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Spreadfall:

The name is Bond… Green Bond

Aleksandre Jorbenadze and Wael Makdessinaoum[1]

Abstract

This paper investigates the influence of the European Central Bank's (ECB) Corporate Sector Purchase Programme (CSPP) and its 'climate-aligned portfolio rebalancing' announcement on July 4 2022 for Euro-denominated corporate green bonds. The study utilizes a difference-in-differences framework and finds that ECB actions significantly reduce financing costs for firms that issue eligible green bonds with varying effects in magnitude and persistence. The results suggest that ECB's purchases increase the attractiveness of green bonds and incentivize firms to escalate subsequent issuance, which could further the Eurozone's role in sustainable finance. These targeted actions, resulting in compressed yields for eligible bonds, encourage the transition towards a lower carbon economy and influence corporates' financing decisions. The research contributes to the discussion regarding climate-aligned financing decisions for firms, emphasizing how central bank monetary incentives can drive corporate debt issuance towards green alternatives.

Keywords: Corporate bond markets, green bond pricing, ECB asset purchases, climate-aligned monetary policy, debt financing decisions

Acknowledgments: Paolo Sodini

[1] Student IDs: #42679, #25154

1. Introduction

The increasing threats related to climate change represent significant systematic risks to global financial stability, long-term economic development and corporate valuations (Network for Greening the Financial System [NGFS], 2021). As a response to the rise in global temperatures, capital markets gradually reallocate funds towards greener alternatives. Sustainability bonds financing climate-aligned projects have become increasingly popular, with global volume surpassing $3 trillion in 2025 (Bank for International Settlements [BIS], 2025).

This expansion has coincided with novel monetary policy initiatives, particularly by the ECB. An interesting development took place in July 2022, when the ECB announced to tilt its corporate bond portfolio purchases towards climate-aligned issuances under CSPP (ECB, 2022a). This policy meant increasing investments towards better climate performance securities and phasing out current holdings of carbon heavy sectors. The announcement represented a significant step in central banking policies, explicitly integrating climate performance objectives into monetary policy initiatives (ECB, 2022a).

This paper, through three research dimensions, investigates how the green bond market is affected by targeted monetary policies. Firstly, it explores the influence of purchase eligibility on the pricing of green bonds compared to conventional bonds in response to the announcement. Secondly, it analyzes ECB purchases' effects on yield spreads for purchased versus non-purchased bonds. Finally, it investigates how such interventions affect subsequent financing decisions.

Research Question

Does ECB climate-aligned monetary policy create persistently lower yield spreads for green bonds, and how does it affect firms' relative reliance on green bond financing?

The ECB's disclosure, to tilt its corporate bond portfolio towards climate-related securities, led to an immediate decrease in yield spreads for eligible green bonds. The effect was persistent for a 12-week window around the announcement date, with the strongest impact observed in the first two weeks following the announcement. Additionally, ECB actions reduced credit spreads for purchased bonds, with effects lasting for more than eight months. Furthermore, firms whose green bonds were purchased by the ECB, were shown to subsequently finance a larger share of their total debt via green bonds compared to counterfactuals. The results suggest that ECB's intervention has a tangible impact on corporate financing decision choices. This research advances the debate on monetary policy importance for sustainable finance, provides empirical evidence of the ECB's impact on green bond dynamics in the Eurozone and provides interesting insights for policymakers and market participants navigating the transition towards the low-carbon economy.

The remainder of this study proceeds as follows: Section 2 provides a literature review of prior research on monetary policy transmission and green bonds. Section 3 delves into the details of theoretical and institutional background in relation to the topic. Section 4 discusses the data collection and transformation processes. Section 5 outlines the methodology employed in the study. Section 6 presents the empirical findings, interpretations and a brief comparison of findings to related studies. Section 7, considers the study's limitations and suggestions for improvement and further research. Section 8 concludes the paper and Section 9 contains the appendix.

2. Literature review

2.1 Bremus, Schütze, and Zaklan - The Impact of ECB Corporate Sector Purchases on European Green Bonds, German Institute (2021).

The study by Bremus, Schütze, and Zaklan (2021) presents empirical evidence for how the ECB's CSPP and Pandemic Emergency Purchase Program (PEPP) affect the bond market. By employing a difference-in-differences approach on multiple control groups, the research shows that ECB purchase-eligibility reduced green bond yields by 18 - 33 basis points under the CSPP, while the PEPP induced reduction was even more pronounced.

The findings of the study bring forward interesting questions regarding the monetary policy's role and effectiveness in the transition towards sustainable finance. While the ECB's actions successfully boosted financing conditions for green eligible bonds, the authors argue that the market-neutral approach by ECB mostly resulted in purchases of conventional bonds due to their much larger share of the overall bond market. Considering that many conventional bonds finance carbon heavy industries, this created a scenario where despite green bonds receiving yield benefits, the ECB indirectly supported carbon-intensive issuers through conventional bond purchases. This tension between market neutrality and sustainability emphasizes how traditionally designed asset purchase programs could hinder transition towards low-carbon economies.

The study uses control groups with different currencies such as USD- and SEK-denominated bonds. The results aid in understanding how central bank intervention impacts sustainable investments, and underscore the need for a more nuanced approach to align central banking with climate objectives. The paper is a relevant benchmark when evaluating the effectiveness of ECB policy in relation to the development of green finance.

2.2 Kanda, Nuno, João Pinto, and João Silva - The CSPP impact on non-financial firms' cost of borrowing and debt choice, Porto Business School (2021)

The study by Kanda, et al., examining the effects of the ECB's CSPP on the debt financing conditions of Eurozone non-financial firms, represents an important contribution to the ongoing discourse regarding ECB actions. This research is noteworthy, since it has dual focus on bond and syndicated loan markets and provides insights into how the CSPP can influence firms' choices between financing alternatives. The study examines a dataset of over 3,200 bonds and 4,600 syndicated loans and employs reduced-form regression models and endogenous switching regressions. The models' additional specifications control for firm, contractual, and macroeconomic factors.

The findings show that the CSPP significantly lowered bond spreads. The decrease for the announcement phase reached 81 basis points, while the implementation phase resulted in an additional 57 basis points decline. The effects were particularly persistent for CSPP-eligible bonds, consistent with the transmission channels of quantitative easing discussed in the literature. The authors provide evidence of further spillover effects, approximately 42 bps decline, into syndicated loan markets despite these instruments not being directly targeted by the program. These findings suggest a strong substitutability between the two instrument markets, CSPP's extending influence beyond eligibility boundaries and broad easing of credit conditions.

Kanda et al. examine the CSPP's effect on firms' capital structure. By employing a Logit model, the study arrives at the conclusion that non-financial sector firms were more likely to opt for bonds as opposed to loans after the introduction of the program. The findings are aligned with literature on the role of flotation costs in financing alternative decisions. Through the investigation of yields and debt choice, the research provides insight into how targeted interventions affect corporate behavior. The research is a useful reference point for understanding corporate response to purchase eligibility and policy effects on debt markets.

2.3 Cohen, Furman - The Impact of the ECB's PEPP Project on the COVID-19-Induced Crisis in the Corporate Bond Market, LSE & Barcelona University (2023)

Cohen and Furman (2023) assess the efficiency of the PEPP in stabilization of the Eurozone corporate bond market during the Covid-19 pandemic. The study separates ECB-eligible bonds from ineligible bonds, and firms in Covid-19 sensitive sectors from those in non-sensitive industries, to assess the impact of monetary policy interventions on credit and liquidity. Utilizing Z-spreads for credit risk and scaled bid-ask spreads to estimate liquidity risk, the research finds that credit spreads increased significantly, by about 180 bps on average across all analysed bonds, in the initial stages of Covid-19, and liquidity worsened for ineligible bonds especially for firms in Covid-19 sensitive sectors. On the other hand, purchase eligible bonds showed more resilience in terms of liquidity.

To identify causal effects, this study employs a difference-in-difference framework supplemented with a propensity score matching on firm level to ensure treatment-control comparability. The results indicate that the PEPP announcement on March 18, 2020 significantly impacted market conditions and resulted in approximately 55 bps reduced credit spreads across firms, especially for bonds issued by firms in Covid-19 sensitive sectors. In contrast to previous asset purchase programs, the PEPP initially failed to enhance liquidity with bid-ask spreads remaining at elevated levels particularly for ineligible bonds. These findings underline the limitations of secondary market purchases in terms of alleviating liquidity stress during systemic shocks.

Additionally, when exploring the two month event window around the PEPP announcement, the findings demonstrate that purchase-eligible firms, especially from Covid-19 affected industries, raised bond issuance by approximately 290%. While noticeable, the respective increase for firms issuing ineligible bonds was significantly lower and reached approximately 30%. The increase in bond issuance by Covid-19 sensitive firms suggests that the PEPP eased credit conditions for vulnerable firms and facilitated capital market access, influencing both primary and secondary market pricing. The research is noteworthy as it focuses on credit and liquidity channels, as well explores the varying effects across sectors.

2.4 Contribution to Existing Literature

The aforementioned literature presents valuable insights into the impact of ECB asset purchase programs on bond markets, however this paper extends the literature in multiple ways. Firstly, it focuses on green bonds, providing a clear view of how monetary policy affects climate-related instruments. Secondly, the study spans a longer and more recent period (2021-2024) which helps in capturing the evolution of ECB interventions in the post-pandemic world. Thirdly, a staggered difference-in-differences approach is used to accommodate the variable timing of bond purchases made by ECB over an extended period of time, which in turn allows for a more accurate estimation of the persistence of effects. Additionally, the research strives to understand how innovative monetary policy impacts green bond dynamics on the primary market by exploring affected firms' subsequent debt financing decisions. These nuances provide additional value to the ongoing debate regarding sustainable economic development and central banks' position in aligning monetary policies with climate objectives.

3. Theoretical and Institutional Background

3.1 Institutional Background of the ECB and the CSPP

Founded in 1998, the ECB is the central bank for the Eurozone, a group of 19 EU countries that use the Euro as their currency. The primary mandate of the ECB is to maintain price stability, and keep inflation rates low and predictable, which are essential for supporting economic growth and employment in the Eurozone. Besides its primary mandate as a central bank, the ECB as an EU institution, supports the economic policies and overall objectives of the EU (ECB, 2021b). In recent years, as part of its monetary toolkit, ECB has started to integrate climate-related considerations to encourage transition towards the low-carbon economy. The ECB maintains a high degree of autonomy which ensures its decision-making is insulated from political influence, a vital consideration for maintaining credibility and monetary policy effectiveness (ECB, 2021a).

CSPP, which has become an integral part of the ECB's Asset Purchase Programs (APP), was launched on March 10, 2016. By easing financing conditions for non-financial corporates domiciled in the Eurozone, the CSPP serves as an expansionary tool in the ECB's monetary arsenal and contributes to keeping inflation rates at desired level. To be eligible under the CSPP, securities must satisfy several criteria, including but not limited to: (1) be Euro-denominated; (2) have an investment-grade rating; (3) mature between 6 months and 30 years; and (4) be issued by non-financial corporations incorporated in the euro area (ECB, 2016). During the Covid-19 pandemic, the ECB launched the PEPP in March 2020 as a form of emergency monetary policy response to the economic shock caused by the pandemic (ECB, 2020). The program allowed for purchasing of assets that were already eligible under the CSPP. This made the PEPP an unofficial continuation or extension of the CSPP. It is noteworthy to mention that following a 2024 Governing Council decision, all APP programs were discontinued indefinitely as a response to an extended period of high inflation in the Eurozone (ECB, 2024).

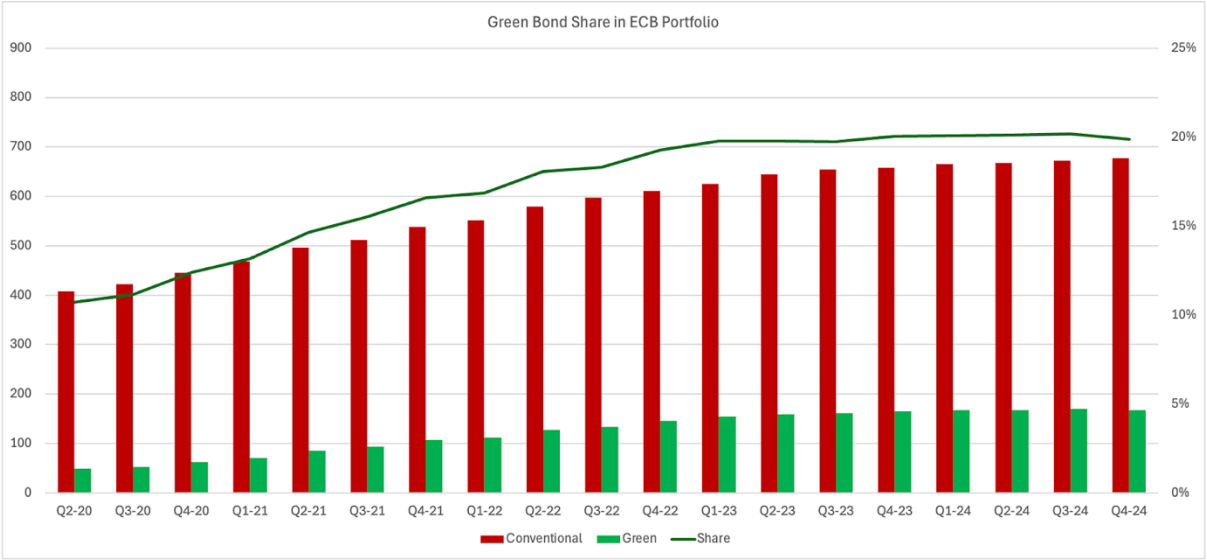
Recognizing the undeniable significance of environmental risks on long-term economic stability, the ECB has decided to incorporate climate-related considerations in the monetary policy framework. On July 4 2022, in order to decarbonize its holdings, the ECB

announced a tilt towards climate-aligned securities to be implemented starting from October 1 2022 (ECB, 2022a). The ECB's primary objective remains price stability through monetary policy, where bond purchase decisions, whether green or conventional, are aligned with the overall mandate of the ECB. The climate tilt in the CSPP and PEPP criteria adjusts weighings of bonds without changing the program's core purpose (ECB, 2022a). For additional details regarding the climate score and portfolio tilting methodology, please refer to *Section 9.1 in Appendix.*

ECB holdings data displays the pronounced trend towards greening. Specifically, the proportion of green bonds in relation to total holdings has almost doubled (from 11% to 20%) over the last four years *(Figure 3.1.1)*. Additionally, the ECB plans to increase the share of green bonds in its own funds portfolio to 25% (ECB, 2024). ECB's share of green bonds in portfolio is significantly larger compared to the share of green bonds in the total outstanding Euro-denominated bond universe, which only accounts for 3-5% (ECB, 2023; (Climate Bonds Initiative [CBI], 2024). It must be noted that green bond issuance has relatively surged recently, with green bonds representing over 10% of newly issued corporate bonds in the EU (BIS, 2025).

