

YTM	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Green bonds	-.188	.112	-1.68	.093	-.408	.031	*
Amount issued	.093	.033	2.82	.005	.028	.157	***
Covered	-1.046	.059	-17.63	0	-1.162	-.929	***
Underwriter	.193	.092	2.09	.036	.012	.373	**
Callable	.389	.062	6.27	0	.267	.51	***
Investment grade	-.674	.06	-11.29	0	-.791	-.557	***
Publicly traded	-.241	.1	-2.41	.016	-.437	-.045	**
Years until maturity	.023	.005	4.31	0	.013	.034	***
Short-term	0	.	.	.	.	.	
Mid-term	-.804	.096	-8.42	0	-.992	-.617	***
Long-term	-1.381	.1	-13.75	0	-1.578	-1.184	***
Senior	-.875	.115	-7.61	0	-1.1	-.65	***
Unsecured	.288	.078	3.70	0	.135	.441	***
Constant	7.414	.23	32.28	0	6.964	7.865	***

Mean dependent var	5.144	SD dependent var	2.477
R-squared	0.144	Number of obs	6199
F-test	105.807	Prob > F	0.000
Akaike crit. (AIC)	27916.267	Bayesian crit. (BIC)	28071.106
Year effects:	Yes	Method	OLS
Standard errors	Robust		

Notes: This regression table reports the results for the regression model 1. The objective is to measure the greenium of bank-issued green bonds. The dependent variable is ***Yield to maturity*** *and the main explanatory variable is* ***Green bonds*** *(Dummy variable equals to 1 for bonds with a "Thomson Reuters Green Flag", and 0 otherwise). The control variables in the regressions are as followed;* ***Amount issued (bnEUR)****;* ***Covered*** *(Dummy variable equals to 1 if the issue is Covered, and 0 otherwise);* ***Underwriter*** *(Dummy variable equals to 1 if the issue is underwritten, and 0 otherwise);* ***Investment grade*** *(Dummy variable equals to 1 if the bond is callable, and 0 otherwise);* ***Callable*** *(Dummy variable equals to 1 if the bond's rating is "Investment Grade", and 0 otherwise);* ***Publicly traded*** *(Dummy variable equals to 1 if the issued bond is traded on an exchange, and 0 otherwise);* ***Years until maturity*** *(h);* ***Short-term*** *(Dummy variable equals to 1 if the bond's original time to maturity is shorter than 5 years, and 0 otherwise);* ***Mid-term (****Dummy variable equals to 1 if the bond's original time to maturity is longer than 5 years and shorter than or equal to 10 years, and 0 otherwise);* ***Long-term (****Dummy variable equals to 1 if the bond's original time to maturity is longer than 10 years, and 0 otherwise);* ***Senior (****Dummy variable equals to 1 if the issue is considered as senior in case of liquidation, and 0 otherwise);* ***Unsecured*** *(Dummy variable equals to 1 if the issue is not collateralized, and 0 otherwise)*

**** p<.01, ** p<.05, * p<.1*

Table 6: Regression Results Models 2-5

	Model 2 YTM	Model 3 YTM	Model 4 YTM	Model 5 YTM
Green bonds	-4.315**	-0.795**	-0.586**	-0.661*
	(2.098)	(0.319)	(0.290)	(0.374)
APP	-0.524*			
	(0.290)			
APP x Green bonds	1.486**			
	(0.753)			
Amount issued	0.089***	0.088***	0.093***	0.091***
	(0.033)	(0.033)	(0.033)	(0.033)
Covered	-1.040***	-1.048***	-1.044***	-1.052***
	(0.059)	(0.059)	(0.059)	(0.059)
Underwriter	0.196**	0.195**	0.195**	0.197**
	(0.092)	(0.092)	(0.092)	(0.092)
Callable	0.391***	0.395***	0.391***	0.391***
	(0.062)	(0.062)	(0.062)	(0.062)
Investment grade	-0.664***	-0.664***	-0.668***	-0.672***
	(0.060)	(0.060)	(0.060)	(0.060)
Publicly traded	-0.238**	-0.235**	-0.243**	-0.234**
	(0.100)	(0.100)	(0.100)	(0.100)
Years until maturity	0.023***	0.022***	0.023***	0.023***
	(0.005)	(0.005)	(0.005)	(0.005)
Short-term				
Mid-term	-0.806***	-0.808***	-0.808***	-0.804***
	(0.096)	(0.095)	(0.096)	(0.095)
Long-term	-1.386***	-1.383***	-1.381***	-1.378***
	(0.101)	(0.100)	(0.101)	(0.100)
Senior	-0.866***	-0.868***	-0.870***	-0.869***
	(0.115)	(0.115)	(0.115)	(0.115)
Unsecured	0.295***	0.292***	0.294***	0.290***
	(0.078)	(0.078)	(0.078)	(0.078)
PEPP		-0.601**		
		(0.234)		
PEPP x Green bonds		0.461**		
		(0.221)		
SFDR			-0.183	
			(0.186)	
SFDR x Green bonds			0.488	
			(0.312)	
Eu taxonomy				-0.265
				(0.175)
EU taxonomy x Green bonds				0.542
				(0.390)
Constant	8.530***	7.935***	7.120***	7.351***
	(0.814)	(0.438)	(0.259)	(0.256)
Observations	6199	6199	6199	6199
R-squared	0.145	0.145	0.144	0.145
Standard errors	Robust	Robust	Robust	Robust
Method	OLS	OLS	OLS	OLS
Year effects	Yes	Yes	Yes	Yes

