Essays on the Dynamics in European Corporate Debt Markets

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CONTENTS

I. INTRODUCTION

In this dissertation, I study recent dynamics within European corporate debt markets during periods marked by macroeconomic and geopolitical challenges, as well as times when the economy addresses the shift towards greater sustainability. Corporate debt markets[1], crucial for economic growth, are constantly exposed to economic and political shifts that can significantly influence market development (Berg, Saunders, & Steffen, 2021). Within corporate debt markets, I focus on the bond and loan market. The relevance for focusing on those markets is apparent, as they constitute a primary source of capital for firms (Florou & Kosi, 2015). This is supported by evidence that European firms tend to rely more on debt financing than equity (Brutscher & Hols, 2018; Fan et al., 2012). Within Europe, loan financing dominated bond financing for a long period of time. However, over the past decade, the European bond market has experienced substantial growth and transformed itself into an equal financing option (e.g., Darmouni & Papoutsi, 2023; Darmouni & Siani, 2020). Additionally, the unique structure of the European debt market, which integrates several national markets, makes it interesting for analysis due to differences in national regulations, enforcement, and stages of market development.

This dissertation contributes to the research on bond markets, which often focuses on the United States (US). In contrast, the European bond market is less developed than that of the US, which means that not all findings from US studies can be applied to Europe (Darmouni & Papoutsi, 2023). Additionally, the European bond market plays a crucial role in addressing climate change. Thus, my research on green bond markets informs ongoing discussions about environmental regulations, such as the European Green Bond Standard (EUGBS) or the EU Taxonomy Regulation (Alessi et al., 2024; Hummel & Bauernhofer, 2024). The dissertation

[1]"Debt markets" refer collectively to bond and loan markets. The term corporate refers to non-financial firms. As all studies in this dissertation center on corporate debt markets, the term debt market is used interchangeably with corporate debt market for brevity.

also delves into the shifts observed in European loan markets post the 2008-2009 financial crisis. The sovereign debt crisis, coupled with a persistently low interest-rate environment, led to macroeconomic policies which provide an interesting setting to study dynamics in loan markets. Notably, these conditions prompted the European Central Bank (ECB) to employ unconventional monetary policy interventions for the first time, which significantly influenced lenders' portfolios (Grosse-Rueschkamp et al., 2019). Therefore, this dissertation comprehensively examines dynamics in the conventional bond market, the green bond market, and the syndicated lending market. Through this research, I provide critical insights that enhance our understanding of market dynamics and inform the development of future regulatory policies.

The three studies of Franke, Kosi, and Stoczek (A)[2], Stoczek (B)[3] and Liss, Noiman, and Stoczek (C)[4] aim to provide policymakers and regulators with robust evidence, elucidating how debt markets have evolved and adapted. They enhance our understanding of debt market dynamics by utilizing novel data sources and targeted econometric strategies. Additionally, the three analyses explore specific events from the past decade to assess their impact on these dynamics. The studied events include Brexit[5] in (A), the emergence of green bond sections (GBS) in (B), and the introduction of the Corporate Sector Purchase Programme (CSPP) in (C). Within this context, they address dynamics within the bond market ((A), (B)), the green bond market ((B)), and the syndicated lending market ((C)). Study (A) focuses on the impact of Brexit on corporate bond market activity and attractiveness. In (B), I analyze whether GBS support investors in the green bond market with their greenwashing challenge. In study (C), we investigate the unique risk-mitigating mechanisms that lending syndicates employ during the

[2]Franke, Benedikt, Kosi, Urska & Stoczek, Pia. Brexit and the Rise of European Corporate Bond Markets. *Working Paper.*
[3]Stoczek, Pia. Lighting the Green: The Role of Green Bond Sections in the European Market. *Working Paper.*
[4]Liss, Alexander, Noiman Boaz & Stoczek, Pia. Controlled risk-taking and corporate QE: Evidence from the Corporate Sector Purchase Programme. *Working Paper*.
[5]Brexit is the term used to describe the United Kingdom's withdrawal from the European Union, which officially took place in 2020.

loan contracting process within the CSPP setting. The insights from these studies can inform the development of policies and regulations that enhance the resilience of debt markets to economic and geopolitical challenges.

In (A), we analyze the impact of Brexit on the development of the European[6] corporate bond market. The motivation stems from the concerning rise of economic nationalism among European Union (EU) member states (Born et al., 2019), which stands against the EU's efforts to build an integrated and resilient capital market (European Commission, 2017). The United Kingdom's withdrawal from the EU in 2020 (Brexit) highlighted these debates. Regulators expressed concerns that Brexit could diminish the attractiveness of the European capital market and lead to its disintegration. During this period, the UK functioned as the largest financial center in the European capital market, providing the primary access point for issuers and investors from non-European countries (Schoenmaker, 2017). Mainly because UK market participants lose their passporting rights[7] and with this their market access, there were uncertainties about the consequences for bond market development (Miethe & Pothier, 2016). Our findings, based on a set of empirical analyses, suggest that the European capital market has successfully adapted to the loss of its largest financial center and shows an increase in corporate bond market activity. Thus, this analysis contributes to the overall goal of this dissertation: to provide regulators with robust evidence on bond market development during and after geopolitical challenges.

The key innovation of (A) is that we leverage novel and granular data by the European Securities and Markets Authority (ESMA) on corporate bond listings across European trading

[6]Prior to Brexit, the European bond market encompasses the 27 member states of the European Union (EU27), three European Economic Area (EEA) countries (Iceland, Liechtenstein, and Norway), and the UK. Following Brexit, the UK's bond market is no longer considered part of the European market. For our analysis, we collectively refer to the remaining markets as the EEA30 market, which includes the EU27 plus the three EEA countries.
[7]Passporting rights allow financial service providers to do business across the entire capital market of the European Economic Area (EEA) while only needing to register in their home member state.

venues[8] between 2018 and 2023. We combine this data with additional publicly available data sources that, to our knowledge, have not been used in academic research so far. This includes data from the Global Legal Entity Identifier Foundation (GLEIF) and from the Financial Conduct Authority (FCA). We rigorously check and prepare this data and make it available for future research in the European Bond Market Database (EBMD)[9]. Hence, we answer calls for more extensive data on the European debt market (Berg, Saunders, & Steffen, 2021; Cascino et al., 2014). With this data, we can observe the movements of bond listings and issuers across the 30 countries of the European Economic Area (EEA30) and the UK.

The results in (A) document a significant increase in bond market activity in the EEA30 market after Brexit compared to the UK, which serves as our baseline group. While both markets show similar trends before Brexit, they diverge with the start of the Brexit transition period in the beginning of 2019. Considering the EEA30 market and the UK market as one, the share of the EEA30 market before Brexit was 35% (measured by the number of bond listings). This share increased to 59% over the Brexit period, constituting an economically meaningful market activity shift. Due to the granularity of the EBMD, we can further differentiate trading venues into regulated markets (RM) with higher transparency requirements and market segments characterized by lower requirements, including multilateral trading facilities (MTF) and organized trading facilities (OTF). We observe that bond listings mainly grow in the MTF segment. We also conduct two types of issuer-level analysis to investigate the attractiveness of the EEA30 market for firms and their exposure to differing market environments. Our first analysis finds that the likelihood of a firm's bonds being listed on an EEA30 trading venue increases after Brexit. This is again significantly driven by the MTF segment. Second, we compare the issuer's share of bonds listed on the EEA30 market to that of the UK market and

[8]A trading venue is a regulated marketplace that provides the infrastructure for trading financial instruments (in our case, corporate bonds). We define all trading venues in a specific geographic region or country to form a market.
[9]Data is available at https://www.accounting-for-transparency.de/data/.

observe that issuer's focus significantly more on the EEA30 market after Brexit. Consequently, our analysis offers critical insights for regulators tasked with evaluating the real impact of Brexit on the capital market. One takeaway is the shift in activity and attractiveness to the MTF segment, which does not have the same standards for investor protection as the RM segment (Clausen & Sørensen, 2012).

(A) also makes important contributions to the literature. While numerous studies have investigated the repercussions of the Brexit vote in 2016 (e.g., Berg, Saunders, Schäfer, & Steffen, 2021; Breinlich et al., 2018), few focus on the bond market (Kadiric, 2022; Kadiric & Korus, 2019) which may be due to limited data availability. To the best of our knowledge, we are the first to systematically investigate the restructuring of the bond market in the aftermath of Brexit. We expand upon discussions regarding Brexit's impact on the UK's role as a gateway for non-European capital and the implications stemming from the loss of passporting rights. In doing so, we uncover new insights into the direct consequences for bond market dynamics as these effects materialize. This study enhances our understanding of how a geopolitical event like Brexit shapes debt market dynamics, making an important contribution to the dissertation's discourse.

In study (B), I stay within the bond market setting but focus on green bonds, an instrument that, while not necessarily new (the first green bond was issued in 2007), has seen particular growth over the past years (Demski et al., 2025). The green bond market is widely acknowledged as a crucial component in obtaining long-term financing essential for moving towards a sustainable economy (OECD, 2017). Still, compared to the conventional bond market investigated in (A), the green bond market is at an early development stage. Market growth is impeded by the absence of a universal definition of what qualifies as a "green" bond and lack of standardized regulations (Deschryver & Mariz, 2020). This leads to challenges for investors in verifying the environmental integrity of these bonds, a problem I describe in (B) as "investors

greenwashing challenge". Thus, in (B), I analyze the role of GBS in supporting investors with their greenwashing challenge by reducing information asymmetries. GBS are separate lists published on trading venues' websites, such as the Luxembourg Green Exchange, the GBS of Luxembourg Stock Exchange. To be included in the list, the trading venue sets certain listing requirements that include at-issuance and post-issuance reporting on the use of proceeds and the environmental impact of the green bond.