Figure 3.1.1[2]

[2] The portfolio is exclusively restricted to instruments analysed by this study



3.2 Theoretical Background

3.2.1 Yield Curve and Quantitative Easing Transmission

The term structure of interest rates and quantitative easing (QE) policy transmission can be understood through the lens of related theoretical frameworks. Preferred habitat theory (Modigliani & Sutch, 1966) and its modern day arbitrage-limited extensions (Vayanos & Vila, 2009) lay the foundation for understanding how asset purchases by central banks affect yield spreads. According to these theories investors have inherent preferences for specific securities creating segmentation across different bond markets that is sensitive to monetary shocks. Central bank interventions alter market observed spreads through multiple inter-related channels.

Firstly, the portfolio rebalancing channel (Greenwood & Vayanos, 2014) stems directly from supply effects. When central banks purchase long-term bonds, the available supply on the market is decreased, pushing investors to reallocate and lower their required yields. This effect is most pronounced for segments where investors have strong preferences (i.e. green bonds), in other words natural habitat. Secondly, the signaling channel (Bauer & Rudebusch, 2014) leads to spread compression through resulting expectations. Central bank asset purchases communicate information to market participants about future intentions,

which anchors long-term rate expectations and reduces premiums for uncertainty. Thirdly, the liquidity channel operates by improving the market functioning (D'Amico & King, 2013). Central banks, as consistent buyers in targeted market segments, enhance tradability of securities and reduce liquidity premiums embedded in the yields.

3.2.2 Credit Spreads versus Bond Yields: Analytical Priorities

Empirical evidence shows that credit spreads, representing differences between corporate and government bonds of the same maturity, are superior to raw yields when analyzing corporate financing conditions and predicting economic activity (Gilchrist & Zakrajšek, 2012; Friewald et al., 2014). Spreads offer three important analytical advantages compared to raw yields. Firstly, they filter out macroeconomic noise resulting from shifts in monetary policy and/or inflation, allowing a better analysis of credit risk (Gilchrist & Zakrajšek, 2012). Secondly, they facilitate a clearer measurement of impact of monetary policies, such as the CSPP (Abidi & Miquel-Flores, 2021). Thirdly, spreads, by adjusting for duration and monetary effects, permit comparison of firms and securities across sectors and markets (Andrade et al., 2016). Due to these advantages, this paper employs credit spreads as the primary analytical metric.

3.2.3 The Nelson-Siegel Model and Its Importance for Yield Curve Estimation

The Nelson-Siegel model provides a flexible framework estimating the term structure of risk-free interest rates. The model contains three interpretable components: level, slope and curvature factors (Annaert et al., 2013). These parameters capture key empirical features of the yield curve, including the typical upward sloping and hump-shaped pattern, while providing simplicity due to the small number of estimated parameters (Nelson & Siegel, 1987).

The model offers several advantages. The functional form results in smooth and economically plausible curves and avoids overfitting seen in complex non-parametric methods (Diebold & Li, 2006). Its factors have interpretable meanings: level reflects

long-term inflation expectations, slope reflects the monetary policy stance, and the curvature signals the medium-term outlook (Annaert et al., 2013). The simplicity makes the model suited for central banks' real-time analysis for policy and debt management (Gürkaynak et al., 2007). The Nelson-Siegel model's effectiveness is backed by extensive research. The model outperforms alternative specifications in both in-sample fit and out-of-sample forecasting (Diebold & Li, 2006)

3.2.4. Corporate Financing Decisions Under Central Bank Asset Purchases

According to the pecking order theory, firms traditionally choose internal financing, followed by debt and finally equity issuance (Myers & Majluf, 1984). However, recent research has demonstrated how central banks' asset purchase programs can impact affected firms' relative financing costs and subsequently alter their financing decisions through several interconnected mechanisms (Darmouni & Rodnyansky, 2017).

The primary channel is transmitted through yield compression in targeted debt securities. As a large-scale buyer and market participant, the central bank reduces the risk-free rate component and credit spreads for purchase-eligible securities (Krishnamurthy & Vissing-Jorgensen, 2011). This creates an opportunity for firms because the after-tax cost of bond financing becomes lower than that of bank loans or the cost of issuing new equity (Modigliani & Miller, 1963). Central banks, serving as a persistent marginal buyer on the market, reduce bid-ask spreads for bonds and improve market efficiency (D'Amico & King, 2013). Consequently, costs of flotation for new issuances are reduced as the liquidity premium becomes lower which makes bonds more accessible to firms which were reliant on bank loans prior (Denis & Mihov, 2003).

4. Data

4.1. Data Collection

This study relies on a comprehensive dataset constructed by consolidating multiple sources, including Refinitiv Eikon for Euro-denominated bond attributes with respective pricing and ratings, S&P Capital IQ for firm-level financial metrics and ECB databases for portfolio holdings and risk-free government yields. The data collection process utilized specialized tools provided by above mentioned platforms, including but not limited to Datastream, Excel conversion plug-ins, etc.

4.1.1 Bond Data Collection

Euro-denominated corporate bonds issued by non-financial corporates were screened using Refinitiv Eikon. Bonds issued by financial institutions were excluded, and only those with maturity dates extending beyond January 1, 2021 were retained. With these selection criteria, the bond universe comprised approximately 2,540 unique ISINs issued by approximately 530 unique firms with broad coverage across various issuer credit profiles. For each bond in the dataset, detailed information was retrieved, including unique ISIN identifier, maturity date, issuance date, issuance amount, country of domicile, ECB eligibility and green bond status. The last two variables are classifications defined and provided by Refinitiv Eikon. The green bond classification relies on issuer self-labeling in combination with recognition by external bodies such as the CBI, ensuring that only bonds meeting certain verification standards are identified as green within the platform (Refinitiv, 2023).

Out of the bond universe, 360 represented green bonds, while the rest, approximately 2180, were conventional *(Figure 4.1.1).* Bonds were classified into three maturity categories: short-term (0-5 years), medium-term (5-10 years), long-term (>10 years). More than half of the universe, approximately 1,500, belonged to the medium-term bracket *(Figure 4.1.2)*.

Figure 4.1.1

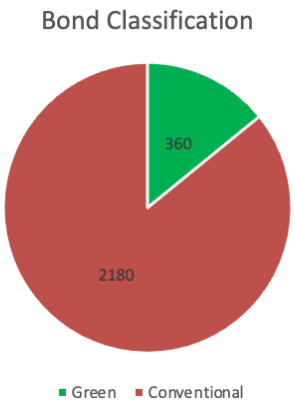
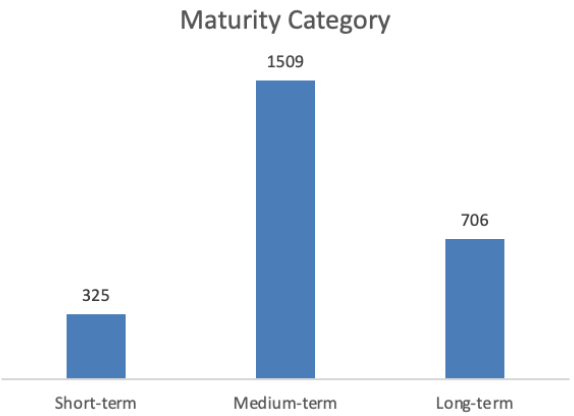


Figure 4.1.2



4.1.2. Yield and Pricing Data

Weekly yield, bid and ask data were obtained from Refinitiv Eikon where each observation corresponds to a Wednesday, starting from January 6, 2021. Bond yields were proxied using the Alternate Yield, known as Refinitiv End-of-Day Yield, which is a widely used approximation of yield-to-maturity (YTM).

The dataset uses weekly observation frequency to achieve balance between granularity and reliability. Higher frequency data, such as daily, could add unnecessary noise to the analysis due to the relatively illiquid nature of secondary bond markets. Lower frequency data, such as monthly, might conceal market reactions to ECB actions and bring additional challenges in making conclusions. Weekly aggregation provides the middle ground, as it smooths out transient, intra-week fluctuations, while retaining sensitivity to the repricing effects triggered by ECB interventions. The choice is consistent with established

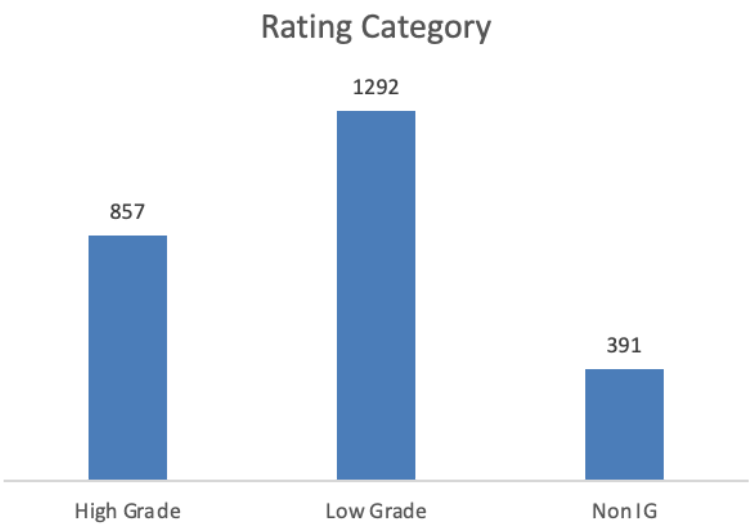
academic practice in fixed-income research (Dick-Nielsen et al., 2012; Pelizzon et al., 2016) where weekly bond data effectively capture liquidity dynamics without overfitting to short-term anomalies.

4.1.3 Bond Ratings

Refinitiv Eikon was used to obtain bond rating information including bond-level ratings, issuer ratings, and agency-specific classifications, namely Moody's. All ratings reflect bond status as of the data retrieval date February 7th 2025, and are thus treated as time-invariant within the study period to maintain consistency in credit risk assessment.

Where bond-specific ratings were unavailable, a conservative protocol was carried out. Issuer-level ratings or alternative agency ratings, i.e. Fitch or S&P, were used as substitute proxies. In those cases, the lowest available rating was assigned to ensure a conservative estimate of credit risk. Following industry conventions (European Banking Authority, 2023), all ratings were standardized and mapped to a numerical Moody's-equivalent scale *(refer to Table 9.4.1 in Appendix for the conversion table)*. For analytical reasons, observations were categorized into three broad credit rating tiers: Upper Investment Grade (Upper IG), Lower Investment Grade (Lower IG) and Non-Investment Grade (Non-IG). Approximately 1,300 bonds, nearly half of the sample, falls into the lower investment grade category reflecting the risk composition of the studied market segment *(Figure 4.1.3)*.

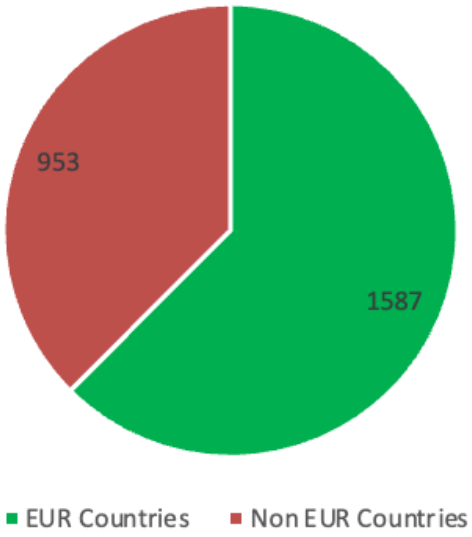
Figure 4.1.3



4.1.4 Firm-Specific Data via S&P Capital IQ

S&P Capital IQ was used to retrieve firm-level data. Each bond's ISIN was matched to the Capital IQ identifier (CIQ ID) using S&P's conversion template in the excel plugin. Preference in matching was given to the publicly-listed entity within the group, i.e. the entity linked to a ticker. This ensured that the financial firm metrics were reflective of the consolidated statements of the group entity rather than an intermediate holding company or a financing subsidiary. In case the ticker was not associated with the respective CIQ identifier, the matching process was completed iteratively to trace the ultimate parent company with a public financial profile. This process ensured maximum data reliability and comparability, which is critical for panel structured analysis. Based on the issuer and parent company countries of incorporation, bonds were categorized into Eurozone (roughly 1,600) and non-Eurozone jurisdictions (roughly 950) respectively *(Figure 4.1.4)*. This distinction is empirically material, since the ECB's purchase eligibility criteria *(Article 2(1a)) (Appendix 9.4.2)* explicitly prioritize Eurozone domiciled issuers.

Figure 4.1.4



After accurate identification of organizations, firm-level financial data was extracted between 2021 and 2024 on a quarterly basis. The retrieved financial metrics captured key dimensions of issuers' financial profile, such as leverage, scale, asset composition, etc. These indicators combined with credit ratings, can be regarded as a relatively accurate proxy for financial health and risk profile of issuers.

It is important to mention that significant gaps and inconsistencies were encountered during the data collection process, a challenge which has been widely observed in international corporate financial studies (Bessembinder et al., 2020). These concerns were addressed by an extensive data cleaning process, prioritizing maximum sample retention and accuracy.