Notes: This regression table reports the results for the regression model 2-5. The objective is to measure the green policy effect on bank-issued bonds. The dependent variable is ***Yield to maturity (%)*** *for all models and the main explanatory variables are* ***Green bonds*** *(Dummy variable equals to 1 for bonds with a "Thomson Reuters Green Flag", and 0 otherwise);* ***APP (tnEUR)*** *(Value of the programme at the issuance date of a Bond, value in trillion euros);* ***PEPP (tnEUR)*** *(Value of the programme at the issuance date of a Bond, value in trillion euros);* ***SFDR*** *(Dummy variable equals 1 if the issue is equal to or past the implementation date of the policy, and 0 otherwise);* ***EU Taxonomy*** *(Dummy* *variable equals 1 if the issue is equal to or past the implementation date of the policy, and 0 otherwise);* ***APP x Green bonds*** *(Interaction term);* ***PEPP x Green bonds*** *(Interaction term);* ***SFDR x Green bonds*** *(Interaction term);* ***EU taxonomy x Green bonds*** *(Interaction term). The control variables in the regressions are as followed;* ***Amount issued (bnEUR)****;* ***Covered*** *(Dummy variable equals to 1 if the issue is Covered, and 0 otherwise);* ***Underwriter*** *(Dummy variable equals to 1 if the issue is underwritten, and 0 otherwise);* ***Investment grade*** *(Dummy variable equals to 1 if the bond is callable, and 0 otherwise);* ***Callable*** *(Dummy variable equals to 1 if the bond's rating is "Investment Grade", and 0 otherwise);* ***Publicly traded*** *(Dummy variable equals to 1 if the issued bond is traded on an exchange, and 0 otherwise);* ***Years until maturity*** *(h);* ***Short-term*** *(Dummy variable equals to 1 if the bond's original time to maturity is shorter than 5 years, and 0 otherwise);* ***Mid-term (****Dummy variable equals to 1 if the bond's original time to maturity is longer than 5 years and shorter than or equal to 10 years, and 0 otherwise);* ***Long-term (****Dummy variable equals to 1 if the bond's original time to maturity is longer than 10 years, and 0 otherwise);* ***Senior (****Dummy variable equals to 1 if the issue is considered as senior in case of liquidation, and 0 otherwise);* ***Unsecured*** *(Dummy variable equals to 1 if the issue is not collateralized, and 0 otherwise)*

Robust standard errors are in the pareentheses
**** p<.01, **p<.05, *p<.1*

Table 7: Regression Results Models 6-9 (one-week lag)