This analysis enriches the dissertation and contributes to the literature by offering detailed insights into the emergence of GBS as a response to investor demand for sustainable investment options and the increasing need for greater transparency and accountability in green financing (Sangiorgi & Schopohl, 2021, 2023). Thus, by providing early evidence on the usefulness of GBS for sustainable bond markets, I aim to contribute to understanding how these sections can facilitate more informed investment decisions, thereby promoting a more robust and transparent market for green bonds. This insight is particularly valuable to regulators, tasked with shaping policies that foster a trustworthy and efficient marketplace, ensuring that sustainable finance genuinely supports the transition towards a greener economy. On a macroeconomic level, these insights thereby indirectly contribute to the promotion of sustainable growth.

I ask in (B) whether green bonds listed on a GBS exhibit differences in information asymmetries compared to green bonds not listed on a GBS, proxied by a liquidity measure, the bid-ask spread. I argue that if GBS support investors with their greenwashing challenge and reduce information asymmetries, this should be reflected in lower bid-ask spreads on the secondary market (Diamond & Verrecchia, 1991; Dorfleitner et al., 2023; Glosten & Milgrom, 1985). However, the signal from the GBS may not carry new information. Since bond investors are often institutional, they might not value the extra transparency. This underscores the need for an empirical analysis. I leverage different data sources, including the EBMD described in

study (A), which I combine with commercial data from the London Stock Exchange Group (LSEG) and hand-collected data on GBS and green bond disclosures.

Findings in (B) demonstrate the usefulness of GBS for reducing information asymmetries. In detail, the listing on a GBS is, on average, associated with a significant reduction in the bid-ask spread by 0.09 to 0.13 percentage points compared to the base group of bonds not listed on a GBS. This can be interpreted as economically meaningful as it translates into a reduction of 14% of the sample mean at the lower bound. Results from dividing the sample indicate that there is a particularly strong negative association for smaller or unrated bonds which are generally characterized as less transparent. Additionally, I divided the GBS based on whether they had above or below the median level of disclosure requirements, using a self-created disclosure score. The findings reinforce the argument that, on average, bonds listed on a GBS with higher disclosure requirements are associated with a significantly greater reduction in information asymmetries. A mediator analysis incorporating characteristics of green bond textual disclosures reveals that GBS listings are not associated with textual disclosures that are easier to comprehend or differ in length.

Firstly, my study contributes to the understanding of the mechanisms that support investors with their greenwashing challenge (Dinh et al., 2023; Dorfleitner et al., 2023; Lebelle et al., 2022). Dorfleitner et al. (2023) call for more extensive research on this topic. By studying the listing of bonds on GBS, I provide novel evidence of how trading venue operators contribute to reducing information asymmetries. Secondly, my analysis shows that a higher regulated environment can mitigate investors' greenwashing challenge and foster market growth. This is a particularly important finding as the European Union plans to introduce, but not mandate, new standards like the European Green Bond Standard. Research by Deschryver and Mariz (2020) highlights the absence of global standards and the risks of greenwashing as key obstacles to green bond market expansion. My findings indicate that standardizing green bond reporting

could be beneficial, instead of merely adding more voluntary standards. Thirdly, I provide novel insights into the European green bond market by outlining the use of textual disclosures and external review mechanisms for green bonds.

Finally, study (C) covers the side of the loan market within this dissertation. In particular, we investigate the European syndicated lending market. Syndicated lending, as opposed to bilateral lending, is done by multiple lenders that provide capital to a firm. This dimension offers several unique research opportunities, since lending syndicates, consisting of lead arrangers and participants, have unique mechanisms to reduce borrower default risk when granting a loan (Sufi, 2007). This is why in (C), we analyze risk-taking by lending syndicates as a response to central banks' corporate quantitative easing (QE). Corporate QE is an unconventional monetary policy tool central banks use to stimulate the economy when conventional monetary policy has become ineffective (e.g., in times of zero policy rates). In our study, we rely on the introduction of the CSPP in 2016, which came as a surprise for the market (Berg et al., 2024). However, Corporate QE was also reintroduced during the COVID-19 crisis, emphasizing the importance of studying debt market dynamics within the context of macroeconomic challenges.

In (C), we present evidence that lenders in the syndicated lending market, who are highly affected by the CSPP, redirect capital towards new and riskier borrowers. At the same time, we offer detailed insights into the risk reduction mechanisms employed by these lenders. The key innovation in (C) is the exploration of risk-taking through a nuanced concept we refer to as "controlled risk-taking". This term describes a scenario where lenders pursue higher returns by extending credit to newer, riskier borrowers while simultaneously implementing strategies to mitigate their risk exposure. This approach is distinct from excessive risk-taking (Agur & Demertzis, 2012), where lenders fail to implement risk management mechanisms (Ioannidou et al., 2015; Jiménez et al., 2014). Controlled risk-taking suggests that the risk exposure faced by

lenders due to monetary policy interventions is less critical, thus easing some worries about financial instability. We examine this concept along four dimensions: the terms of loan contracts (non-pricing and pricing), the structure of syndicates and the intensity of relationships within them, and the role of the country's debt enforcement regime. By examining this concept, (C) contributes to the aim of this dissertation by providing nuanced and robust insights into the consequences of macroeconomic policies for the loan market.

We combine commercial data sources with publicly available data from the European Central Bank (ECB). We leverage the fact that lenders were differently exposed to CSPP-eligible borrowers and employ a difference-in-differences design. Thus, we compare lenders with high exposure to CSPP-eligible borrowers prior to the CSPP introduction to those with low exposure. We show that, within the European syndicated lending market, the CSPP is associated with a significant decrease in the share of loans extended to eligible borrowers by 8.5-10.3 percentage points. Simultaneously, we record that lenders significantly increase their share to new and riskier borrowers.

Next, in line with our concept of controlled risk-taking, we note changes in the terms of loan contracts for CSPP-exposed lenders compared to the control group. This includes, for example, a significant increase in the probability of collateralizing the loan of 11.80% (compared to the mean of 44%). We also observe a significant reduction in maturity by 6.2 months (compared to the mean of 6.5 years). Secondly, our research shows that the size of lending syndicates grows, which is primarily driven by an increase in the number of participants within the syndicate. This indicates that exposed syndicates tend to increase their participants, possibly as a strategy to spread risk more broadly across the syndicate. Thirdly, we emphasize the relevance of the borrower country's debt enforcement regime on lending practices. Lastly, we observe no significant changes in loan spreads. These findings imply that lending syndicates

proactively employ risk mitigation strategies in response to corporate QE, adopting a prudent approach to handle increased risks rather than engaging in excessive risk-taking.

The contribution of (C) is threefold. We primarily add to the growing literature on the effects of unconventional monetary policy interventions (Brunnermeier et al., 2021; Kandrach & Schlusche, 2021), particular studies focusing on corporate QE (e.g., Berg et al., 2024; De Santis & Zaghini, 2021; Grosse-Rueschkamp et al., 2019). Further, we add to the literature on monetary policies and risk-taking by lenders (Adrian & Shin, 2010; Ioannidou et al., 2015; Jiménez et al., 2014). Lastly, we also contribute to the literature on the determinants and formation of lending syndicates (Godlewski, 2010; Saidi & Žaldokas, 2021; Sufi, 2007), thereby providing comprehensive and insightful perspectives on how macroeconomic policies influence the loan market. This analysis not only aligns with the goals of this dissertation but also enriches our understanding of lenders risk taking in response to policy changes, demonstrating the unique mechanisms of the syndicated lending market.

In summary, this dissertation provides novel and robust evidence on dynamics within European corporate debt markets during periods marked by macroeconomic and geopolitical challenges, as well as during transitions toward greater sustainability. The results from studies (A), (B) and (C) can inform regulators and policymakers about the influence on debt markets. Study (A) leverages novel data and provides detailed evidence for the rise of the European corporate bond market after Brexit. Study (B) highlights the usefulness of GBS for supporting investors with their greenwashing challenges and thereby gives important indications for the growth of sustainable debt markets. Lastly, study (C) investigates the debt contracting mechanisms of lending syndicates within the nuanced concept of controlled risk-taking and offers a new perspective on lenders' risk-taking after corporate QE interventions. Nevertheless, debt markets are constantly subject to various dynamics, and the risks associated with climate change represent just one of many challenges they will need to withstand in the future. The

studies within this dissertation provide insights useful for evaluating future shifts within debt markets and thereby provide avenues for future research. Furthermore, each study demonstrates how future research can use a variety of publicly available data sources to advance debt market research.

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II. STUDIES OF THE DISSERTATION

Brexit and the Rise of European Corporate Bond Markets*

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Abstract

We investigate the impact of Brexit on the corporate bond market by analyzing a comprehensive database covering corporate bond listings on European and UK trading venues. We find a significant shift in bond market activity, evidenced by a 49% increase in the number of bond listings in the EEA30 countries relative to the UK market after Brexit. Country-level analyses reveal a staggered effect on market activity, with predominantly international issuers adjusting their bond listings between the initially scheduled Brexit date and the final withdrawal date. At the issuer level, our findings indicate that the relative attractiveness of the EEA30 market has increased post-Brexit. Overall, these results suggest that the European capital market has successfully adapted to the loss of its largest financial center and exhibits a rising corporate bond market activity.

Keywords: Corporate bonds, Brexit, European capital market, European Bond Market Database

JEL classifications: G15, G18, G20

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1 INTRODUCTION

"The Capital Markets Union remains at the heart of our efforts to boost European investment and create jobs and growth. As we face the departure of the largest EU financial centre, we are committed to stepping up our efforts to further strengthen and integrate the EU capital markets."