4.1.5 ECB Data

Daily yield data for AAA-rated European government bonds across maturities, 3 months to 30 years, were obtained to construct the risk-free benchmarks. These were used to estimate Nelson-Siegel yield curves, further discussed in section 5: Methodology, which enabled the calculation of precise credit spreads for corporate bonds. This was a crucial step in isolating issuer-specific risk premia from term structure effects.

The ECB portfolio holding weekly data was collected at the ISIN level. It should be noted that while the ECB discloses which securities are held, it does not report position sizes, which is a limitation that may obscure the intensity of policy effects across different bond purchases. Nonetheless, information from the database was obtained to create three key variables in the final dataset: (i) a binary indicator denoting whether a bond was ever held by the ECB during the observation period, (ii) the initial acquisition date for bonds in the ECB's portfolio, and (iii) the latest or most recent observable holding date for such securities.

4.2 Data Cleaning and Transformation

4.2.1 Cleaning

The dataset was finalized with strict exclusion criteria to ensure consistency and reliability. Firstly, all observations with missing yield values were removed, as the analysis mainly depends on this variable. Observations with extremely high credit spreads (less than 0.2% of the total number of observations), exceeding 30 percentage points were also excluded, since these typically reflect either distressed securities undergoing idiosyncratic events or data inconsistencies resulting from illiquid trading (Bessembinder et al., 2017).

To ensure comparability within the dataset, securities with remaining tenors exceeding 35 years were excluded. Additional rational quality filters were implemented to eliminate logical inconsistencies: observations with negative tenors, negative yields and negative debt to capital measures. Missing quarterly financial metrics were interpolated using the average values of neighboring quarters in case the values were available and non-zero. This method outperformed complete cases, i.e. dropping missing observations approach in robustness checks. The aforementioned data cleaning protocol significantly strengthened the credibility of the dataset and improved validity of analysis.

4.2.2 Transformations

Market liquidity was proxied using the relative bid-ask spread, calculated as:

$$Bid - Ask\ Spread = \frac{Ask - Bid}{\frac{Ask + Bid}{2}}$$

where the denominator represents the bid-ask midpoint. This standardized measure captures what is known as the round-trip transaction cost as a percentage of bond value, and is done in accordance with established literature (Chen et al., 2007).

The remaining time-to-maturity for each bond was computed as the time difference between the observation date and the contractual maturity date. This precise tenor measure enables accurate yield curve alignment.

The Eurozone domicile classification indicator, 'eu_dummy', was constructed by double-checking domicile information against the ECB's eligibility criteria specified in Article 2(1a) of the CSPP framework *(Appendix 9.4.2)*. Furthermore, the purchase eligibility was modelled through a multi-dimensional screening process. This included verifying institutional eligibility via Refinitiv Eikon's ECB-eligible metric, a bond tenor between 6 months and 31 years, and fulfillment of jurisdictional criteria of being domiciled in the Eurozone. The green purchase eligible subset was constructed as the intersection of purchase-eligible bonds and those classified as green securities in Refinitiv Eikon's database.

5. Methodology

5.1 Yield Curve Construction

5.1.1 Nelson-Siegel Model Specification

The estimation used weekly observations of AAA-rated Euro-denominated government bond yields across seven maturities: 3-month, 1-year, 2-year, 5-year, 10-year, 20-year, and 30-year tenors. These risk-free benchmark rates served as the starting point for term structure modeling. The term structure of risk-free rates was estimated using the parsimonious three-factor model presented by Nelson and Siegel (1987):

$$r_t(\tau) = \beta_0 + \beta_1\left(\frac{1 - e^{-\lambda\tau}}{\lambda\tau}\right) + \beta_2\left(\frac{1 - e^{-\lambda\tau}}{\lambda\tau} - e^{-\lambda\tau}\right)$$

where $r_t(\tau)$ represents the continuously compounded yield, β_0 denotes the long-term yield level, β_1 controls the short-term slope component, β_2 controls the medium-term curvature, and λ controls the exponential decay rate of short-term effects (Christensen, Diebold, & Rudebusch, 2011).

5.1.2 Optimization Procedure

The model coefficients $\{\beta_0, \beta_1, \beta_2, \lambda\}$ were estimated using the Levenberg-Marquardt (1963) nonlinear least squares minimization procedure provided by Python's scipy.optimize.curve_fit module. The implementation aimed to minimize the sum of squared differences between the actual market yields and model predicted rates for the above mentioned risk free maturities.

The procedure of optimization included multiple safeguarding elements to ensure that the model retains numerical stability and economic plausibility. Starting values were determined using empirical yield curve characteristics as such: the initial β_0 parameter was set at the mean yield of different maturity groups, β_1 to the 90th-10th percentile yield differential, β_2 to the midpoint of the observed yield range, and λ to the median yield. Explicit constraints on parameters were imposed by the estimation, with β_0 set at bounds between -5% and 15%

to maintain plausible long-term rate values. Both β_1 and β_2 are restricted to [-20%, 20%] to prevent cases involving extreme slope and curvature, and λ is constrained to [0.1 - 15] to ensure a plausible decay rate.

5.1.3 Risk-Free Yield Interpolation and Credit Spread Calculation

For each corporate bond with maturity τ_{corp}, the corresponding risk-free yield was estimated:

$$RF(\tau_{corp}) = \beta_0 + \beta_1\left(\frac{1-e^{-\lambda\tau_{corp}}}{\lambda\tau_{corp}}\right) + \beta_2\left(\frac{1-e^{-\lambda\tau_{corp}}}{\lambda\tau_{corp}} - e^{-\lambda\tau_{corp}}\right)$$

Subsequently, the credit spread for each corporate bond was computed as:

$$Credit\ Spread = Corporate\ Bond\ Yield - RF(\tau_{corp})$$

5.2 Difference-in-Differences Framework

A standard difference-in-differences (DiD) model is used to analyse the causal effect of ECB actions on eligible green bond spreads. The approach involves comparing evolution of credit spreads before and after announcement dates for treatment, namely purchase-eligible green bonds, and multiple control groups. The DiD specification allows researchers to isolate external confounding factors and concentrate on policy's impact for comparison groups (Angrist & Pischke, 2008; Abadie, 2005). Sample is designed in a balanced panel structure, meaning that examination is exclusively restricted to bonds with available observations for the entire analysis period. This approach prevents compositional changes that could bring additional bias into the analysis (Bertrand et al., 2004). The DiD estimator is constructed using the following equation:

$$spread = \alpha + \beta_1 Treat + \beta_2 Post + \delta(Treat \times Post) + \varepsilon$$

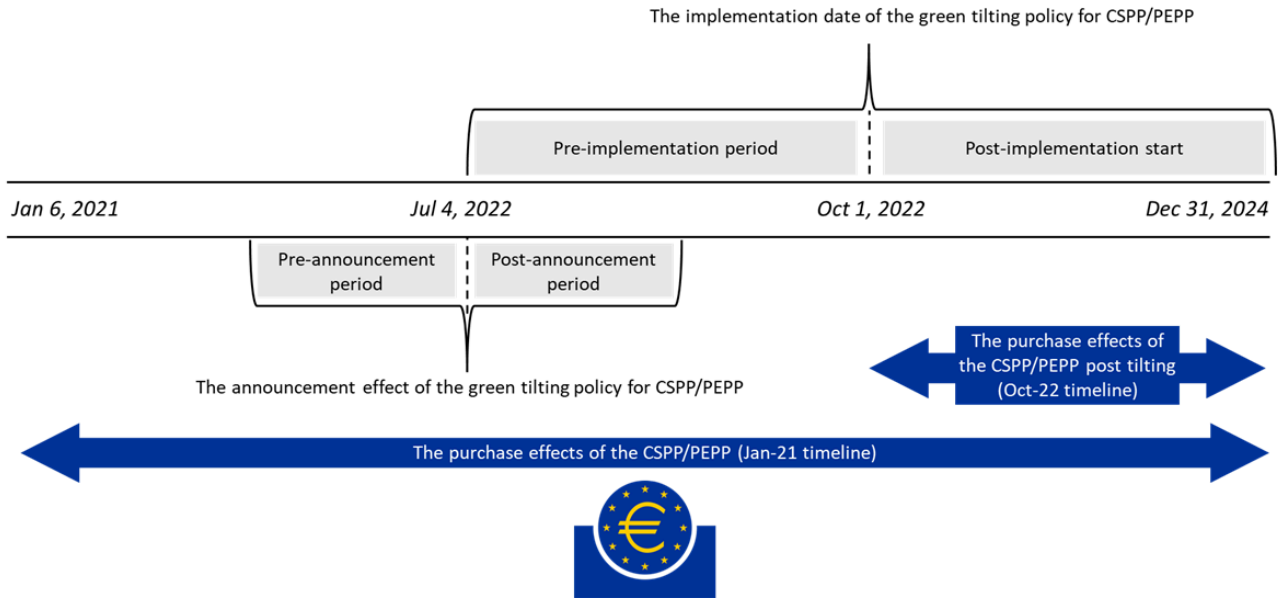
where the coefficient δ for the interaction term represents the DiD estimator of interest in the study.

Two assumptions need to hold for the DiD estimates to be unbiased, no anticipation and parallel trends. The no anticipation assumption requires that the policy shock, i.e. the announcement of ECB tilt in favor of green bonds, was not foreseen by market participants. Otherwise the treatment effect δ would be understated, as investors may partially incorporate the expected effect into spreads ahead of the official announcement. A series of lead and lag indicators are constructed around the announcement and purchase dates, and the absence of statistically significant pre-announcement effects would suggest that market participants did not anticipate the policy tilt (Nakamura & Steinsson, 2018).

The parallel trends assumption implies that in the absence of treatment, the bond spreads of the treatment and control groups would follow the same path. If this assumption is not satisfied the validity of the control group as a counterfactual to the treatment is undermined. To ensure the DiD estimated effect is unbiased, the aforementioned lead-lag regressions and pre-trend plots are used (Roth et al., 2023).

5.3 Specification

The paper first evaluates ECB's July 4 2022 announcement and its subsequent causal effect on Euro-denominated corporate bonds. Thus, July 4 2022 serves as a temporal cutoff for the announcement analysis. Secondly, the research investigates the impact of ECB's actual purchases on the market over the analysis period. Dynamic DiD model, staggered around the actual purchase dates, is designed for this purpose. This approach is widely used in similar studies for econometric soundness (Callaway & Sant'Anna, 2021; Sun & Abraham, 2021).



Two sample study windows are used to examine the purchase effects: the full study period from January 2021 through December 2024, and the post-tilting policy phase, spanning from October 2022 through December 2024. This distinction aims to analyse whether the post-announcement actions have resulted in a stronger impact on spreads.

The standard DiD specification is estimated at the bond-week level. The panel regression for the target variable, the credit spread $spread_{it}$ follows the equation:

$$spread_{it} = \alpha + \beta_1 (Treat \times Period)_{it} + \delta_i + \gamma_t + \varepsilon_i$$

and where δ_i are bond fixed effects, γ_t are time fixed effects, and β_1 captures the average treatment effect after the announcement. The announcement analysis is run on the weekly event windows of ±2, ±4 , and -4 & +8 weeks.

To analyse the effects of ECB purchases, bond-specific transaction dates are defined based on the earliest holding date retrieved from ECB holdings dataset. A dynamic DiD model is subsequently estimated on relative timestamps displaying the amount of weeks before and after each action date. The dynamic DiD model takes the following form:

$$spread_{it} = \alpha + \sum_{(k \neq -1)} \beta_k (Treat \times Period_k)_{it} + \delta_i + \gamma_t + \varepsilon_i$$

where k indexes weeks relative to the bond-specific purchase date. The coefficient β_k is estimated for each $k \in [-8, 0, 1, ..., 52]$ where $k = -1$ is omitted and serves as the reference period to avoid multicollinearity in the regression, where the pre-period is 8 weeks and post-period at 52 weeks. The time and entity fixed effects setup is used to control for unobserved heterogeneity across both time and bonds (Imai & Kim, 2021). This enables the analysis of dynamic treatment effects over time and serves as a check for pre-trends (Bertrand et al., 2004; Cameron & Miller, 2015). The dynamic DiD allows the treatment effect to apply at different times for each entity and uncovers the temporal pattern of the response. The estimations use clustering standard errors at the bond level to account for potential correlation in the error term.

The subsequent step of analysis investigates whether the ECB actions encouraged firms to subsequently increase green debt issuance. The analysis focuses on dual issuers which are firms that issue both green and conventional bonds during our study period. This choice of design ensures that the treatment and the control firm have access and familiarity to both debt markets. Additionally, it mitigates the selection bias that could stem from considering firms that exclusively issue green bonds, which could have different financing strategies or environmental commitments. The analysis implements a dynamic DiD at the firm-quarter (q) level, specified as follows:

$$GreenShare_{qi} = \alpha + \beta_1 (Treat \times Post)_{qi} + \mu_i + \tau_q + \varepsilon_i$$

Here, $GreenShare_{qi}$, is defined in two alternate ways as (i) the share of green bond in total bond volume or (ii) the share of green debt relative to total outstanding debt, for firm i in quarter q. The interaction term $(Treat \times Post)_{qi}$ represents the effect of ECB actions: $Treat_i$ shows whether any of firm$_i$'s green bonds were purchased by the ECB, and $Post_{qi}$ represents quarters following the firm's initial green bond purchase. Firm μ_i and quarter fixed effects τ_q jointly control for issuer specific and market volatility risks, ε_i is the error term. Standard errors are clustered at firm level to account for correlation in the error term.

5.4 Construction of Treatment and Control Groups

For the announcement effects, the treatment group is ECB-eligible green bonds which is tested against three distinct control groups: (i) ineligible green bonds, (ii) ECB-eligible conventional bonds, and (iii) all conventional bonds. The sample is restricted to a minimum 4-week window around July 4, 2022 and includes only bonds with observations before and after the announcement, ensuring data balance and preventing confounding due to data unavailability (Bertrand et al., 2004).

In the following step, analysis of ECB transactions effect, the treatment group is defined as purchased green (conventional) bonds, while control groups consist of (i) non-purchased eligible green (conventional) bonds and (ii) ineligible green (conventional) bonds. The sample is restricted to bonds with available observations surrounding the purchase date.