	Model 6 YTM	Model 7 YTM	Model 8 YTM	Model 9 YTM
Green bonds	-4.255**	-0.787**	-0.592**	-0.659*
	(2.084)	(0.316)	(0.290)	(0.374)
APP 1W	-0.556*			
	(0.291)			
APP 1W x Green bonds	1.465*			
	(0.748)			
Amount issued	0.089***	0.088***	0.092***	0.091***
	(0.033)	(0.033)	(0.033)	(0.033)
Covered	-1.040***	-1.048***	-1.043***	-1.052***
	(0.059)	(0.059)	(0.059)	(0.059)
Underwriter	0.195**	0.195**	0.194**	0.197**
	(0.092)	(0.092)	(0.092)	(0.092)
Callable	0.391***	0.395***	0.391***	0.391***
	(0.062)	(0.062)	(0.062)	(0.062)
Investment grade	-0.665***	-0.664***	-0.668***	-0.671***
	(0.060)	(0.060)	(0.060)	(0.060)
Publicly traded	-0.238**	-0.235**	-0.243**	-0.235**
	(0.100)	(0.100)	(0.100)	(0.100)
Years until maturity	0.023***	0.022***	0.023***	0.023***
	(0.005)	(0.005)	(0.005)	(0.005)
Short-term				
Mid-term	-0.806***	-0.809***	-0.809***	-0.804***
	(0.096)	(0.095)	(0.096)	(0.095)
Long-term	-1.386***	-1.383***	-1.382***	-1.377***
	(0.101)	(0.100)	(0.101)	(0.100)
Senior	-0.866***	-0.868***	-0.869***	-0.869***
	(0.115)	(0.115)	(0.115)	(0.115)
Unsecured	0.295***	0.292***	0.294***	0.290***
	(0.078)	(0.078)	(0.078)	(0.078)
PEPP 1W		-0.613***		
		(0.235)		
PEPP 1W x Green bonds		0.458**		
		(0.219)		
SFDR 1W			-0.259	
			(0.200)	
SFDR 1W x Green bonds			0.496	
			(0.312)	
EU taxonomy 1W				-0.243
				(0.174)
EU taxonomy 1W x Green bonds				0.541
				(0.390)
Constant	8.616***	7.954***	7.196***	7.328***
	(0.817)	(0.440)	(0.268)	(0.255)
Observations	6199	6199	6199	6199
R-squared	0.145	0.145	0.145	0.145
Standard errors	Robust	Robust	Robust	Robust
Method	OLS	OLS	OLS	OLS
Year effects	Yes	Yes	Yes	Yes

Notes: This regression table reports the results for the regression model 6-9. The objective is to measure the green policy effect on bank-issued bonds with a one-week lag. The dependent variable is ***Yield to maturity (%)*** *for all models and the main explanatory variables are* ***Green bonds*** *(Dummy variable equals to 1 for bonds with a "Thomson Reuters Green Flag", and 0 otherwise);* ***APP (tnEUR)*** *(Value of the programme at the issuance date of a Bond, value in trillion euros);* ***PEPP (tnEUR)*** *(Value of the programme at the issuance date of a Bond, value in trillion euros);* ***SFDR*** *(Dummy variable equals 1 if the issue is equal to or past the implementation date of the policy,* *and 0 otherwise);* ***EU Taxonomy*** *(Dummy variable equals 1 if the issue is equal to or past the implementation date of the policy, and 0 otherwise);* ***APP x Green bonds*** *(Interaction term);* ***PEPP x Green bonds*** *(Interaction term);* ***SFDR x Green bonds*** *(Interaction term);* ***EU taxonomy x Green bonds*** *(Interaction term). The control variables in the regressions are as followed;* ***Amount issued (bnEUR)****;* ***Covered*** *(Dummy variable equals to 1 if the issue is Covered, and 0 otherwise);* ***Underwriter*** *(Dummy variable equals to 1 if the issue is underwritten, and 0 otherwise);* ***Investment grade*** *(Dummy variable equals to 1 if the bond is callable, and 0 otherwise);* ***Callable*** *(Dummy variable equals to 1 if the bond's rating is "Investment Grade", and 0 otherwise);* ***Publicly traded*** *(Dummy variable equals to 1 if the issued bond is traded on an exchange, and 0 otherwise);* ***Years until maturity*** *(h);* ***Short-term*** *(Dummy variable equals to 1 if the bond's original time to maturity is shorter than 5 years, and 0 otherwise);* ***Mid-term (****Dummy variable equals to 1 if the bond's original time to maturity is longer than 5 years and shorter than or equal to 10 years, and 0 otherwise);* ***Long-term (****Dummy variable equals to 1 if the bond's original time to maturity is longer than 10 years, and 0 otherwise);* ***Senior (****Dummy variable equals to 1 if the issue is considered as senior in case of liquidation, and 0 otherwise);* ***Unsecured*** *(Dummy variable equals to 1 if the issue is not collateralized, and 0 otherwise)*

Robust standard errors are in the pareentheses
**** p<.01, **p<.05, *p<.1*

Table 8: Regression Results Models 10-13 (one-month lag)