(Valdis Dombrovskis, European Commission Vice-President, 2017)

In 2020, the United Kingdom (UK) withdrew from the European Union (EU)-an event commonly referred to as "Brexit"-delivering a significant shock to Europe's efforts to build an integrated and resilient capital market. At the time, the UK served as the largest financial center within the European capital market and acted as the primary entry point for non-European issuers and investors (Miethe & Pothier, 2016; Schoenmaker, 2017). Consequently, Brexit raised concerns that it could reduce the attractiveness of the European capital market and even lead to its disintegration (Born et al., 2019).

In this paper, we analyze the effects of Brexit on the European corporate bond market. The bond market is a critical source of financing for firms, enabling them to fund large-scale investments, working capital, and innovation. In the years leading up to Brexit, bond financing grew significantly faster than bank lending, with the aggregate outstanding amount of public firms' bonds reaching EUR 1.4 trillion in the Euro area alone by 2018 (Darmouni & Papoutsi, 2023). Following the UK's withdrawal, questions arise about whether activity in the European bond market will change and how its attractiveness might be affected. The 30 remaining countries in the European Economic Area (EEA30) may struggle to attract a sufficient number of financial institutions, firms, and investors. Moreover, since the UK expressed it will not be a "rule-taker" from the EU, regulatory divergence is likely, increasing costs for firms seeking to access both the UK and the EEA30 markets.[1] Thus, it remains an empirical question to what

[1]The UK Listing Review, for example, called for a rehaul of the UK Prospectus Regulation (ICMA, 2021).

extent Brexit affects current and future market activity–which we term market attractiveness–of the EEA30 market compared to the UK market.

We begin by examining the direct impact of Brexit on market activity in the EEA30 and UK markets. Specifically, we compare corporate bond listings on the EEA30 market to those in the UK–serving as the baseline group–both before and after Brexit. For our analysis, we construct a novel database–the European Bond Market Database (EBMD)–which enables a micro-level analysis of corporate[2] bond market developments. The EBMD covers all corporate bond listings on EEA30[3] and UK trading venues[4] for bonds issued by public and private non-financial firms between 2018 and 2023.[5] It provides data on individual bonds, issuers, and trading venues, encompassing 270,414 bond listings on 150 trading venues and representing 44,752 bonds by 6,567 unique issuers.

We document a significantly greater increase in market activity in the EEA30 compared to the UK, with bond listings rising by 49% in the EEA30 market after Brexit. While listings in both markets develop similarly in the pre-Brexit period, we observe a significantly larger increase in EEA30 bond listings post-Brexit. This finding remains robust after accounting for country and quarter fixed effects. As the European bond market consists of market segments with different disclosure requirements, we further differentiate between regulated markets (RM), multilateral trading facilities (MTF), and organized trading facilities (OTF). Our results indicate that the primary driver of the increase is bond listings on MTFs, which, while subject

[2]We use the term corporate to refer to non-financial corporations as bond issuers (as opposed to financial corporations or governments as bond issuers).
[3]Prior to Brexit, the European bond market encompasses the 27 member states of the European Union (EU27), three European Economic Area (EEA) countries (Iceland, Liechtenstein, and Norway), and the UK. Following Brexit, the UK's bond market is no longer considered part of the European market. For our analysis, we refer to the remaining markets collectively as the EEA30 market, which includes the EU27 plus the three EEA countries. This allows us to study how Brexit impacted the European market.
[4]A trading venue is a regulated marketplace that provides the infrastructure for trading of financial instruments (in our case, corporate bonds). We define all trading venues in a specific geographic region, or country to form a market.
[5]While the data currently ends in 2023, we plan to regularly update the EBMD to allow more timely analysis.

to regulatory supervision, offer greater flexibility in post-trade transparency and reporting requirements than regulated markets.

To examine the timing of the shift, we divide the post-Brexit period into an initial period (April 2019 until December 2020) and a final period (after December 2020). Our results reveal a staggered increase of 28% in the initial Brexit period, followed by an additional 20 percentage point increase, resulting in a total increase of 48%, in the final Brexit period. This pattern suggests a gradual shift in bond market activity toward the EEA30 market in anticipation of Brexit. The number of bond listings on EEA30 trading venues indicates a mature, liquid, and active bond market.

Next, we examine the effects of Brexit on the market attractiveness of European corporate bond markets. While market activity relates to the number of bond listings on a market, market attractiveness refers to the likelihood that participants will choose to list a bond on a market in the future. To compare the likelihood of listing a bond across the EEA30 and UK markets, we analyze the changes in bond listings at the issuer-trading venue level. Our results show a 29% increase in the likelihood of a firm's bond being listed on an EEA30 trading venue rather than a UK venue following Brexit. This shift is primarily driven by a broad-based expansion in issuer presence across the European market. In particular, issuers headquartered in EEA30 countries and international issuers list bonds on more trading venues located in the EEA30 while reducing their presence on UK trading venues. Our findings remain consistent across different regression specifications. These results suggest that, in the post-Brexit period, the UK market experiences a decline in attractiveness while the remaining European market benefits from increased issuer participation.

Lastly, we examine the consequences of Brexit for bond issuers by investigating how their focus on a particular bond market is affected. To measure the change in EEA30 market focus, we calculate the proportion of bond listings on EEA30 markets relative to the total

number of bond listings per issuer. Our first-difference regression analysis reveals that all issuers significantly increase their focus on the EEA30 market due to Brexit. Notably, issuers headquartered within the EEA30 tend to adjust their strategies before the final Brexit date. In contrast, UK and non-European issuers demonstrate a more modest and delayed increase in EEA30 market focus during the Brexit period. These results provide evidence that Brexit influences issuers' bond market strategies, necessitating adjustments to engage diverse investor groups and adaptation to different market environments.

Our paper contributes to the literature investigating the implications of Brexit for non-financial firms and capital markets. Bloom et al. (2019) study the impact of the Brexit referendum on UK firms using survey data. They show increased uncertainty among UK firms, reduced investments due to anticipation of Brexit, and loss of productivity. Breinlich et al. (2018) examine stock market reactions around the referendum, while Berg, Saunders, Schäfer, and Steffen (2021) study the effects of the Brexit referendum on the UK syndicated lending market, showing that a declining demand from UK firms drove a contraction in lending. Kadiric (2022) investigates the European and UK government bond market development surrounding Brexit, focusing on the risk premium and pricing after the referendum. Results show increases in risk premiums in the UK and selected European countries. Kadiric and Korus (2019) investigate the effects of Brexit-related news, such as the referendum, on bond credit spreads for financial and non-financial firms, finding a more pronounced increase in credit spreads for the UK compared to the Eurozone. The authors highlight the need for future research on the relocation of financial services that could considerably affect the UK market's liquidity. Our study complements this body of work by examining the restructuring of the European capital market in the aftermath of Brexit. While prior studies primarily address the uncertainty and anticipatory effects associated with the Brexit referendum, our work focuses on the direct consequences on the bond market as these effects unfold.

We also add to the literature discussing the restructuring of capital markets after Brexit from a political perspective (Donnelly, 2023; Miethe & Pothier, 2016; Panitz & Glückler, 2023). Miethe and Pothier (2016) specifically address the ramifications of Brexit for the financial sector, notably emphasizing the UK's role as a key entry point for non-European capital and the risks associated with the loss of passporting rights for financial services. Following Brexit, the European Central Bank (ECB, 2020) and the European Commission (EC) required UK-based financial services to relocate to the EEA capital market by conditioning market access on geographical location, effectively stripping UK financial service providers' EU passporting rights for cross-border services. As a result, a substantial share of UK financial services relocated to European financial centers (ECB, 2020). Importantly, the regulatory environments of individual member states play a crucial role in the location decisions of financial service providers. Moreover, the level of competition among providers also influences these decisions, with greater competition leading to different location choices (Panitz & Glückler, 2023). Our study builds on these discussions by documenting shifts in market activity from the UK to the EEA30 market post-Brexit, offering insights into the consequences of losing access to the EU's single market passporting regime.

Lastly, our study contributes to the literature on the development of debt financing in Europe and responds to calls for more extensive data about the European debt market (Cascino et al., 2014). Traditionally, European firms relied heavily on bank financing, but in recent years the importance of bonds as a financing source for non-financial firms has grown. However, Berg, Saunders, and Steffen (2021) highlight the limited availability of debt market data for European firms. To address this gap, we construct a comprehensive database of the European secondary corporate bond market. To the best of our knowledge, this database is the most comprehensive dataset of corporate bonds listed on European capital markets, providing valuable new insights. The EBMD contains extensive information on bonds listed on any European trading venue and includes unique identifiers for both listed bonds and issuers. This

feature facilitates the integration of additional bond-specific and firm-specific information from commercial databases (e.g., BvD Orbis, Dealogic), facilitating future research opportunities. Furthermore, leveraging the EBMD, our study examines market dynamics following Brexit, a key event that has significantly influenced the European bond market. We provide novel insights into how Brexit has shaped bond listing decisions and affected different issuer groups.

The paper proceeds as follows. Section 2 provides background information, related literature, and data description. We show our key results for the market activity analysis in section 3 and the market attractiveness analysis in section 4. Section 5 investigates changes in the issuers' market focus. Section 6 concludes.

2 INSTITUTIONAL BACKGROUND AND DATA

2.1 The European capital market and Brexit

The European single capital market has not a single creation date, but developed through a series of treaties, directives, and policy initiatives over several decades. Since its beginning, the EU has pursued the creation of a single capital market. The Treaty of Rome in 1957 laid the groundwork for economic integration, already including the free movement of capital. However, capital controls remained in place in many member states. The efforts intensified in the 1990s and 2000s, with the Maastricht Treaty officially recognizing the free movement of capital as one of the four fundamental freedoms of the single market. Following the 2008 financial crisis, the EC introduced the first Capital Market Union action plan in 2015, entailing 16 initiatives aimed at reducing capital market fragmentation across the 27 EU member states and three European Free Trade Association (EFTA) states.