For the examination of changes in financing decisions subsequent to ECB purchases, the study concentrates on dual issues, i.e. firms issuing both conventional and green bonds. Tthe treatment is defined as occurring from the quarter of ECB purchase and onwards. Two distinct control groups are constructed for a robust counterfactual: (i) Eligible Non-Purchased Dual Issuers and (ii) Ineligible Dual Issuers. Group (i) comprises firms that issued CSPP-eligible green bonds purchased by the ECB though differing from the treatment only in that they didn't receive ECB participation. Group (ii) group comprises firms whose green bonds failed to meet ECB eligibility requirements mainly due to the country of domicile. The dual-control approach takes inspiration from recent work in program evaluation and facilitates the distinction between ECB-specific effects and general market trends (Flammer, 2021). All firms in the sample have at least one quarter of pre-treatment data.

5.5 Robustness Checks and Subgroup Analyses

A range of robustness checks and supplements are employed. Firstly, treatment effect heterogeneity is investigated for maturity brackets (0-5 years, 5-10 years, 10-20 years, and

20-30 years)[3] and broad credit rating categories. This design follows a common approach used by studies concerning central bank purchase programs and facilitates analysis of ECB intervention across different market segments (Krishnamurthy & Vissing-Jorgensen, 2011).

A duration analysis is conducted to aggregate the dynamic DiD coefficients into four temporal windows: immediate (0–4 weeks), short-term (5–8 weeks), medium-term (9–16 weeks), and long-term (17–52 weeks) after the purchase date to analyze whether treatment effects persist and are sustained over time. Such temporal categorization summarizes treatment dynamics while reducing noise from individual weekly coefficients (Callaway & Sant'Anna, 2021; Borusyak et al., 2024).

Announcement and purchase effect regressions are re-estimated with additional control variables; the debt-to-capital ratio to capture firm leverage characteristics and the constructed bid-ask metric as a liquidity proxy (Gilchrist & Zakrajšek, 2012). This allows for the separation of the ECB-related direct effect from the total market impact. The DiD specification with controls takes the following form:

$$spread = \alpha + \beta_1 Treat + \beta_2 Post + \delta(Treat \times Post) + \beta_3 D/C + \beta_4 Bid\,Ask + \epsilon$$

[3]The limited sample size in the 20-30 year precludes statistically reliable estimation

6. Empirical Findings

6.1 Pre-trends Assessment

The study uses both visual inspection and statistical testing of pre-trends for a 12-week period before the announcement date. Visual investigation of the pre-trends (Figures 9.6.1 - 9.6.2, appendix) demonstrates only minor variations between treatment and control groups, confirming compliance with DiD requirements. Conclusions made based on trends are empirically validated by formal testing. Time-trend coefficient is $\beta = 0.0008$ when comparing with ineligible green bonds and $\beta = -0.011$ respective to conventional bonds, both coefficients are not different from 0 at any conventional significance levels.

When examining the pre-trends coefficient in relation to purchase eligible bonds, both the empirical testing ($\beta = -0.0238$, $p = 0.001$) and visual inspection *(Figure 9.6.3 appendix)* display slight violation of parallel trends, representing approx. 2.38 basis points of average spreads. Further testing shows that trends remain comparable over the 8-week period before the announcement. Taking into account that purchase-eligible bonds are most similar to treatment group in terms of characteristics other than the green status and observing only weak pre-trend divergence, this subset was also kept as a control group for robustness check. Subgroup analysis by credit rating and maturity categories demonstrate that parallel trends generally hold across all examined control groups *(Figure 9.6.4)*.

6.2 Announcement Effects

6.2.1 Primary Announcement Effects

The ECB's announcement to tilt its portfolio towards climate-aligned securities created a strong market response, causing significant both economically and statistically reduction in eligible green bonds' spreads. As displayed *(in Table 6.2.1)*, eligible green bonds' spread declined by 17.1 bps and 13.4 bps in comparison to non-eligible green bonds and conventional bonds respectively in the initial 2-2 week period. Both figures are statistically significant at 1% level *($p < 0.01$)*. The 1.5 bps compression relative to conventional purchase eligible bonds is not statistically significant, likely due to absence of parallel trends prior to

announcement. The findings demonstrate that ECB's announcement had an immediate effect on eligible bonds' pricing.

Table 6.2.1 - Announcement: Purchase-eligible Green Bonds against Control Groups 4 weeks[4]

Table 3: Announcement Effects for Investment Grade Full Sample for 2 Weeks Pre-Post for Different Control Groups

	Green non-eligible bonds	Conventional bonds	Conventional Eligible
Treat x Post	-17.13***	-13.36***	-1.48
# of Observations	712	6544	3356

6.2.2 Temporal Evolution of Effects

Even though the observed announcement effect diminishes with time passage (as expected), it remains both economically and statistically significant over an extended period *(Table 6.2.2)*. Spread compression stays at 12.1 bps and 8.9 bps in comparison to non-eligible green bonds and conventional bonds respectively in the extended 4-8 week period, retaining significance at 1% level. This persistence, representing only 30-40% decay from initial effects, indicates that market participants believed in ECB announcement's credibility and viewed the tilt as enduring rather than temporary.

Table 6.2.2 - Announcement: Purchase-eligible Green Bonds against Control Groups 12 weeks

Table 3: Announcement Effects for Investment Grade Full Sample for 4-8 Weeks Pre-Post for Different Control Groups

	Green non-eligible bonds	Conventional bonds	Conventional Eligible
Treat x Post	-12.05***	-8.85***	0.5
# of Observations	2133	19631	10060

6.2.3 Cross-Sectional Heterogeneity

Announcement effects varied across credit quality and maturity sub-segments. Sub-group analysis demonstrates that the reaction was particularly observable for higher quality and medium- to long-term maturity bonds. The decrease in spreads (33 bps) for high-rated

[4] *Significance levels considered in the study: (***) - 1%, (**) - 5%, (*) - 10%*

investment grade bonds was almost twice *(Table 9.6.5 in Appendix)* compared to (26 bps) lower investment grade bonds *(Table 9.6.6 in Appendix)*. The effect was also more pronounced for long-maturity bonds (33 bps) with tenors between 10-20 years relative to short-maturity bonds (19 bps) with tenors between 0-5 years. Examining ECB holdings distribution among maturity and credit rating categories *(Figures 9.4.3-4 in Appendix)* demonstrates that ECB purchases are inherently more tilted towards medium to long-maturity and high-rated green bonds.

6.2.4 Alternative Specifications and Robustness checks

The baseline results prove robustness to additional model specifications, including differing time periods, additional controls, bond and time fixed effects and clustered standard errors. The interaction term, *TreatXPost* retains both statistical and economical significance under alternative variations of DiD framework.

The analysis of varying time periods to evaluate evolution of treatment effects displays persistent results (discussed in Section 6.2.2). The statistically and economically significant compression of yields over the 4-8 week event window, representing only 30-40% decay from the immediate (2-2 week) effects, reveals ECB announcement's persistent rather than transient effects. While the additional control (Debt to capital and bid-ask spread) variables present contrasting results, frequently showing no economic or statistical significance, the intersection term maintains persistence across virtually all variations presented *(Tables 9.6.10 in Appendix)*. The statistically insignificant coefficients of additional control variables could stem from their collinearity with fixed effects and be further compounded by the short event window for announcement effect analysis.

The stability of the interaction term *TreatXPost* across alternative specifications, indicates the credibility of the analysis and suggests that observed decrease in yields does not stem from model specification choices or driven from biased pre-trends assumptions, but instead reflect real economic effects created by the ECB's announcement.

6.3 The Purchase Effect of ECB Secondary Market Interventions

6.3.1 Variation in Purchase Effects after Implementation

For the January 2021 through December 2024 timeline, green bond purchases reduce spreads by 25.4 bps *($p < 0.01$)* against eligible non-purchased green bonds, and by 21.6 bps *($p < 0.05$)* against ineligible green bonds. When concentrating on the post-announcement event window of October 2022 through December 2024, the implementation phase purchases yield a 22.1 bps reduction *($p < 0.01$)* only when tested against ineligible green bonds *(Table 6.3.1)*.

Table 6.3.1

Table X: Purchase Effects for Green Investment Grade Full Sample for 2-12 months Pre-Post for Different Control Groups

	October 2022		January 2021	
	Green Eligible non-Purchased	Ineligible Green	Green Eligible non-Purchased	Ineligible Green
Treat x Post	-2.20	-22.10***	-25.41***	-22.57**
# of Observations	7237	16605	18780	28148

In contrast, conventional bond purchases show a weaker effect where only those purchased after October 2022 exhibit significant spread compression of 19.9 bps *($p < 0.01$)* relative to ineligible bonds *(Table 9.6.21 in Appendix)*.

6.3.2 Heterogeneous Effects by Credit Rating and Maturity

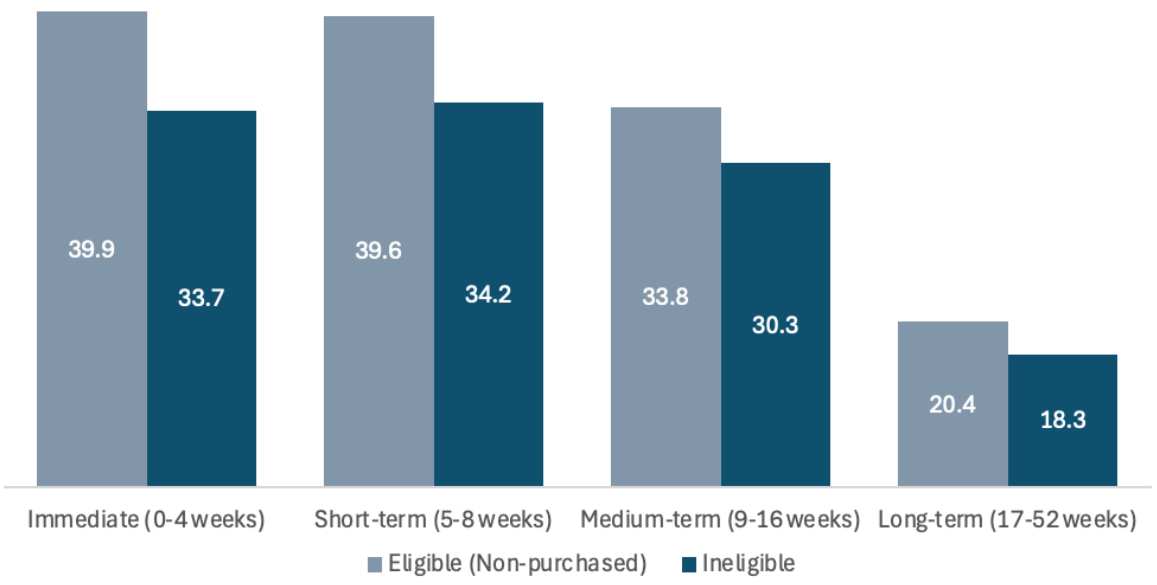
The significant effects are concentrated in 5-10Y maturity subgroups, where for the event period starting Oct-22 upper investment grade category displays drops in observed spreads -18.8 and -34.9 bps against green eligible non-purchased and ineligible green control groups respectively. Interestingly, the analysis period starting Jan-21 lower investment grade category shows pronounced compression of yields -20.4 and -24.6 bps against the same respective comparison groups. All the above mentioned figures are significant both economically and statistically *(Tables 9.6.11–14 in Appendix)*. The purchase effects being most pronounced in 5–10Y maturities suggests institutional demand for sustainable bonds is duration-aligned, which is further reinforced by the ECB portfolio concentration in the 5-10Y bucket *(Figures 9.4.3. - 9.4.4. in Appendix)*. Further examination of conventional bond purchases displays similar results, with upper investment grade medium-term bonds

experiencing the largest reduction of 28.1 bps against ineligible conventional bonds *($p < 0.01$) (Tables 9.6.17 - 20 in Appendix).*

6.3.3 Cross-Category Patterns and Duration analysis

For green bond purchases in the analysis period January 2021 similar persistence is observed, where -39.9 bps immediate *($p < 0.01$)*, declining to -20.37 bps *($p < 0.05$)* long-term *(Figure 6.3.2)* and effects are also stronger against ineligible control bonds. The effects retain statistical significance for around 8 months in total, implying a durable market effect.

Figure 6.3.2 - Effects of ECB purchases on Green bonds starting Jan-21 (Reduction effects in bps)



Green bond purchases in the October 2022 analysis period show significant effects against ineligible green bonds as the control group, revealing strong and lasting spread compressions: -31.08 bps immediate *($p < 0.01$)*, -29.02 bps short-term *($p < 0.01$)*, -25.93 bps medium-term *($p < 0.01$)*, and -19.54 bps long-term *($p < 0.05$) (Table 9.6.27 in Appendix)*. All

the time windows remain statistically significant which indicates an even more durable market effect.

In contrast, conventional bond effects are smaller and less persistent over time *(Table 9.6.27 in Appendix)*. These patterns suggest that the ECB's green purchases achieved stronger and more sustained market impacts for purchased bonds against ineligible comparators and compared to conventional bond purchases.

6.3.4 Robustness Checks via Specification with Firm and Bond Controls

When controlling for issuer debt-to-capital and bond liquidity, green bond purchased effects for the full sample show significance only for January-2021 timeline against non-purchased eligibles *(Table 9.6.16 in Appendix)*. Subgroup analysis shows greater sensitivity to controls where among green bonds fewer subsets' results remain significant with controls *(Table 9.6.16 in Appendix)*. It is worth noting that the uncontrolled specification still better reflects the full policy impact which captures both direct and indirect channels and is more relevant for policy evaluation (Li, Mercatanti, Mäkinen, & Silvestrini, 2021). Conventional bonds show resilience and robustness in terms of the significance of results for the full sample and the subsets in short-and medium-term maturities and lower-rated categories which mirrors earlier findings *(Tables 9.6.22–26 in Appendix)*.