	Model 10 YTM	Model 11 YTM	Model 12 YTM	Model 13 YTM
Green bonds	-4.098**	-0.766**	-0.582*	-0.926**
	(2.048)	(0.307)	(0.301)	(0.371)
APP 1M	-0.570*			
	(0.299)			
APP 1M x Green bonds	1.410*			
	(0.736)			
Amount issued	0.089***	0.087***	0.093***	0.092***
	(0.033)	(0.033)	(0.033)	(0.033)
Covered	-1.040***	-1.049***	-1.045***	-1.050***
	(0.059)	(0.059)	(0.059)	(0.059)
Underwriter	0.195**	0.194**	0.196**	0.200**
	(0.092)	(0.092)	(0.092)	(0.092)
Callable	0.391***	0.394***	0.389***	0.391***
	(0.062)	(0.062)	(0.062)	(0.062)
Investment grade	-0.665***	-0.664***	-0.670***	-0.670***
	(0.060)	(0.060)	(0.060)	(0.060)
Publicly traded	-0.237**	-0.235**	-0.242**	-0.235**
	(0.100)	(0.100)	(0.100)	(0.100)
Years until maturity	0.023***	0.022***	0.023***	0.023***
	(0.005)	(0.005)	(0.005)	(0.005)
Short-term				
Mid-term	-0.807***	-0.811***	-0.806***	-0.804***
	(0.096)	(0.095)	(0.096)	(0.095)
Long-term	-1.387***	-1.385***	-1.380***	-1.376***
	(0.101)	(0.101)	(0.101)	(0.100)
Senior	-0.867***	-0.868***	-0.870***	-0.870***
	(0.115)	(0.115)	(0.115)	(0.115)
Unsecured	0.295***	0.292***	0.294***	0.291***
	(0.078)	(0.078)	(0.078)	(0.078)
PEPP 1M		-0.677***		
		(0.243)		
PEPP 1M x Green bonds		0.448**		
		(0.215)		
SFDR 1M			-0.061	
			(0.223)	
SFDR 1M x Green bonds			0.474	
			(0.322)	
EU taxonomy 1M				-0.267
				(0.177)
EU taxonomy 1M x Green bonds				0.833**
				(0.387)
Constant	8.651***	8.058***	6.997***	7.350***
	(0.837)	(0.451)	(0.289)	(0.261)
Observations	6199	6199	6199	6199
R-squared	0.145	0.146	0.144	0.145
Standard errors	Robust	Robust	Robust	Robust
Method	OLS	OLS	OLS	OLS
Year effects	Yes	Yes	Yes	Yes

*Notes: This regression table reports the results for the regression model 10-13. The objective is to measure the green policy effect on bank-issued bonds with a one-month lag. The dependent variable is **Yield to maturity (%)** for all models and the main explanatory variables are **Green bonds** (Dummy variable equals to 1 for bonds with a "Thomson Reuters Green Flag", and 0 otherwise); **APP (tnEUR)** (Value of the programme at the issuance date of a Bond, value in trillion euros); **PEPP (tnEUR)** (Value of the programme at the issuance date of a Bond, value in trillion euros); **SFDR** (Dummy variable equals 1 if the issue is equal to or past the implementation date of the policy, and 0 otherwise); **EU Taxonomy***

(Dummy variable equals 1 if the issue is equal to or past the implementation date of the policy, and 0 otherwise); ***APP x Green bonds*** *(Interaction term);* ***PEPP x Green bonds*** *(Interaction term);* ***SFDR x Green bonds*** *(Interaction term);* ***EU taxonomy x Green bonds*** *(Interaction term). The control variables in the regressions are as followed;* ***Amount issued (bnEUR)****;* ***Covered*** *(Dummy variable equals to 1 if the issue is Covered, and 0 otherwise);* ***Underwriter*** *(Dummy variable equals to 1 if the issue is underwritten, and 0 otherwise);* ***Investment grade*** *(Dummy variable equals to 1 if the bond is callable, and 0 otherwise);* ***Callable*** *(Dummy variable equals to 1 if the bond's rating is "Investment Grade", and 0 otherwise);* ***Publicly traded*** *(Dummy variable equals to 1 if the issued bond is traded on an exchange, and 0 otherwise);* ***Years until maturity*** *(h);* ***Short-term*** *(Dummy variable equals to 1 if the bond's original time to maturity is shorter than 5 years, and 0 otherwise);* ***Mid-term (****Dummy variable equals to 1 if the bond's original time to maturity is longer than 5 years and shorter than or equal to 10 years, and 0 otherwise);* ***Long-term (****Dummy variable equals to 1 if the bond's original time to maturity is longer than 10 years, and 0 otherwise);* ***Senior (****Dummy variable equals to 1 if the issue is considered as senior in case of liquidation, and 0 otherwise);* ***Unsecured*** *(Dummy variable equals to 1 if the issue is not collateralized, and 0 otherwise)*

Robust standard errors are in the pareentheses
**** p<.01, **p<.05, *p<.1*