One part of the broader EU financial integration efforts has been the passporting regime, allowing seamless cross-border operations for financial firms and issuers. The regime allows issuers or financial institutions to offer and trade securities, e.g., bonds, shares, and other

financial instruments, across the entire EEA without requiring separate regulatory approvals in each member state. In principle, a firm can issue bonds and list them on multiple exchanges in Europe by submitting a single prospectus to its home country's regulatory authority (e.g., the Financial Conduct Authority (FCA) in the UK before Brexit, or Autorité des marchés financiers (AMF) in France). Once approved, this prospectus could be passported to other EEA countries, enabling cross-bored listings without additional approval. The UK was highly integrated into the EEA capital market and served as a pivotal international financial hub. Its market size and high degree of internationalization made it essential for global firms and investors. The financial services industry in London also made it the main gateway for European capital markets.

On 23 June 2016, the UK held a referendum in which voters decided to leave the EU. Brexit marked the first time a member state left the EU, casting uncertainty about the future of the single European capital market. In response, the EC, and the UK government-initiated negotiations to ensure legal continuity and security for both the UK and EEA member states after Brexit (for a timeline of events, see Figure 1). The formal withdrawal process began on 29 March 2017, setting off a two-year countdown for the UK's scheduled exit from the EU on 29 March 2019 (i.e., the initial Brexit date). However, repeated negotiations led to multiple extensions, creating what became known as the "Brexit window". The final withdrawal agreement was ratified with royal assent on 23 January 2020, commencing a transition period that lasted until 31 December 2020 (i.e., the final Brexit date). At the end of the transition period, the UK formally exited the EU.

[Insert Figure 1 about here.]

After Brexit, UK-based financial institutions–including banks, investment firms, and trading venues–lost automatic access to the EEA passporting regime, disrupting cross-border dissemination of trade securities and market integration. As a result, these institutions are now required to obtain new licenses or establish subsidiaries within the EEA to maintain access to

the European market (ECB, 2020; Schoenmaker, 2017). With UK-based trading venues and issuers no longer benefiting from passporting, only EEA trading venues offer broad market access under single regulatory approval.

The removal of the passporting regime complicates cross-border financial market operations, likely increasing compliance costs, reducing liquidity in the UK market, and altering investment strategies (Kadiric & Korus, 2019; Schoenmaker, 2017). These shifts could significantly affect both the current activity and the future attractiveness of the European bond market.

2.2 Data and sample

To investigate the effect of Brexit on the European corporate bond market, we collect data on all bond listings between 2018 and 2023. We combine various publicly available sources that, to the best of our knowledge, have not been used in academic research so far to form the EBMD. The database contains daily observations of bonds listed by public and private non-financial firms on any trading venue in the EEA30 and the UK market since 2018.[6]

Our starting point is the Financial Instrument Reference Data System (FIRDS) maintained by the European Securities and Markets Authority (ESMA) since 1 January 2018. After Brexit, trading venues in the UK report to the FCA, which created its version of the FIRDS after Brexit. Both registers are compatible, and we use the FCA FIRDS for UK-based bond listings after 31 December 2020.[7] Both FIRDS versions include the Classification of Financial Instruments (*CFI*) code, which allows us to separate bonds from other securities.[8] They also include various identifiers such as the *ISIN,* which uniquely identifies each bond, the Legal

[6]In the Data Appendix accompanying this study, we provide a comprehensive description of the methodology employed to compile the EBMD, along with a detailed account of the data verification processes utilized to ensure the accuracy and reliability of our findings.
[7]When we refer to the FIRDS, we refer to both registers from ESMA and FCA.
[8]In general, the *CFI* consists of six alphabetical characters. The first character describes the overall category of the financial instrument. The second character further defines each category by subdividing the securities into specific groups. We are exclusively interested in bonds and thus only collect FIRDS data for financial instruments that belong to the category "DB".

Entity Identifier (*LEI*), which uniquely identifies the bond issuer, and the trading venue identification code (*VenueMic*), which uniquely identifies each trading venue. From the raw FIRDS data, we extract each bond's maturity date, coupon, nominal amount, and the beginning and end date of the listing period per trading venue. We also add additional trading venue information, such as the name, host country, or type of market segment, using ESMA's *Market Register*[9] and data on FCA trading venues. A detailed description of the data sources and consistency checks for the EBMD are in Data Appendix A.

We select debt securities using the *CFI* code "DB" that are not government guaranteed or classified as commodity derivatives, keeping plain-vanilla bonds. We identify the issuer of a listed bond and, in case of the issuer being part of a group, the ultimate parent using the relationship files from the Global Legal Entity Identifier Foundation (GLEIF). The relationship files map ownership and control structures between legal entities and are widely used for regulatory, risk management, and compliance purposes. We exclude bond listings for which the trading venue operator is reported as the bond issuer and keep listings on trading venues classified as RM, MTF or OTF. We exclude bond listings before 2018 and those reported to ESMA by trading venues in the UK after 31 December 2020. The FCA version of the FIRDS provides bond listings on UK-based trading venues after 31 December 2020. We exclude issuers with missing SIC codes or classified as financial institutions (SIC 6) or government entities (SIC 9). [10] Finally the EBMD contains 270,415 bond listings related to 44,752 unique bonds from 6,568 firms from 2018-2023. These listings occur on 150 trading venues.[11] We include a detailed description of the EBMD construction and coverage in Data Appendix B.

[9]The *Market Register* refers to the MiFID II/MiFIR TV/SI/DRSP database of ESMA. For more information, see Data Appendix A.
[10]We rely on the BvD Orbis database for this step because it covers 98% of observations in the FIRDS.
[11]Originally, 312 trading venues of type RM, MTF, and OTF have listed debt securities in the FIRDS. During our data management and sample selection, this reduced to 150 trading venues. We give details on the trading venue coverage in Data Appendix C.

[Insert Table 1 about here.]

The EBMD is a comprehensive data source for studying corporate bonds in the European market. It stands out from other databases, such as Dealogic and the ECB's Statistical Data Warehouse, due to several key features outlined in Table 1. First, it is compiled from publicly available sources, making it freely accessible to researchers. The EBMD is available on the TRR 266 Accounting for Transparency webpage.[12] Moreover, the database provides daily data, enabling timely analysis of the bond market. While it covers data from 2018 onwards, the EBMD is regularly updated, making it a relevant resource for analyzing current market events. Additionally, the database includes several identifiers, allowing integration with other databases to supplement bond data with the issuers' financial information or bond credit ratings.

2.3 Structure of the European corporate bond market

To evaluate how the European corporate bond market has developed in recent years, we examine trading venues, bond listings, and their exposure to different types of bond issuers.

[Insert Table 2 about here.]

Table 2 lists the 10 countries in the European bond market with the largest number of trading venues and bond listings between 2018 and 2023. The remaining 21 countries are summarized under "Rest of Europe". The UK is the largest market based on the number of trading venues and bond listings. The second and third largest markets are Germany and the Netherlands, accounting for 25.38% and 18.36% of total bond listings, respectively. These three countries account for over 90% of all bond listings in Europe. Perhaps surprising, Luxembourg–known as an important financial center–presents a relatively low percentage of bond listings.

[12]Data available at https://www.accounting-for-transparency.de/data/.

In the EU, trading venues are broadly classified into three categories: regulated markets (RM), multilateral trading facilities (MTF), and organized trading facilities (OTF). These market segments operate under the MiFID II regulatory framework, which harmonizes certain aspects of their operations. However, they differ in their level of regulation and the types of instruments they offer. RMs are the most strictly regulated, while MTFs and OTFs provide greater flexibility, particularly for non-equity instruments such as bonds. MTFs are predominant with 56% of all trading venues, followed by RMs with 27% and OTFs with 17%. Across countries this distribution varies. In the UK, over 50% of trading venues are MTFs, whereas in Germany they even account for over 70% of trading venues. While the UK, Germany, and France have a comparably high number of trading venues, the median country hosts two trading venues, usually one RM and one MTF. The distribution of OTFs is highly skewed across countries, as only France, the Netherlands, Spain and the UK have corporate bond listed on this market segment (see Data Appendix C, Table C2).

The Netherlands shows the highest share of bond listings by international issuers, followed by the UK and Germany. While a lot of bond markets are dominated by firms headquartered outside Europe, the share of international firms usually increases with bond market size. Only a few countries seem to be able to attract international bond listings, whereas local listings dominate smaller markets.

3 IMPACT OF BREXIT ON MARKET ACTIVITY

3.1 Descriptive evidence

[Insert Figure 2 about here.]

Figure 2 plots the natural logarithm of bond listings (*Ln(Number Listings)*) in the EEA30 market and the UK market between 2018 and 2023. Bond listings are indexed to one in 2019 Q1, i.e., the quarter before the start of the post-Brexit window. The shaded area highlights the Brexit window, i.e., the period between the initial and final Brexit date between 2019 Q2 to 2020 Q4.

Prior to Brexit, the EEA30 and UK markets exhibited similar trends in bond listings. However, both markets began to diverge significantly during the Brexit transition period, marked by the Brexit window. Specifically, the EEA30 market sees a steady increase in bond listings, whereas the UK market maintains levels consistent with those observed around the Brexit announcement. Following the ratification of the withdrawal agreement in January 2020, the UK market returned to its pre-Brexit listing levels. In contrast, the EEA30 market continued to experience growth in bond listings. These developments underscore a notable shift in the European bond market dynamics, with the EEA30 market increasingly outpacing the UK in terms of activity post-Brexit.