6.4 Effects on capital structure

The analysis of capital structure decisions focuses exclusively on firms issuing both conventional and green bonds (dual issuers N=74). Treatment group consists of firms with ECB purchased green bonds via CSPP/PEPP. Control groups represent ineligible dual issuers and eligible, but not purchased dual issuers..

Analysis shows that treatment effects are statistically significant for both control groups. Compared to eligible non-purchased peers, firms that experienced ECB purchases of their green bonds show a 15.4 percentage point increase in their green bond share *($p < 0.01$)*, while relative to ineligible issuers the effect represents 11.8 percentage points *($p < 0.05$)*.

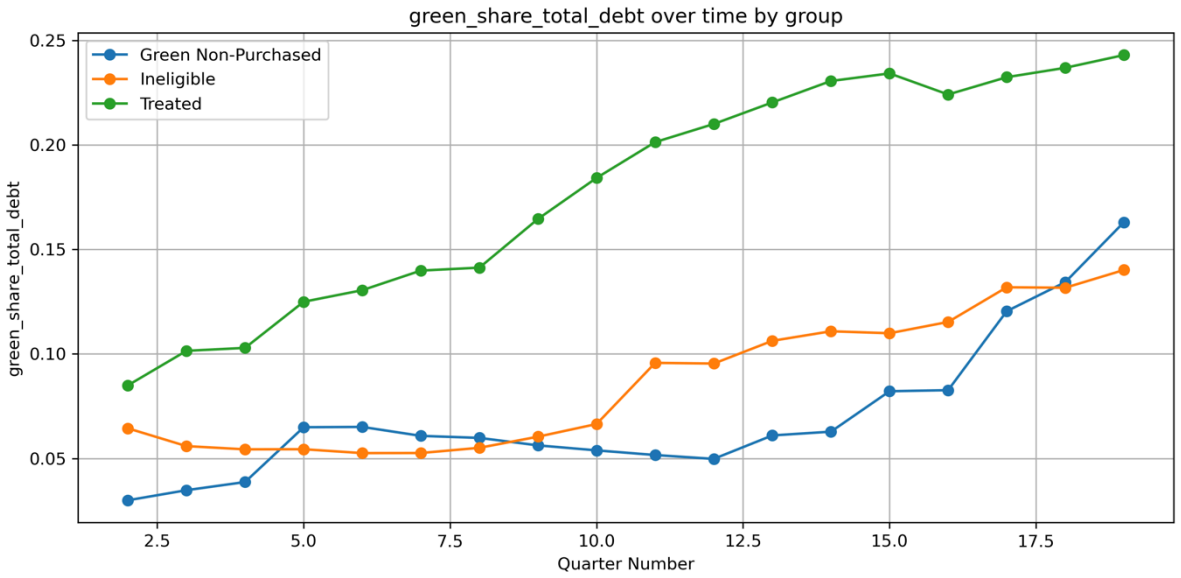
Table 6.4.1

DiD results	Control Group	Coeff.	Std. Error	P-value	Number of Obs.
Green share (of bonds issued)	Non-Purchased firms	*0.154***	*0.043*	*< 0.001*	*997*
Green share (of total debt)	Non-Purchased firms	*0.122***	*0.033*	*< 0.001*	*997*
Green share (of bonds issued)	Ineligible firms	*0.118***	*0.053*	*0.025*	*975*
Green share (of total debt)	Ineligible firms	*0.119***	*0.035*	*0.001*	*975*

The graph (*Figure 6.4.2*) reveals that all three groups: treated, eligible non-purchased, and ineligible firms show analogous levels of green bond to total debt ratio pre-intervention. This validates the assumption that prior to ECB intervention the groups were comparable in terms of their green financing behavior. Formal parallel trends testing was precluded by data limitations however the absence of systematic level differences pre-treatment mitigates concerns about selection bias for this analysis (Kahn-Lang & Lang, 2020) (Roth et al., 2023).

After the ECB intervention (Quarter 0), the treatment group shows a steep upward trend that diverges from both control groups. It can be observed that the treated firms' green bond share of total debt rises gradually from 8% to 24%. The figure provides visual confirmation of the estimated treatment effects *(β=0.122 and β=0.119)*, but also reveals a trend of an overall increased reliance on green bonds among the controls.

Figure 6.4.2



The results align with theoretical frameworks in sustainable finance and imply that targeted asset purchase programs may accelerate a green transition beyond what the market forces would achieve organically and independently.

6.5 Comparison to Peer Literature

The analysis aligns with similar literature on ECB asset purchase programs and also provides additional insights post-2021 with a focus on green bond dynamics. Similar studies demonstrate general compression of bond spreads as a result of ECB purchases, but few concentrate on the climate-aligned bond segment and subsequent financing decisions by eligible firms.

The findings of Bremus et al. (2021), conducted during the 2016-2020 event window, observe persistent compression of green bond yields in the range of 20-25 bps between comparison groups. Current study indicates comparable magnitude of decrease spanning from 17 bps for announcement effect to 25 for purchase analysis. The analysis is extended to credit rating and maturity subgroups, finding largest effects (32 bps) for high-grade medium to long term bonds. Kanda et al. (2021), exploring subsequent capital structure decisions, show CSPP affected firms' shift from loans to bond financing, this paper finds 10 - 15

percentage point increase in green bond issuance among treated firms, hinting at “green tilting”.

In summary, the findings of this paper are in line with broad literature focusing on ECB asset purchase programs' impact on financial markets. Nevertheless, the paper contributes to ongoing debate by (i) extending the analysis to most recent period incorporating ECB’s latest decisions, (ii) exclusively focusing on climate-aligned issuances, (iii) breaking down the impact across maturity and credit rating categories and (iv) identifying causal links between ECB’s policy alteration and firms’ subsequent issuance behavior. The results point to the role central banks can play in low-carbon economy transition while remaining committed to their primary mandate of financial stability.

7. Research Limitations and Suggestions for Further Studies

7.1 Data Sources

Despite the valuable insights on ECB climate-aligned monetary policy effects provided by the study, several limitations that warrant careful consideration of analysis must be noted. The classification of green bonds relies on information provided by Refinitiv Eikon, which itself depends on issuer disclosures and does not represent the ECB's categorization of securities. It is noteworthy that the ECB does not publicly disclose the official list of purchase eligible green bonds, thus researchers are required to reconstruct eligibility independently based on the set of criteria published by the ECB.

Additional constraint stems from the sole reliance on Refinitiv Eikon as the main source for bond characteristics, pricing and issuer financial metrics. Even though Refinitiv Eikon provides wide coverage of data on bonds, similar studies frequently employ other sources, such as Bloomberg, for enhanced granularity and accuracy. Detailed information on transactions by ECB, such as bond purchase volumes, dates and frequency of recurrent investments could make the study more nuanced. Using data from multiple sources may have alleviated the degree of data inconsistencies and gaps encountered in the data collection stage, and decreased the necessity of researchers' manual work in data cleaning and transformation processes. These actions, while important for the reliability of the study, raise risks associated with research design and may introduce additional bias.

7.2 Study Timeframe

Even though the research covers a relatively extended period (2021 - 2024) compared to similar studies, the analysed timeframe may still be regarded insufficient for the assessment of long-term changes in firms' financing decisions in response to ECB policy amendments. Longer period, possibly expanding back to the implementation of CSPP in 2016, could enable detailed investigation of the ECB policy influence on corporates' long-term funding decisions. The inclusion of previous years in the research would require substantial consolidation of historical data across multiple platforms, which was not feasible due to time resources and computational constraints. The analysis does not extend to varying business

cycles or monetary environments, which could permit the assessment whether the observed shifts towards green financing alternatives represent short-term increases or reflect persisting changes in financing decisions by the treated firms. Conducting the study at a later time, with accumulated data over the upcoming periods, could bring additional insights and shed light on long-term trends influenced by consistent ECB climate-aligned monetary policy.

The study timeframe also coincided with notable macroeconomic volatility, including Covid-19 pandemic, subsequent monetary responses and increased geopolitical turbulence in Europe. Even though rigorous actions were taken to filter out the macroeconomic noise by introducing fixed effect estimators and time controls, the results might still be influenced by external confounding factors that could distort the analysis. It is also relevant to mention that the ECB made an announcement to limit balance sheet expansion under the APP (ECB, 2024) which may have impacted market conditions.

7.3 Methodology

Unlike conventional monetary policy shocks that take place at a specific point in time, the ECB's climate-aligned portfolio tilt is a continuous process and was gradually implemented throughout the study period. This means no single treatment date exists for purchase effect, which would allow traditional difference-in-differences framework. To overcome this methodological constraint, a dynamic difference-in-differences approach was used that staggers the analysis to bond-specific purchase dates. While this design provides evolution of treatment effects over the sample period, the continuous nature of purchases may introduce attenuation bias, as control bonds may become treated later in the sample period.

Alternative approaches, that could enhance the construction and specification of control groups, were also identified. Additional control groups, such as non-investment grade bonds or other currency denominated securities (e.g. USD, SEK, GBP) could bring additional insights and strengthen the robustness of the counterfactual analysis. Applying more precise firm-level fundamentals, for example propensity score matching that has been used in similar empirical research, could allow for more accurate matching between comparison groups and improve the estimation of treatment effects.

7.4 Scope of the study

It must be noted that, ECB's security selection decision-making is not publicly available information, thus the analysis remains limited in its ability to model ECB's investment decision process. While the central bank's bond holdings' exploration shows that ECB is prone towards investments in high-rated medium-long term securities, the selection process might involve additional risk assessments or unobserved internal considerations. Even though the analysis incorporates publicly available information, it can not account for undisclosed elements behind the ECB's final purchase decision, thus only providing a comprehensive approximation of purchase eligibility. Furthermore, the absence of transaction dimensions represents a significant limitation on the researchers' capability to analyse ECB intervention effects. The current study only traces bond purchases based on appearance in the weekly ECB portfolio holdings disclosures, thus fails to capture critical characteristics of the purchase effect, including volume, exact timing and subsequent repetitive purchases. As a result, the study is limited in its ability to establish a direct connection between the scale of ECB intervention and observed changes in pricing of purchased security.

While the study covers a wide range of corporate issuers in the Eurozone, it would be beneficial to broaden the scope to investigate non-euro markets in order to explore any potential cross-border spillovers. Furthermore, the research does not examine alternative climate-aligned financing mechanisms, for example syndicated loans or equity, failing to address whether ECB actions encouraged broader reallocation of funds towards greener initiatives. These implementations could further enhance the findings of the study and provide insights regarding ECB's climate-aligned monetary policy's effectiveness in facilitation of low-carbon transition.

8. Conclusion

The purpose of this study has been to investigate the influence of ECB interventions on Euro-denominated corporate bond market and subsequent financing decisions by affected firms following the ECB's announcement to tilt its portfolio holdings towards climate-aligned securities. The research discovers that ECB's targeted actions successfully lowered financing costs for eligible green bonds and consequently encouraged a noticeable shift towards green financing alternatives.

The findings indicate that ECB actions significantly enhanced the relative pricing of green bonds compared to conventional ones, especially for high-rated, medium to long term maturity issuances. The effect was persistent for both announcement and implementation stages. Beyond secondary market effects, the analysis shows that ECB's climate-aligned monetary decisions altered corporate financing decisions, resulting in treated firms' increased issuance of green bonds relative to comparison groups.

The study highlights the ECB's capability to influence financial markets as a result of climate-related policy implementations. The analysis suggests that central banks, by using traditional monetary tools in innovative ways, can crucially facilitate the low-carbon economy transition. The observed results in secondary market pricings and corporate financing patterns demonstrate that persistent climate-aligned interventions can create reinforcing mechanisms which subsequently leads to improvement in market conditions for carbon efficient securities and incentivizes firms to prioritize green financing alternatives.

The study contributes to ongoing debate on how monetary policy, aligned with climate-related objectives, can play an important role towards the low-carbon economy transition. The analysis provides valuable insights for policymakers aiming to incorporate climate consideration into their monetary policy framework in the future.

9. Appendix:

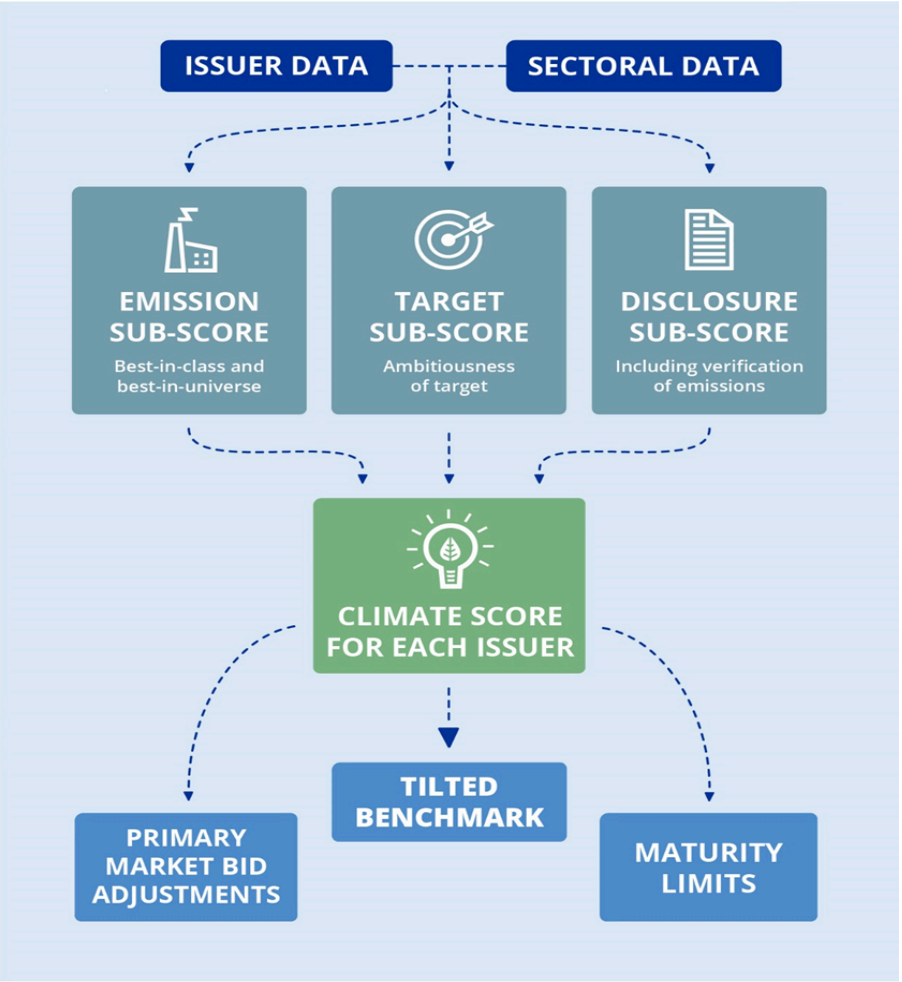
9.0. AI Disclosure

Realizing the growing significance and applicability of AI-powered tools, the authors, with approval from the supervisor, decided to incorporate AI-based instruments for the purposes of the research. Microsoft Copilot and ChatGPT were used to assist with coding, mostly in order to correct syntax errors, automate repetitive processes and optimize computational efficiency. For the writing part, ChatGPT and Grammarly were employed for the purpose of proofreading, correcting grammatical errors and structuring sentences in line with academic standards. The suggestions were exhaustively analysed and selectively integrated to improve the quality of the writing without undermining the academic integrity of the work.