[Insert Figure 3 about here.]

Figure 3 differentiates between RM, MTF, and OTF market segments. The bond listings on the less regulated and more flexible MTFs and OTFs drive the overall pattern shown in Figure 2 . For the MTFs, we observe a clear divergence in the number of bond listings after the initial Brexit date. For the OTFs, the divergence emerges later during the Brexit window. The RMs do not exhibit significant changes in the EEA30 and the UK markets between the pre-Brexit and post-Brexit period.

[Insert Figure 4 about here.]

Figure 4 highlights the shift in market activity in the European market (including the EEA30 countries and the UK) by showing the listings on the EEA30 market as a percentage of the listings on the whole European market. Before Brexit, the EEA30 market's share is around 35%. The share increases steeply to on average 48% in the initial Brexit period (2019 Q1 to 2020 Q4) and grows further to 59% in the final Brexit period (2021 Q1 and after). In line with Figure 2, we observe a significant growth of the EEA30 market's share of 24 percentage points, which suggests an economically meaningful shift in market activity.

3.2 Research design

Next, we investigate the Brexit effects using a difference-in-differences regression:

$$Ln(Number\ Listings)_{c,t} = \beta \times EEA30\ Market(0/1)_c \times Post\ Brexit(0/1)_t + \gamma_c + \gamma_t + \gamma_{c,t} + \varepsilon_{c,t} \quad (1)$$

Where *Ln(Number Listings)*$_{c,t}$ is the natural logarithm of the number of bond listings in country *c* in quarter *t*. The dummy variable *EEA30 Market(0/1)*$_c$ equals one if the listing takes place in a country belonging to the EEA30 market, and zero if the listing takes place in the UK market. The dummy variable *Post Brexit(0/1)*$_t$ is zero until 2019 Q1, and equal to one from 2019 Q2 onwards. We further add country (γ_c) and quarter (γ_t) fixed effects to control for unobserved, time-invariant country characteristics and time-specific effects that could impact bond markets in all countries in a given period. We also include interacted country and quarter of the year fixed effects ($\gamma_{c,t}$) to consider potential differences in bond market seasonality in the EEA30 market compared to the UK market. The coefficient of interest is β, which captures the effect of Brexit on the EEA30 market relative to the UK market. A positive coefficient β suggests that Brexit increases the number of listings more in the EEA30 market than in the UK market, while a negative coefficient would suggest the opposite. We use robust standard errors.[13]

3.3 Results

[Insert Table 3 about here.]

Table 3 presents the results from estimating Equation (1) using a weighted linear regression on a sample of 709 country-quarter observations. The weights are based on each country's number of bonds listed in 2018, giving greater emphasis to larger markets (e.g., Germany) compared to

[13]In untabulated tests, we also apply robust standard errors clustered at the country level. The results remain unchanged.

smaller ones (e.g., Romania). Consistent with the descriptive evidence, the coefficient on the interaction term between the EEA30 dummy and the post-Brexit dummy is positive and highly statistically significant (coefficient: 0.398; t-value: 14.65). The economic magnitude is also sizable, with the number of bond listings in the EEA30 market increasing by 48.88% (exp(0.398) -1) more than in the UK after the initial Brexit date. Column (2) further controls for differences in bond market seasonality. We find a similar effect. In Columns (3) to (5), we split the sample by market segments.[14] We find a large and positive effect for the MTF segments of 73.85% (exp(0.553)-1), whereas we do not find a significant effect on the RM and OTF segments. Thus, the OTFs do not exhibit a statistically significant increase in market activity in our multivariate tests. OTFs are also the smallest group of venues in our sample, as only four countries have OTFs with corporate bonds.

[Insert Table 4 and Figure 5 about here.]

Next, we take a close look at the time-series evolution of the Brexit effect. Table 4 provides results for estimating separate coefficients for the initial Brexit period (from 2019 Q2 to 2020 Q4) and the final Brexit period (from 2021 Q1 to 2023 Q4). Figure 5 shows the time-series evolution of the coefficient of interest for each quarter in our sample period. Results for the initial Brexit period show a 32.18% (exp(0.279)-1) increase in the number of bond listings. The effect is substantially larger in the final Brexit period, with the coefficient close to doubling to 59.68% (exp(0.468)-1). The difference between the two coefficients is statistically significant at the 1% level. Figure 5 further confirms no discernible pre-trend before the initial Brexit date. The coefficient on the EEA30 market indicator is insignificantly different from zero in the pre-Brexit period (in line with parallel-trends assumption). The coefficients of interest are significantly different from zero starting in 2019 Q3, solidifying over the post-Brexit period. Adjusting for seasonality yields similar results in Column 2 of Table 4. Moreover,

[14]We adjust the weights accordingly and limit it to the respective market segment.

consistent with prior results, the initial and final effects are driven by an increase in listings on the MTFs, whereas we do not find significant effects for the RM and OTF segments.[15] Taken together, our results confirm the descriptive evidence that bond market activity in the EEA30 market increases significantly compared to the UK market after Brexit.

Next, we categorize our results by different issuer groups and investigate how market activity evolves post-Brexit for EEA30, UK, and non-European bonds separately. We split bond issuers by their headquarter country and in case of groups by the headquarter country of the ultimate parent. Prior to Brexit, the UK market served as the primary entry point to the European capital market for numerous non-European firms (Miethe & Pothier, 2016; Schoenmaker, 2017). However, as indicated in Table 2, countries within the EEA30 with larger bond markets also appear attractive for non-European bonds, which includes those issued by firms outside both the EEA30 and the UK. Thus, we might observe changes in market activity, especially for bonds by non-European issuers, but also the activity for EEA30 firms and UK firms might be affected.

[Insert Table 5 about here.]

Table 5 reports the results for the market activity analysis following Equation (1) split by EEA30, UK and Non-European issuers, over the full period as well as the time series. In the post-Brexit period, bond listings in the EEA30 market grow for all three groups. The strongest effect, a significant increase in bond listings of 57% compared to the UK, is observed for non-European bonds. Additionally, listings of EEA30 bonds rise by 35% in the EEA30 market, whereas issuers of UK bonds increase their listings by 30% compared to the UK market. As expected, the EEA30 market exhibits a significant increase in market activity, especially for

[15]In our robustness analysis, we omit Market Axess, the predominant MTF trading venue in the UK, to avoid our results being overly dependent on its market influence. This exclusion helps ensure that our findings are representative of the broader market rather than being driven by this specific venue. The consistency of the results is confirmed in Appendix B.

non-European bonds. Still, the results across all three groups speak to significant market movements.

4 IMPACT OF BREXIT ON MARKET ATTRACTIVENESS

The increase in activity on EEA30 trading venues in terms of the actual volume of bond listings suggests a higher level of operational intensity and participation post-Brexit. Next, we investigate market attractiveness and consider a forward-looking perspective at the issuer level. Investigating changes in bond listings at the issuer, market segment, and trading venue level provides insights into the drivers of the increased market activity.

4.1 Univariate results on market segment attractiveness

[Insert Table 6 about here.]

We start by presenting univariate results at the issuer and segment level. In particular, an issuer can be an EEA30, UK, or Non-European issuer and bond listings can be on the EEA30 market, or UK market and within markets on one of the three segments (RM, MTF, OTF). For these distinct groups, we present univariate results for changes in bond listings in Table 6. We present an issuer's average number of bond listings per quarter (p.q.) before and after Brexit (Bond listings p.q.) and next to it the percentage share on the EEA30 market (EEA30 market share (%)). Then, we present the change from post to pre-period (Change Bond listings p.q. (%)) and also the change in percentage points in the EEA30 market share (Change EEA30 market share (pp)). This presentation allows us to disentangle the contributions of the increase in the EEA30 market activity as documented in section 3.

We observe that an EEA30 issuer had on average 2.39 bond listings on the RM before Brexit of which over 97.22% took place in the EEA30 market (columns (1) and (2)). Similarly, an EEA30 issuer had 13.83 bond listings on the MTF segment of which about half (52.52%) were on the EEA30 market. Especially, the average UK and non-European issuer had a high

number of listings in the MTF segment (21.33 and 24.24, respectively) but less than half on the EEA30 market.

Columns (3) and (4) report the same calculations for an issuer's average number of bond listings after Brexit, while column (5) reports the percentage change in the average issuer's number of bond listings and column (6) the change in the EEA30 market share in percentage points. We observe an increase in the number of bond listings across all groups after Brexit. Importantly, the MTF segment dominates with an increase of 41.11% for the average EEA30 issuer, 36.17% for the average UK issuer and 88.94% for the average non-European issuer. Similarly, the OTF segment grows considerably after Brexit, while the RM segment registers smaller increases.

Turning to the change in the EEA30 market share, we observe an increase in the average issuer's EEA30 market share of 14.48 percentage points. Based on measurement following Berg, Saunders, Schäfer, and Steffen (2021) we disentangle this increase in the market share and investigate whether it is driven by an increase in bond listings (p.q.), or an increase in the EEA30 market share (%) (see columns (7), (8)). For example, for an EEA30 issuer we observe a change in EEA30 market share of 18.40 percentage points in the MTF segment. This change could either be driven by an increase in the number of bond listings in the EEA30 market (column (7)), or by a shift of bond listings from the UK to the EEA30 market (column (8)). For an average EEA30 issuer on the MTF, we observe that the number of listings contributes negatively to the change in EEA30's market share (-0.46%), while the EEA30 market share contributes positively to the change with 2.83%. In column (9) we report the results of second-order interaction terms between the first two effects.

Our results highlight that an increase in the EEA30 market share, rather than an increase in bond listings, contributes most to the change in the EEA30 market share. About 11.74 percentage points can be attributed to gains in share of EEA30, UK, and non-European issuers

in the MTF segment (2.83% + 3.82%. + 5.09%). Taken together, our results speak to the EEA30 market gaining attractiveness compared to the UK market. However, this attractiveness does not seem to hold across all market segments. While the lower-regulated MTFs benefit, RM and OTF segments record lower and even negative changes.

4.2 Multivariate regression design on trading venue attractiveness

In order to substantiate our univariate results, we turn to a multivariate regression design. While in the previous section we disentangled the attractiveness of different market segments, in this section we are interested in market attractiveness at the trading venue level. Therefore, we consider that the number of bond listings might increase in the EEA30 market and for example on the MTF segment, but bond listings might be concentrated only in a few venues (i.e., Euronext Amsterdam, or Frankfurt Stock Exchange). Our results offer novel insights into the future attractiveness of the EEA30 market.

We measure market attractiveness as the likelihood of an issuer having a bond listed on a trading venue. We construct our sample from 2018 Q1 to 2023 Q4 on the firm-trading venue level. The majority of the 55,925 observations (79%) are from the MTF segment, 19% from the OTF, and below 1% from the RM. We calculate our dependent variable in two steps. First, the variable $Bond\ Listing(0/1)_{f,v,t}$ is a dummy variable that equals one if at least one bond of issuer *f* is listed on trading venue *v* in quarter *t*, and zero otherwise.[16] Second, the dependent variable $\Delta Bond\ Listing_{f,v}$ is the change in the bond listing variable for issuer *f* on trading venue *v* from the pre-Brexit period to the post-Brexit period, eliminating the quarterly dimension in our data.[17] Therefore, we collapse our data on the issuer - trading venue level in the pre-Brexit and

[16]If we do not observe a bond listing for issuer *f* on trading venue *v* in quarter t, then $Bond\ Listing(0/1)_{f,v,t}$ is equal to zero. Issuer-trading venue-quarter observations that have zero issuances in every single quarter are dropped as they would be absorbed by our fixed effects.

[17]The variable $Bond\ Listing(0/1)_{f,v,t}$ is on quarterly level. Collapsing it to a pre- and post-Brexit period results in a scaling effect. For the pre and post Brexit period, we calculate the average (e.g., Pre: 12 quarters and issuer has bond listed in 6 quarters = 6/12= 0.5; Post: 12 quarters and issuer has bond listed in 8 = 8/12=0.66). Then, we calculate the change in the average from the pre- to post-period. The result is an increase of 0.66 - 0.5 = 0.16. It is

post-Brexit period, respectively. This approach addresses possible autocorrelation in the standard errors (Berg, Saunders, Schäfer, & Steffen, 2021; Bertrand et al., 2004). Our primary focus is on the final Brexit that came into effect at the end of December 2020. Thus, we split the periods using the final Brexit date with the post-period starting in 2021.[18]

Our regression model is as follows:

$$\Delta Bond\ Listing(0/1)_{f,v} = \beta \times EEA30\ Market(0/1)_v + \gamma_f + \gamma_s + \varepsilon_{f,v} \quad (2)$$

EEA30 Market(0/1)$_v$ is a dummy equal to one for trading venues located in countries belonging to the EEA30 market, and zero for UK-based trading venues. We control for bond demand using issuer cluster fixed effects and for market segment activity using segment fixed effects. We employ issuer cluster fixed effects to control for time-invariant characteristics within industry and issuer-country clusters that might influence the likelihood of bond listings. Additionally, we include segment fixed effects to account for any segment-specific factors that could affect bond listing activity. Our coefficient of interest is β, with a positive coefficient implying an increase in the likelihood of listing a bond on EEA30 trading venues compared to UK trading venues after Brexit. We cluster standard errors at the issuer-level.

4.3 Multivariate results on trading venue attractiveness

[Insert Table 7 about here.]

Table 7 presents the results. We present the baseline effect without any fixed effects in Column (1). We observe a positive and significant coefficient of interest (coefficient: 0.279; t-value: 63.29). The change in the likelihood that an issuer has a bond listed on an EEA30 trading venue

crucial to interpret the results in the context of the overall trend, hence the coefficient in equation (2) should be viewed relative to the unconditional mean of the data. We report the unconditional mean in the accompanying tables.

[18]Relying on the final Brexit date is the more cautious and reliable approach. If any changes in firms' bond listings (i.e., bonds previously only listed in the UK market, are moved to the EEA30 market) occur during the Brexit window (between the initial and final dates), it would bias the analysis against detecting a change in the likelihood of bond listings.

compared to a UK trading venue represents about 48% of the unconditional likelihood that an issuer has a bond listed. This indicates that Brexit impacts where bonds are listed with EEA30 trading venues gaining attractiveness. Issuers expand their presence across the EEA30 market. In column (2) we control for industry-country effects and in column (3) for market segment effects. Our results remain significant and robust across all specifications with the coefficient ranging between 0.244 and 0.289. Adding segment fixed effects in Column (3) increases the coefficient to 0.289 (t-value: 69.11), which represents 50% of the unconditional likelihood. The increase suggests some heterogeneity across market segments.[19]

[Insert Figure 6 about here.]

Figure 6 illustrates the observed effect by plotting the distribution of our dependent variable $\Delta Bond\ Listing_{f,v}$. We observe a value of zero for our dependent variable if an issuer has a bond listed on a venue before Brexit for the same number of quarters as after Brexit. Dividing venues by their location into EEA30 and UK venues, we observe no change for 17.40% of EEA issuer-venue combinations and slightly higher 23.28% of UK venue combinations (not plotted). Turning to the change, we observe that the EEA30 market has a higher density than the UK market for positive changes in our dependent variable. The EEA30 clearly dominates the UK market concerning issuers entering trading venues for the first time, as indicated by the higher right-side bar around values of one. The left side shows negative changes, which in turn is dominated by the UK market. We do not observe a high density at the left tail, which indicates that bonds are not entirely removed from trading venues in the UK market. Results for a Kolmogorov-Smirnov test indicate a significant difference in the distribution of $\Delta Bond\ Listing_{f,v}$ between UK market and EEA30 market with a KS statistic of 0.289 ($p < 0.01$). These

[19]In untabulated tests we include issuer fixed effects instead of issuer cluster fixed effects. Results remain qualitatively similar with a β-coefficient of 0.20 in the baseline regression.

results suggest that the EEA30 market gains attractiveness after Brexit, driven by a broad-based expansion in issuer presence across EEA30 trading venues.

Next, we split the sample into the three market segments in Table 7 columns (4) to (6). In line with our previous results, we observe the largest effect on trading venues belonging to the MTF segment. The coefficient of 0.334 is significant at the 1% level and corresponds to 58% of the unconditional likelihood for listing on an MTF. We also observe a significantly positive effect on the OTF segment (coefficient: 0.109; t-value: 13.29), which represents 19% of the unconditional likelihood of 57% for listing a bond on an OTF. However, the increase on the MTF is significantly larger compared to the increase on the OTF (significant at the 1% level). We find no significant effect on the RM.

For the three issuer groups, we observe significantly stronger increases in the likelihood of having a bond listed on EEA30 trading venues compared to UK trading venues. For EEA30 issuers, the coefficient is 0.337 (t-value: 44.82), which corresponds to a 60% increase from the unconditional mean of 56% for this group. For non-European issuers, the increase is slightly smaller, representing 47% of the unconditional likelihood of 58%. For UK issuers, results show an increase of 41% of the unconditional likelihood of 61%. Consequently, the most pronounced increase in issuer presence on EEA30 trading venues is observed among EEA30 issuers, which is reasonable considering that the EEA30 constitutes their home market.

[Insert Figure 7 about here.]

Figure 7 provides a graphical presentation of the dependent variable $\Delta Bond\ Listing_{f,v}$ for the three groups of issuers.[20] EEA30 issuers' bonds are increasingly listed on EEA30 trading venues and less often listed on UK trading venues. UK issuers' bonds are not systematically delisted from the UK trading venues but additionally listed on the EEA30 market. This group

[20]The zero change group for EEA30 issuers has a density of 18.24% on EEA30 venues and 21.11% on UK venues. For UK issuers it is 16.08% and 31.58%, respectively and for non-European issuers 16.97% and 23.18%, respectively.

also shows a high density for zero change. As the UK market is their home market this is in line with trading venues catering to investor's home bias (Krebbers et al., 2022; Obstfeld & Rogoff, 2000; Van Campenhout & Vanpée, 2017). The plot for non-European issuers also shows that the observed effect is driven by negative values for UK trading venues and positive values for EEA30 trading venues.

[Insert Figure 8 about here.]

Next, we split the sample into issuers listed before Brexit and newly listed issuers. We do so to ensure that our results are not driven by new issuers entering bond markets but reflect a shift in the issuer's trading venue presence by issuers already present in the market before Brexit. Descriptively, already the number of issuers in the pre-Brexit group confirms that our results are driven by established issuers. The majority of firms (5,973) have a bond listed before Brexit compared to 594 firms that enter the market in the post-period. Graphically, Figure 8 confirms that our main results depicted in Figure 6 are driven by the group of established issuers. In contrast, new issuers seem to enter EEA30 trading venues and UK trading venues at similar levels.

Taken together, our results suggest a shift in the dynamics of trading venue attractiveness after Brexit. In particular, the EEA30 market demonstrates an increased ability to attract bonds by non-European issuers, challenging the UK's previous dominance. While the UK market continues to play a role, also for new issuers, the expanded presence of issuers on the EEA30 market signals a broader diversification of bond listings.