Despite their benefits, AI instruments pose noteworthy risks, i.e. inaccurate code suggestions and incorrect / inconsistent sentence formulations, that must be thoroughly addressed to maximize the reliability and interpretability of the study. Human judgement remains critical to ensure the correct application of these tools and to mitigate risks of logical fallacies. While AI enhances efficiency, manual verification is still essential for maintaining quality and ensuring accuracy. This section emphasizes that AI tools were utilized ethically and transparently, without compromising scholarly standards.

9.1. *Climate Score and Portfolio Tilting Methodology*

Figure 9.1.1 - ECB Climate Scoring Methodology (ECB, 2022b)



Climate Score and Tilt Methodology (ECB, 2022b)

In order to formalize the structure of the tilt, the ECB developed a framework to assess climate risk for eligible issuers. The score incorporates three main sub-factors: (i) backward-looking GHG emission metrics capturing past effects, (ii) forward-looking targets evaluating the credibility and validity of company-set targets and (iii) climate disclosure quality assessing completeness and transparency of reporting data. The framework also sets maturity limits for lower-scoring issuers, further limiting ECB's long-term exposure to carbon heavy industries.

Even though the framework concentrates on issuer-level climate score, green bonds were given preferential treatment in purchase considerations, provided they met ECB screening criteria, such as alignment with ICMA green bond principles, third-party verifications, etc. These safeguards aimed to minimize the risks of potential greenwashing.

9.4 Data Appendix

9.4.1. Credit Rating Conversion Table

Fitch Rating	Moody's Rating	Numerical Rating	
AAA	Aaa	1	
AA+	Aa1	2	
AA	Aa2	3	
AA-	Aa3	4	High Grade
A+	A1	5	
A	A2	6	
A-	A3	7	
BBB+	Baa1	8	
BBB	Baa2	9	Low Grade
BBB-	Baa3	10	
BB+	Ba1	11	
BB	Ba2	12	
BB-	Ba3	13	
B+	B1	14	
B	B2	15	
B-	B3	16	Non IG
CCC+	Caa1	17	
CCC	Caa2	18	
CCC-	Caa3	19	
CC	Ca	20	
C	C	21	

9.4.2. CSPP Eligibility Criteria

Article 2.

Article 2

Eligibility criteria for corporate bonds

In order to be eligible for outright purchase under the CSPP, marketable debt instruments issued by corporations shall comply with the eligibility criteria for marketable assets for Eurosystem credit operations pursuant to Part 4 of Guideline (EU) 2015/510 of the European Central Bank (ECB/2014/60) ([1]) and the following additional requirements.

1. The issuer of the marketable debt instrument:

   (a) is incorporated in a Member State whose currency is the euro;

   (b) is not a credit institution as defined in point (14) of Article 2 of Guideline (EU) 2015/510 (ECB/2014/60);

   (c) does not have a parent undertaking as defined in point (15) of Article 4(1) of Regulation (EU) No 575/2013 of the European Parliament and of the Council ([2]) that is also a credit institution as defined in point (14) of Article 2 of Guideline (EU) 2015/510 (ECB/2014/60);

   (d) does not have a parent company which is subject to banking supervision outside the euro area;

   (e) is not a supervised entity as defined in point (20) of Article 2 of Regulation (EU) No 468/2014 of the European Central Bank (ECB/2014/17) ([3]) or a member of a supervised group as defined in subpoint (b) of point (21) of Article 2 of Regulation (EU) No 468/2014 (ECB/2014/17), in each case, as contained in the list published by the ECB on its website in accordance with Article 49(1) of Regulation (EU) No 468/2014 (ECB/2014/17), and is not a subsidiary, as defined in point (16) of Article 4(1) of the Regulation (EU) No 575/2013, of any of those supervised entities or supervised groups;

([1]) Guideline (EU) 2015/510 of the European Central Bank of 19 December 2014 on the implementation of the Eurosystem monetary policy framework (ECB/2014/60) (OJ L 91, 2.4.2015, p. 3).
([2]) Regulation (EU) No 575/2013 of the European Parliament and of the Council of 26 June 2013 on prudential requirements for credit institutions and investment firms and amending Regulation (EU) No 648/2012 (OJ L 176, 27.6.2013, p. 1).
([3]) Regulation (EU) No 468/2014 of the European Central Bank of 16 April 2014 establishing the framework for cooperation within the Single Supervisory Mechanism between the European Central Bank and national competent authorities and with national designated authorities (SSM Framework Regulation) (ECB/2014/17) (OJ L 141, 14.5.2014, p. 1).

(f) is not an investment firm as defined in point (1) of Article 4(1) of Directive 2014/65/EU of the European Parliament and of the Council [1];

(g) has not issued an asset-backed security within the meaning of point (3) of Article 2 of Guideline (EU) 2015/510 (ECB/2014/60);

(h) has not issued a *multi cédula* within the meaning of point (62) of Article 2 of Guideline (EU) 2015/510 (ECB/2014/60);

(i) has not issued a structured covered bond within the meaning of point (88) of Article 2 of Guideline (EU) 2015/510 (ECB/2014/60);

(j) is not an asset management vehicle resulting from the application of an asset separation tool in a resolution action pursuant to Article 26 of Regulation (EU) No 806/2014 of the European Parliament and of the Council [2] or national legislation implementing Article 42 of Directive 2014/59/EU of the European Parliament and of the Council [3];

(k) is not a national asset management and divestment fund established to support financial sector restructuring and/or resolution [4]; and

(l) is not an eligible issuer for the PSPP.

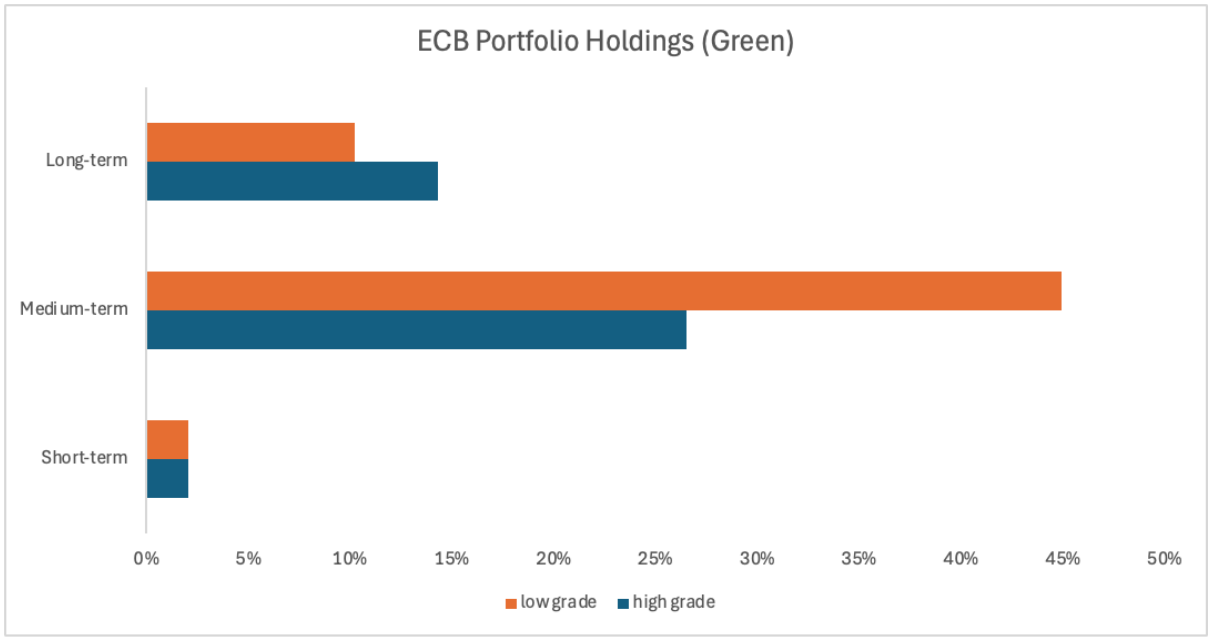
2. The marketable debt instrument has a minimum remaining maturity of 6 months and a maximum remaining maturity of 30 years and 364 days at the time of its purchase by the relevant Eurosystem central bank.

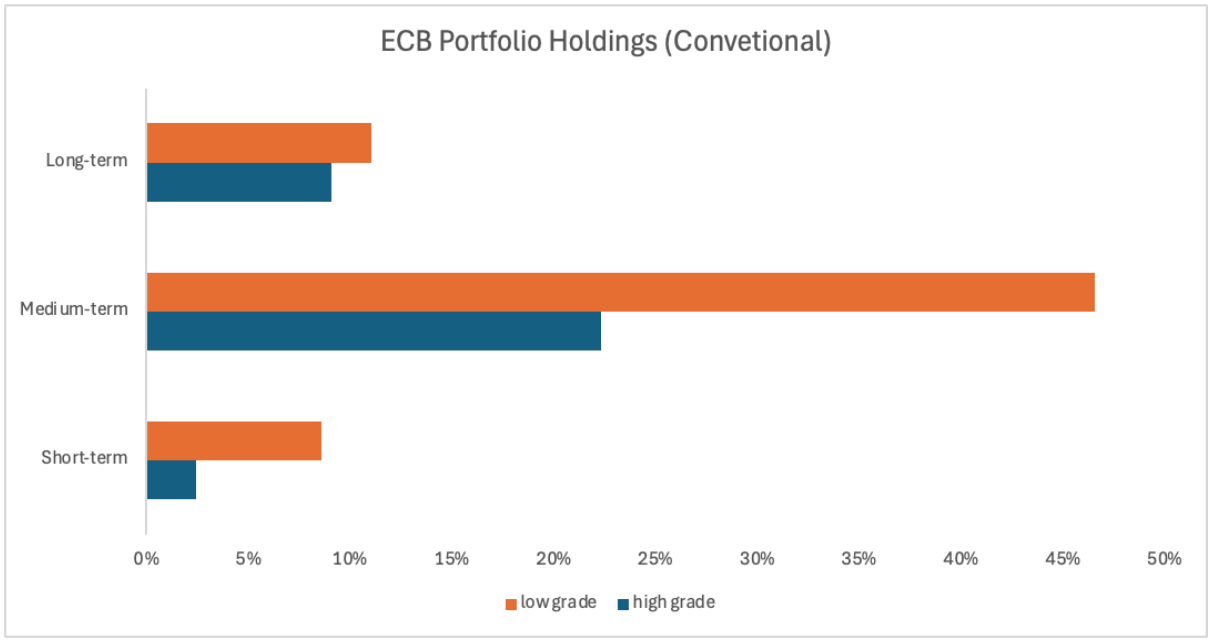
3. In deviation from Article 59(5) of Guideline (EU) 2015/510 (ECB/2014/60), only credit assessment information that is provided by an external credit assessment institution accepted within the Eurosystem credit assessment framework will be taken into account for the assessment of the credit quality requirements of the marketable debt instrument.

4. The marketable debt instrument is denominated in euro.

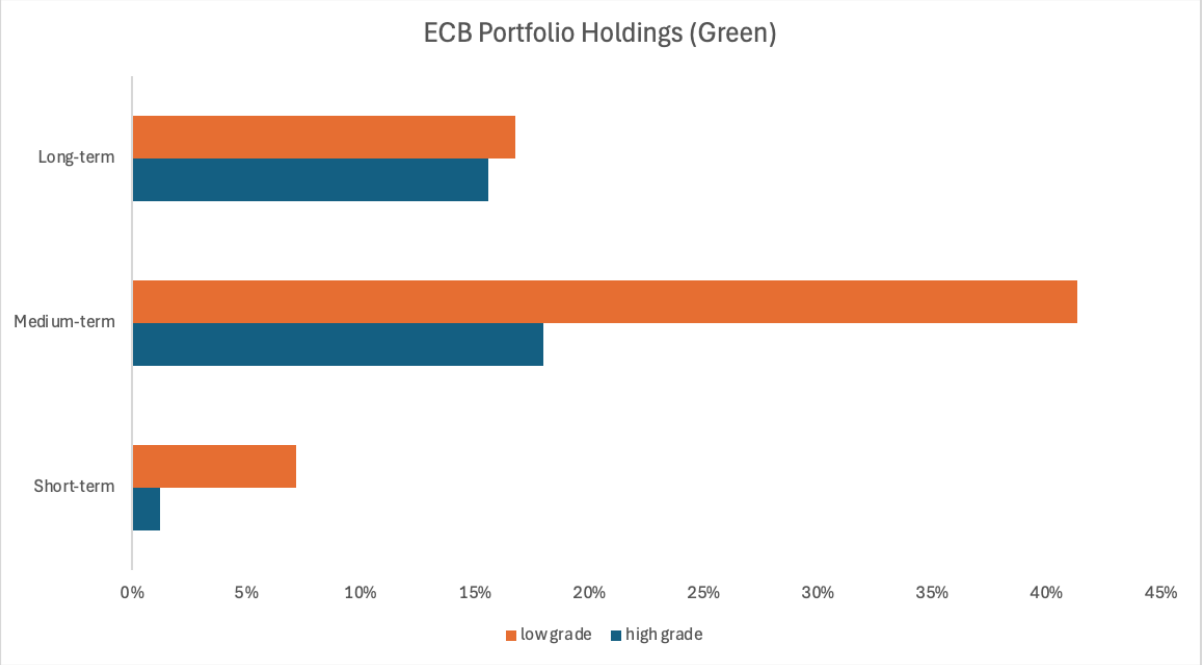
5. Purchases of nominal marketable debt instruments at a negative yield to maturity (or yield to worst) above the deposit facility rate are permissible.