5 INVESTIGATING CHANGES IN BOND ISSUERS MARKET FOCUS

We examine the consequences for bond issuers by investigating how their focus on bond markets is affected by Brexit. Despite bonds being previously issued, the choice of where they are listed, and which investors are targeted remains crucial. This decision determines the range

of investors that can access the bonds. Moreover, the listing location can influence transaction costs and the ease of future bond issuances, making it vital for issuers to carefully consider their market focus as Brexit unfolds and new trade and investment rules are established.

To examine the effect of Brexit on the issuers' bond market focus, we test the following first-difference regression:

$$\Delta EEA30\ Focus_{f,t} = \beta_0 + \beta_1 \times Post\ Brexit_t + \beta_2 \times HQ\ Group_f + \beta_3 \times Post\ Brexit_t \times HQ\ Group_f + \gamma_t + \varepsilon_{f,t} \quad (3)$$

Where f and t denote issuer and quarter; and Δ is the first-difference operator. The dependent variable $\Delta EEA30\ Focus_{f,t}$ represents the issuers quarterly change in $EEA30\ Focus_{f,t}$ that is calculated as the proportion of bond listings in the EEA30 market to total bond listings. The variable $Post\ Brexit_t$ is an indicator equal to one after the final Brexit date (2020 Q4) and zero otherwise. $HQ\ Group_f$ is a categorical variable that divides issuers by their headquarter country into EEA30, UK and non-European issuers. β_3, the coefficient on the interaction term $Post\ Brexit_t x\ HQ\ Group_f$ captures the change in the dependent variable from pre- to post-Brexit. We employ the first-difference approach, which removes unobserved, time-invariant firm characteristics, enhancing the accuracy of our analysis by isolating the effects attributable solely to changes over time.

[Insert Figure 9 about here.]

We present the development of the dependent variable, which represents the rate of change in EEA30 market share, in Figure 10, and the regression results in Table 8. Our findings indicate significant shifts in the EEA30 market share for all three issuer groups following Brexit. Graphical results highlight a peak in the rate of change of the EEA30 market share during the Brexit window, with a particularly sharp increase for EEA30 issuers. Additionally, a subsequent rise is observed after the final Brexit date.

[Insert Table 8 about here.]

Regression analysis using first-difference methodology reveals a significant positive change in the baseline rate of EEA30 market share change for our base group, the EEA30 issuers, by 1.3 percentage points. After Brexit, this rate of change decreases slightly but remains significantly positive at 0.6 percentage points, as indicated by the post-Brexit coefficient. This finding underscores a consistent increase in EEA30 issuers' focus on their home market throughout the observed period.

Moreover, we note a marked adjustment towards the EEA30 market by non-European firms after the final Brexit date, with an increase of 0.9 percentage points in their rate of change, which is significantly higher than the base group. The graphical representation corroborates that the most notable shifts in the rate of change of EEA30 market share for non-European firms occur primarily after the final Brexit date. In contrast, UK issuers exhibit a generally lower rate of change in the EEA30 market share, which aligns with a tendency to maintain focus within their domestic market. However, the post-Brexit interaction term indicates a positive shift, with a modest increase of 0.5 percentage points in the rate of change towards the EEA30 market. This suggests that while the overall shift is smaller compared to other groups, UK issuers did make some adjustments to increase their market presence in the EEA30 post-Brexit. Our results also hold when including quarter-fixed effects to control for seasonal variability.

6 CONCLUSION

The exit of Europe's former largest financial center from the Capital Markets Union represented a unique event in European history. We investigate the effect of Brexit on the European corporate bond market's activity and attractiveness using the novel EBMD database covering bond listings on trading venues in EEA30 countries and the UK.

Our first key result shows that after Brexit, overall activity in the EEA30 market, measured by the number of bond listings, increases by 49% compared to the UK market. This increase begins after the initial Brexit date and continues after the final Brexit date. The cross-sectional results show that bond listings on the more flexible and less regulated MTF market segment drive the results. Our second key result highlights an increase in the likelihood of bond listings on the EEA30 market relative to the UK market after Brexit. As such, EEA30 trading venues have become more attractive for bond listings, especially trading venues belonging to the MTF segment. However, issuers not only enter one trading venue, but we observe a broad-based expansion in issuer presence across EEA30 venues. This observation suggests that several EEA30 trading venues are emerging as significant hubs for corporate bond trading. Lastly, we investigate changes in the market share on the issuer level. In line with our previous findings we observe that the EEA30 market share of issuers increases after Brexit. This effect is particularly pronounced for EEA30 and non-European issuers, while the increase in the market share of UK issuers is of lower magnitude. Thus, corporate bond issuers must adapt to a change in their market focus, which may result in changes in the investor base. In summary, we demonstrate that the European market is on the rise following Brexit.

Taken together, our results contribute to a deeper understanding of the current developments in the European corporate bond market following the exit of its largest financial center. We provide valuable information to policymakers who are introducing policies to strengthen the Capital Markets Union and integrate the capital market. Future research can leverage the EBMD to explore further questions about the corporate bond markets and bond financing in Europe.

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FIGURES

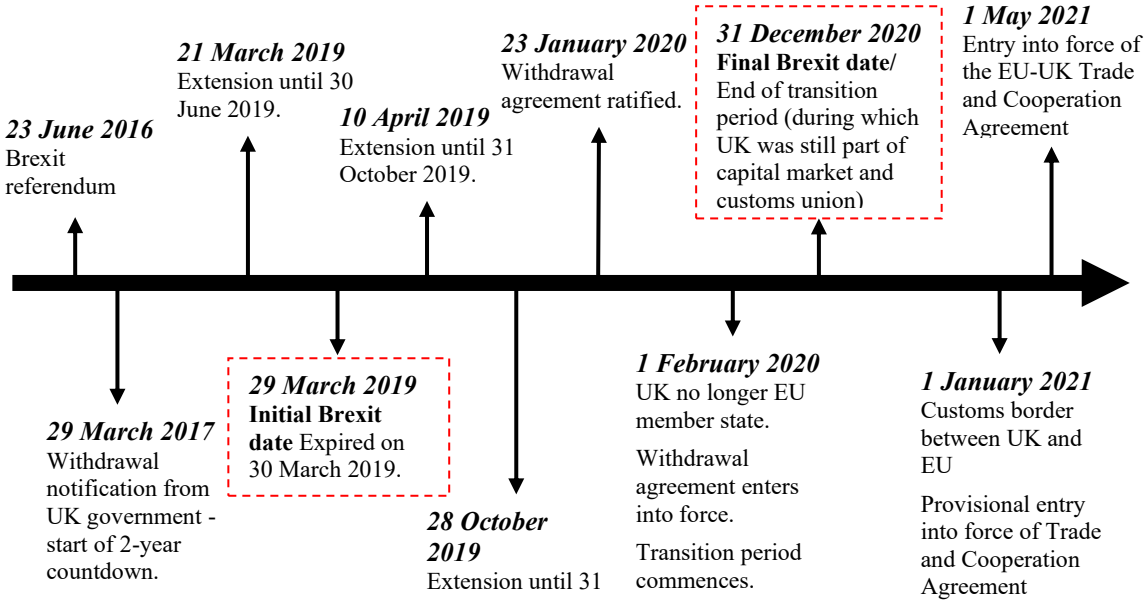

Figure 1: Brexit timeline.

Notes: This figure reports the timeline with Brexit-related events relevant for the European capital market. The initial (29 March 2019) and final Brexit dates (31 December 2020) are highlighted. They define the Brexit window from 2019 Q2 until 2020 Q4.

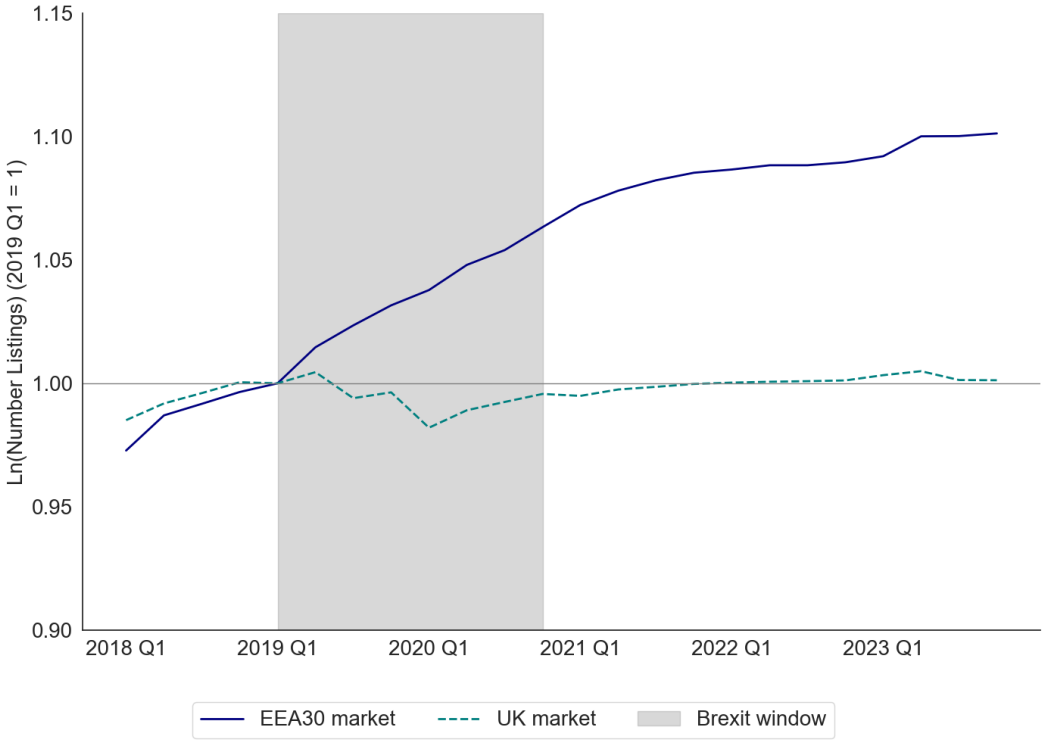

Figure 2: Development of the EEA30 and UK corporate bond market.