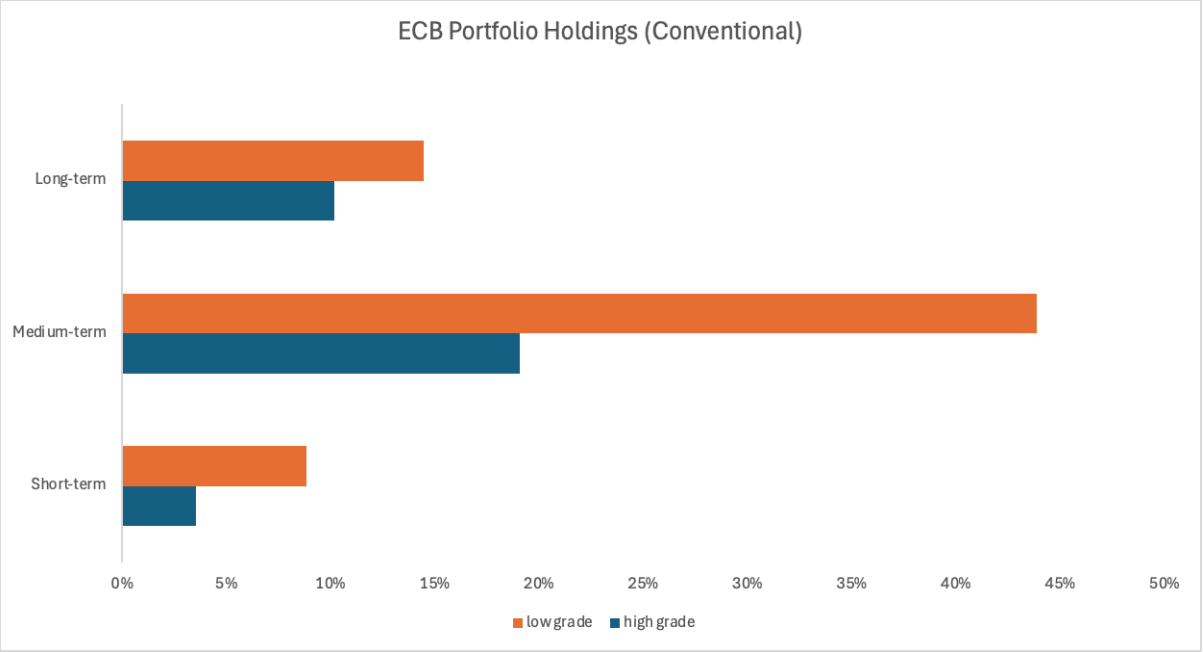
9.4.3. ECB Bond Holdings Composition by Maturity and Rating Categories as of January 2021





9.4.4. ECB Bond Holdings Composition by Maturity and Rating Categories as of December 2024





9.6 Results Appendix

Figure 9.6.1 - Pre-trends Purchase-eligible Green Bonds against Non-purchase-eligible Bonds

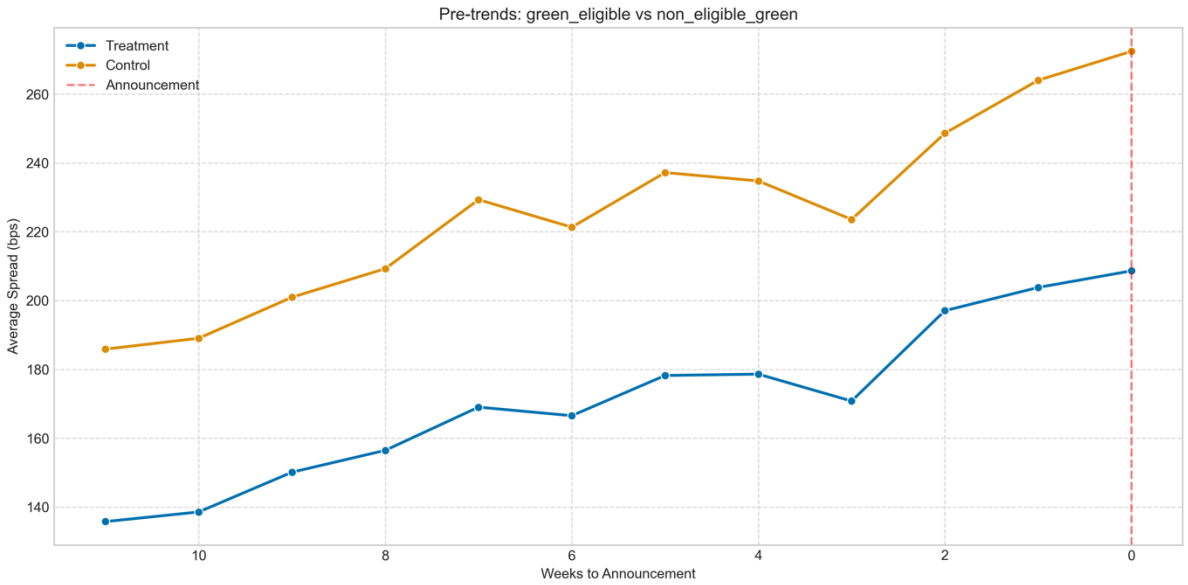


Figure 9.6.2 - Pre-trends Purchase-eligible Green Bonds against Conventional Bonds

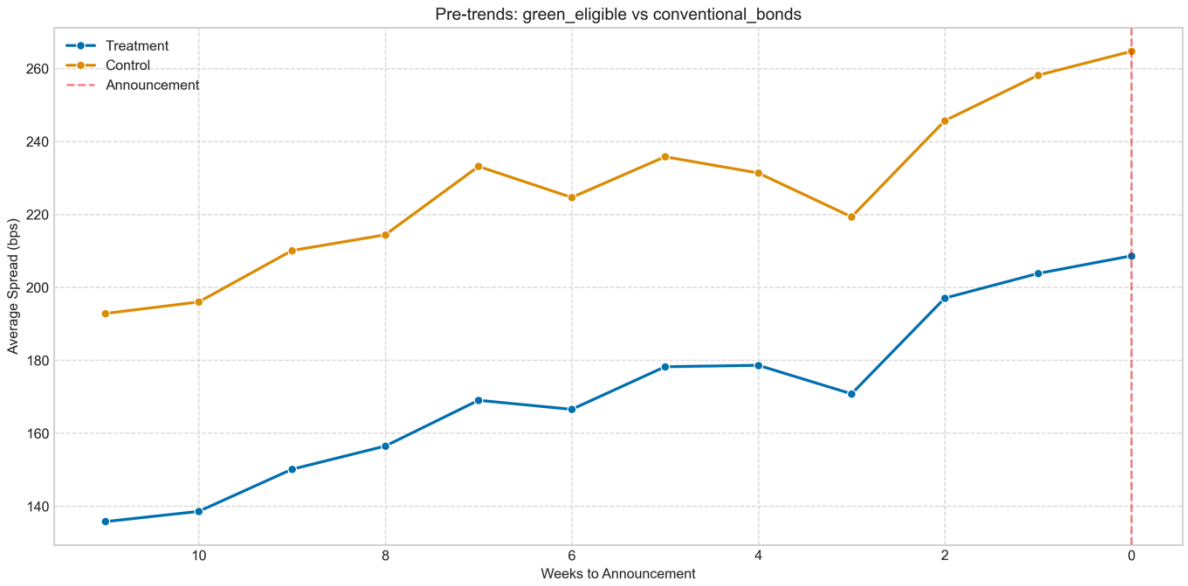
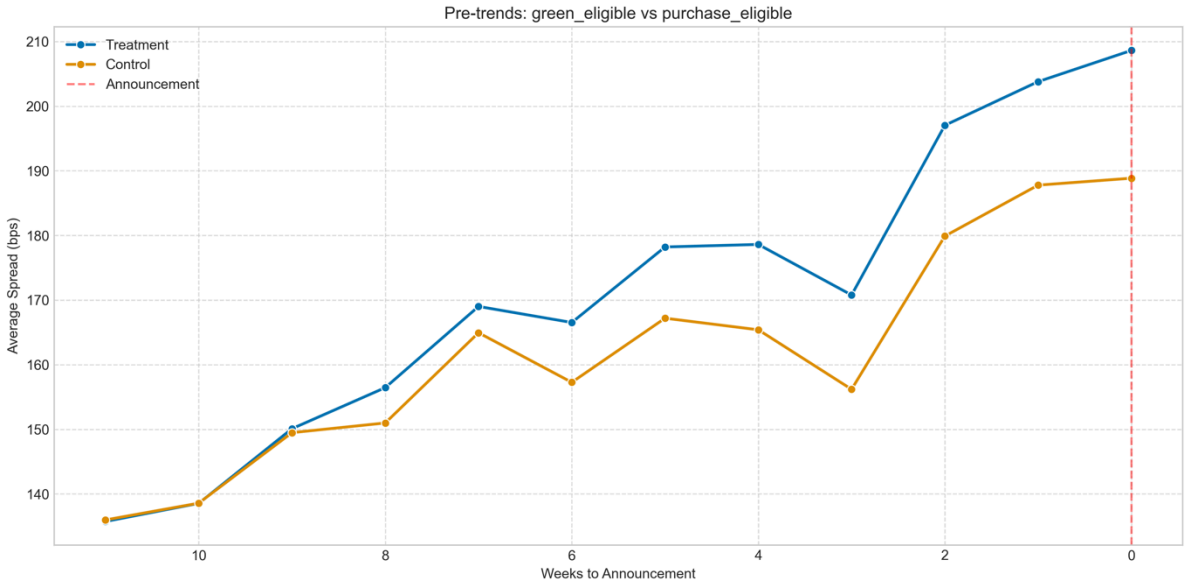
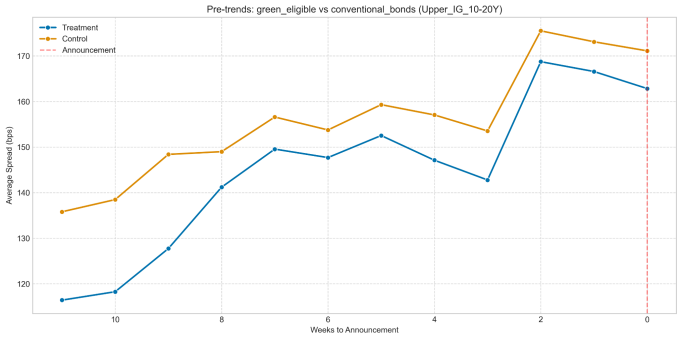
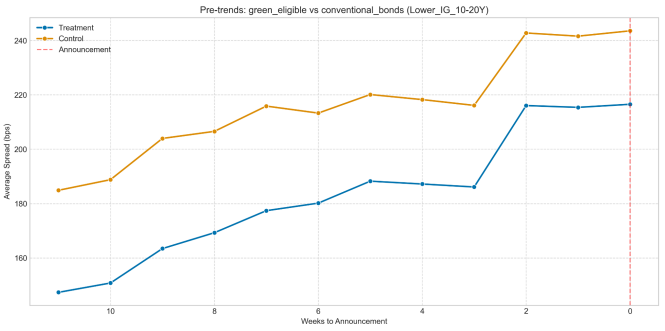


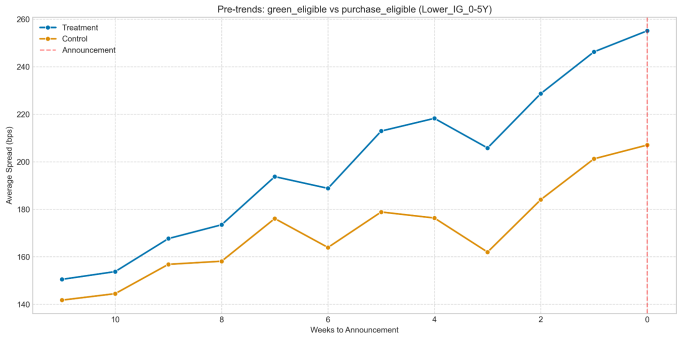
Figure 9.6.3 - Pre-trends Purchase-eligible Green Bonds against Conventional Purchase-eligible Bonds

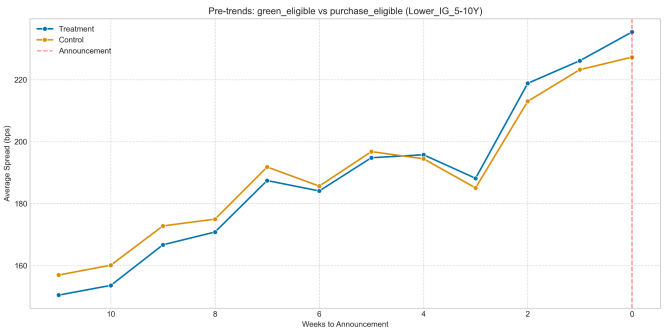


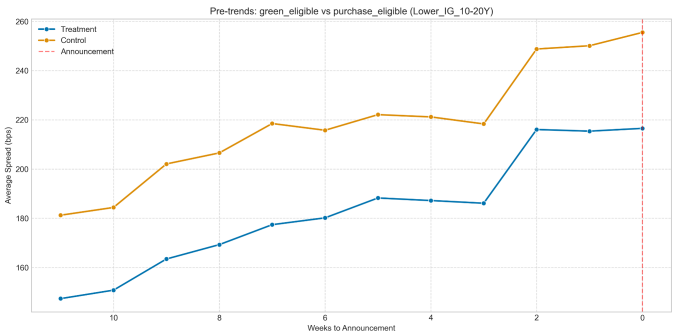
Figures 9.6.4 - Pre-trends for Rating and Maturity Subsets

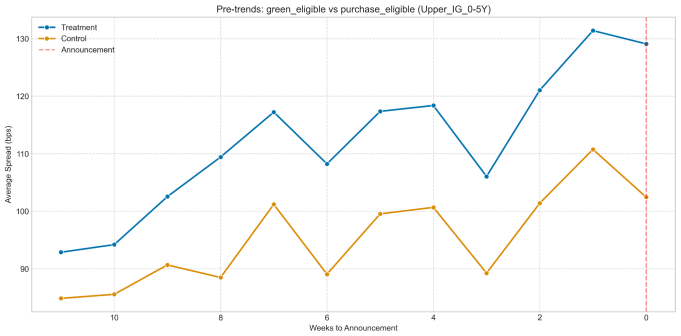












Announcement Effects:

To estimate the announcement effect of the ECB's green bond policy, the study employs a DiD framework comparing credit spreads of treatment (green) and control (non-green) bonds before and after the July 1, 2022 announcement. The baseline regression follows the equation: $spread = \alpha + \beta_1 Treat + \beta_2 Post + \delta(Treat \times Post) + \varepsilon$. In the final specification, both $Treat$ and $Post$ variables are absorbed by bond and time fixed effects, respectively. Therefore the regression becomes: $spread_{it} = \alpha + \beta_1 (Treat \times Period)_{it} + \delta_i + \gamma_t + \varepsilon_i$ where δ_i and γ_t denote bond and time fixed effects. The coefficient β captures the DiD estimate of the announcement effect. This specification is run for the full sample of bonds as well as across subsamples defined by maturity and rating groups to assess heterogeneity in the policy impact. An extended version of the model also includes bond-level controls for firm leverage (debt-to-capital ratio, D_C) and bond liquidity (bid-ask spread, Bid_Ask).

Table 9.6.5 - Announcement Effects for Upper Investment Grade Subsets against Control Groups

	Green non-eligible bonds			Conventional bonds			Conventional Eligible		
Maturity Group (years)	*0 - 5*	*5 - 10*	*10 - 20*	*0-5*	*5 - 10*	*10 - 20*	*0 - 5*	*5 - 10*	*10 - 20*
Treat x Post	-19.27***	-18.62***	-32.89***	-15.5***	-14.85***	-29.12***	-3.62	-2.98	-17.24***
# of Observations	232	288	256	6064	6120	6088	2872	2928	2896

Table 9.6.6 - Announcement Effects for Lower Investment Grade Subsets against Control Groups

	Green non-eligible bonds			Conventional bonds			Conventional Eligible		
Maturity Group (years)	*0 - 5*	*5 - 10*	*10 - 20*	*0 - 5*	*5 - 10*	*10 - 20*	*0 - 5*	*5 - 10*	*10 - 20*
Treat x Post	-9.05	-13.35**	-25.68***	-5.28	-9.59***	-21.90***	6.1	2.29	-10.02***
# of Observations	300	388	244	2940	6212	6076	6132	3032	2888

Table 9.6.7 - Announcement Effects for Investment Grade Full Sample against Control Groups (2-2 weeks Pre-Post)

	Green non-eligible bonds	Conventional bonds	Conventional Eligible
Treat x Post	-17.13***	-13.36***	-1.48
# of Observations	712	6544	3356

Table 9.6.8 - Announcement Effects for Investment Grade Full Sample against Control Groups (4-4 weeks Pre-Post)

	Green non-eligible bonds	Conventional bonds	Conventional Eligible
Treat x Post	-18.14***	-12.69***	0.68
# of Observations	1421	13075	6700

Table 9.6.9 - Announcement Effects for Investment Grade Full Sample against Different Control Groups (4-8 weeks Pre-Post)

	Green non-eligible bonds	Conventional bonds	Conventional Eligible
Treat x Post	-12.05***	-8.85***	0.5
# of Observations	2133	19631	10060

Table 9.6.10 - Announcement Effects for Investment Grade Full Sample with additional Control Variables against Control Groups (2-2 weeks Pre-Post)

	Green non-eligible bonds	Conventional bonds	Conventional Eligible
Treat x Post	-13.5**	-9.24***	-0.7
D_C	-0.04	0.4	-0.1
Bid_Ask	-13.1***	4.74	0.2
# of Observations	688	5880	3088

Purchase Effects:

To estimate the impact of actual ECB green bond purchases on secondary market spreads, a dynamic DiD approach centered around bond-level purchase dates. The specification compares treated bonds (purchased by the ECB) to non-purchased bonds before and after the observed purchase date $spread_{it} = \alpha + \sum_{(k \neq -1)} \beta_k (Treat \times Period_k)_{it} + \delta_i + \gamma_t + \varepsilon_i$. As in the announcement analysis, the final specification absorbs both TreatiTreat_iTreati and PosttPost_tPostt through bond and time fixed effects, respectively: where δ_i and γ_t denote bond and time fixed effects. The coefficient β captures the DiD estimate of the purchase effect. This model is estimated using the full bond sample, and separately across subsets defined by maturity and rating to explore heterogeneity in market reactions. A further specification includes bond-level controls for firm leverage (debt-to-capital ratio, D_C) and bond liquidity (bid-ask spread, Bid_Ask).

Table 9.6.11 - Purchase Effects for Green Upper Investment Grade Subsets against Control Groups (October 2022 Timeline)

	Green Eligible non-Purchased	Ineligible Green
Maturity Group (years)	*5 - 10*	*5 - 10*
Treat x Post	-18.76***	-34.85***
# of Observations	4562	13930

Table 9.6.12 - Purchase Effects for Green Lower Investment Grade Subsets against Control Groups (October 2022 Timeline)

	Green Eligible non-Purchased		Ineligible Green	
Maturity Group (years)	*5 - 10*	*10 - 20*	*5 - 10*	*10 - 20*
Treat x Post	1.25	1.29	-17.93	-19.55*
# of Observations	5106	4515	14474	13883

Table 9.6.13 - Purchase Effects for Green Upper Investment Grade Subsets against Different Groups (January 2021 Timeline)

	Green Eligible non-Purchased		Ineligible Green	
Maturity Group (years)	*5 - 10*	*10 - 20*	*5 - 10*	*10 - 20*
Treat x Post	4.63	14.82	-2.06	12.34
# of Observations	9722	5534	15120	14781

Table 9.6.14 - Purchase Effects for Green Lower Investment Grade Subsets against Control Groups (January 2021 Timeline)

	Green Eligible non-Purchased		Ineligible Green	
Maturity Group (years)	*5 - 10*	*10 - 20*	*5 - 10*	*10 - 20*
Treat x Post	-20.44**	1.01	-24.61**	-9.84
# of Observations	5752	5413	19090	14902

Table 9.6.15 - Purchase Effects for Green Investment Grade Full Sample against Control Groups

Table X: Purchase Effects for Green Investment Grade Full Sample for 2-12 months Pre-Post for Different Control Groups

	October 2022		January 2021	
	Green Eligible non-Purchased	Ineligible Green	Green Eligible non-Purchased	Ineligible Green
Treat x Post	-2.20	-22.10***	-25.41***	-22.57**
# of Observations	7237	16605	18780	28148

Table 9.6.16 - Purchase Effects for Green Investment Grade Full Sample and Subsets with Control Variables against Control Groups

	January 2021	October 2022	
	Green Eligible non-Purchased	Green Eligible non-Purchased	Ineligible Green
Rating Group	All Investment Grade	Upper IG	Lower IG
Maturity (years)	*All Maturities*	*5 - 10*	*10 - 20*
Treat x Post	-21.1**	-17.80*	-12.70*
D_C	-0.0022	-0.011	0.032**
Bid_Ask	23.3***	4.10	82.71**
# of Observations	18780	5880	3086

Table 9.6.17 -Purchase Effects for Conventional Upper Investment Grade Subsets against Control Groups (October 2022 Timeline)

	Conventional Eligible non-Purchased		Ineligible Conventional	
Maturity Group (years)	*5 - 10*	*10 - 20*	*5 - 10*	*10 - 20*
Treat x Post	-11.78**	-7.41	-28.13***	-16.95**
# of Observations	44431	43877	195831	195277

Table 9.6.18 - Purchase Effects for Conventional Lower Investment Grade Subsets against Control Groups (October 2022 Timeline)

	Conventional Eligible non-Purchased	Ineligible Conventional
Maturity Group (years)	*5 - 10*	*5 - 10*
Treat x Post	0.93	-14.41**
# of Observations	45700	197100

Table 9.6.19 - Purchase Effects for Conventional Upper Investment Grade Subsets against Different Control Groups (January 2021 Timeline)

	Conventional Eligible non-Purchased
Maturity Group (years)	*5 - 10*
Treat x Post	-4.66
# of Observations	47403

Table 9.6.20 - Purchase Effects for Conventional Lower Investment Grade Subsets against Control Groups (January 2021 Timeline)

	Conventional Eligible non-Purchased			Ineligible Conventional
Maturity Group (years)	*0 - 5*	*5 - 10*	*10 - 20*	*10 - 20*
Treat x Post	-26.93**	-1.49	-1.63	-7.38
# of Observations	51338	54916	46148	197548

Table 9.6.21 - Purchase Effects for Conventional Full Sample against Control Groups

	October 2022
	Ineligible Conventional
Treat x Post	-19.9***
# of Observations	200834

Table 9.6.22 - Purchase Effects for Conventional Full Sample with Control Variables against Control Groups

	October 2022	October 2022
	Conventional Eligible non-Purchased	Ineligible Conventional
Rating Group	All Investment Grade	All Investment Grade
Maturity Group (years)	*All Maturities*	*All Maturities*
Treat x Post	-12.4**	-21.1**
D_C	0.027**	0.02***
Bid_Ask	11.07***	48.48**
# of Observations	198578	197933

Table 9.6.23 - Purchase Effects for Conventional Upper Investment Grade Subsets with Control Variables against Different Groups (October 2022 Timeline)

	Conventional Eligible non-Purchased	Ineligible Conventional
Maturity Group (years)	*5 - 10*	*5 - 10*
Treat x Post	-17.3***	-19.1***
D_C	0.028**	0.018***
Bid_Ask	11.44***	48.73**
# of Observations	44196	194205

Table 9.6.24 - Purchase Effects for Conventional Lower Investment Grade Subsets with Control Variables against Control Groups (October 2022 Timeline)

	Conventional Eligible non-Purchased
Maturity Group (years)	*5 - 10*
Treat x Post	-10.4*
D_C	0.028**
Bid_Ask	10.69***
# of Observations	45465

Table 9.6.25 - Purchase Effects for Conventional Upper Investment Grade Subsets with Control Variables against Control Groups (January 2021 Timeline)

	Ineligible Conventional
Maturity Group (years)	*5 - 10*
Treat x Post	-13.7*
D_C	0.019***
Bid_Ask	40.72*
# of Observations	195216

Table 9.6.26 - Purchase Effects for Conventional Lower Investment Grade Subsets with Control Variables against Control Groups (January 2021 Timeline)

Table 5: Purchase Effects for Conventional Lower Investment Grade Sub-sets for 2-12 months Pre-Post for Different Control Groups with Controls (Jan 2021)

	Conventional Eligible non-Purchased	Ineligible Conventional
Maturity Group (years)	*5 - 10*	*5 - 10*
Treat x Post	15.7*	11.2*
D_C	0.021**	0.017***
Bid_Ask	10.82***	37.53*
# of Observations	44196	194205

Table 9.6.27 - Duration Analysis for ECB Bond Purchases again Different Control Groups

Treatment Group	Starting Period	Control Group	Window	Effect (bps)	Effects Persistence (# of weeks)
Purchased Green	Oct-22	Ineligible Green	Immediate (0-4 weeks)	-31.08	5
Purchased Green	Oct-22	Ineligible Green	Short-term (5-8 weeks)	-29.02	4
Purchased Green	Oct-22	Ineligible Green	Medium-term (9-16 weeks)	-25.93	8
Purchased Green	Oct-22	Ineligible Green	Long-term (17-52 weeks)	-19.54	36
Purchased Green	Jan-21	Green Eligible non-purchased	Immediate (0-4 weeks)	-39.85	5
Purchased Green	Jan-21	Green Eligible non-purchased	Short-term (5-8 weeks)	-39.62	4
Purchased Green	Jan-21	Green Eligible non-purchased	Medium-term (9-16 weeks)	-33.84	8
Purchased Green	Jan-21	Green Eligible non-purchased	Long-term (17-52 weeks)	-20.37	23
Purchased Green	Jan-21	Ineligible Green	Immediate (0-4 weeks)	-33.66	5
Purchased Green	Jan-21	Ineligible Green	Short-term (5-8 weeks)	-34.16	4
Purchased Green	Jan-21	Ineligible Green	Medium-term (9-16 weeks)	-30.35	8
Purchased Green	Jan-21	Ineligible Green	Long-term (17-52 weeks)	-18.33	20
Purchased Conventional	Oct-22	Ineligible Conventional	Immediate (0-4 weeks)	-15.87	4
Purchased Conventional	Oct-22	Ineligible Conventional	Short-term (5-8 weeks)	-21.41	4
Purchased Conventional	Oct-22	Ineligible Conventional	Medium-term (9-16 weeks)	-16.69	8
Purchased Conventional	Oct-22	Ineligible Conventional	Long-term (17-52 weeks)	-3.80	14
Purchased Conventional	Jan-21	Ineligible Conventional	Immediate (0-4 weeks)	-11.12	0
Purchased Conventional	Jan-21	Ineligible Conventional	Short-term (5-8 weeks)	-15.10	0
Purchased Conventional	Jan-21	Ineligible Conventional	Medium-term (9-16 weeks)	-10.38	1
Purchased Conventional	Jan-21	Ineligible Conventional	Long-term (17-52 weeks)	-6.86	2

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