Notes: This figure compares the number of bond listings (*Ln(Number Listings)*) in the EEA30 bond market to the number of bond listings in the UK bond market over the 2018 Q1 to 2023 Q4 period. The variable is indexed to an average level of 1 in the quarter 2019 Q1, the quarter before the start of the post-Brexit window. Detailed variable definitions can be found in Table A1 of the Appendix.

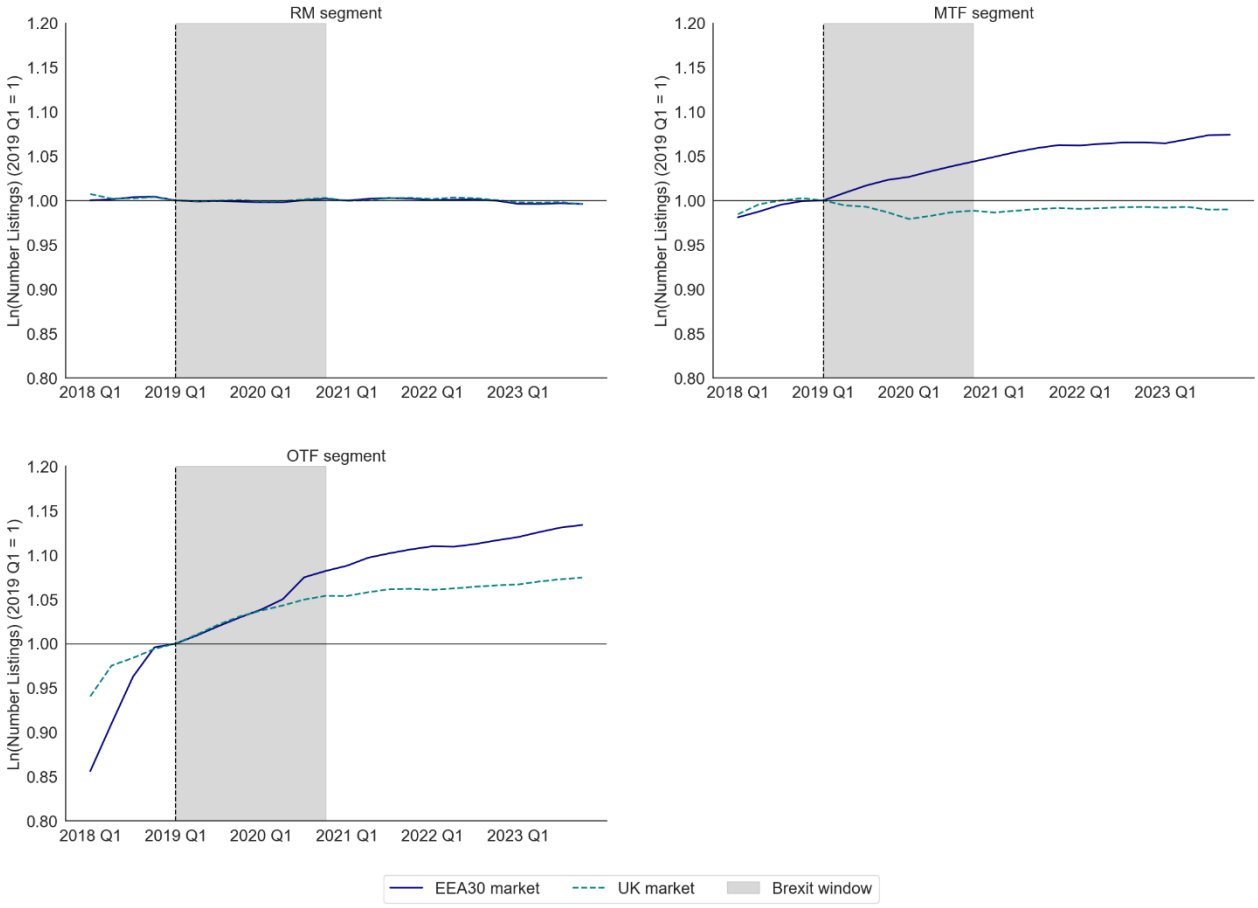

Figure 3: Development of the EEA30 and UK corporate bond market segments.

Notes: This figure compares the number of bond listings (*Ln(Number Listings)*) in the EEA30 bond market to the number of bond listings in the UK bond market over the 2018 Q1 to 2023 Q4 period for RM, MTF and OTF market segments separately. The variable is indexed to an average level of 1 in the quarter 2019 Q1, which is the start of the Brexit window. Detailed variable definitions can be found in Table A1 of the Appendix.

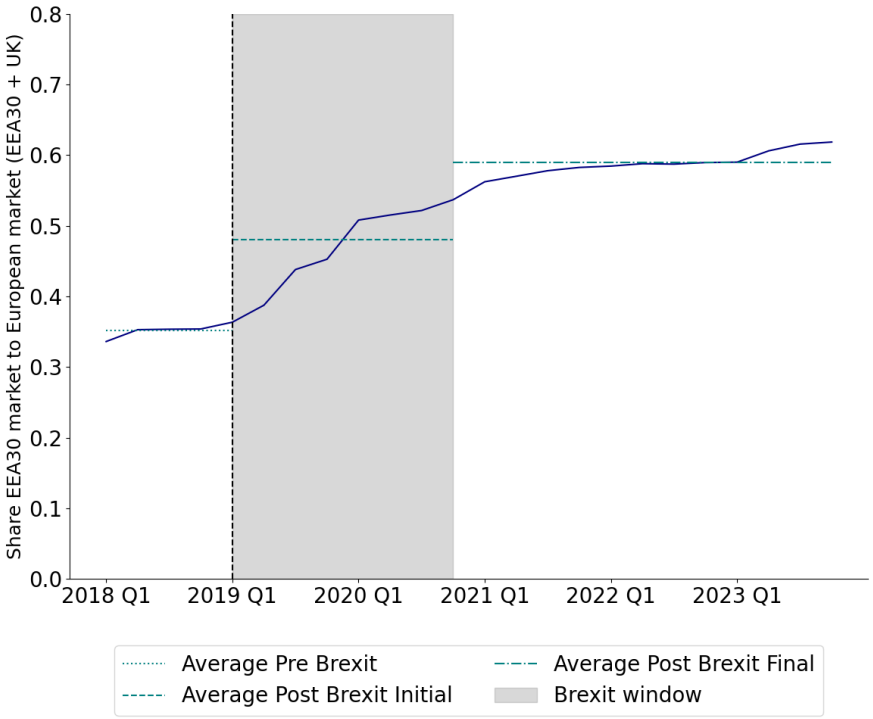

Figure 4: Share of EEA30 market as a percentage of the EEA30 and UK corporate bond market.

Notes: This figure shows the percentage share of the EEA30 market in the total bond market (EEA30 and UK) over the 2018 Q1 to 2023 Q4 period. The share is calculated using the number of bond listings. Detailed variable definitions can be found in Table A1 of the Appendix.

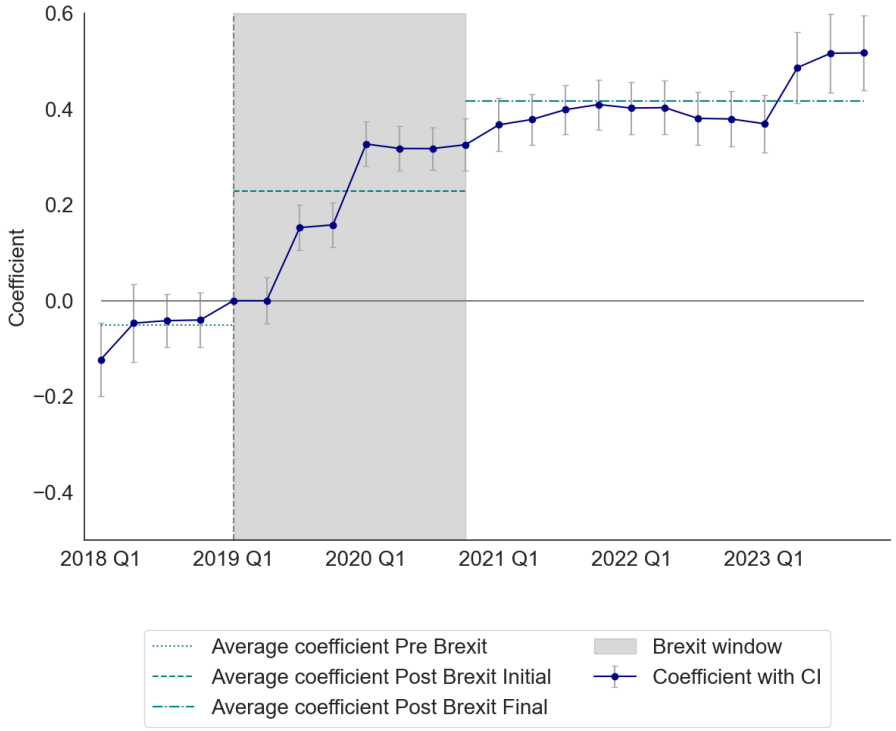

Figure 5: Coefficient estimates for the effect of Brexit on the number of bond listings in EEA30.

Notes: This figure plots coefficients β_t from the following regression:

$$Ln(Number\ Listings)_{c,t} = \sum_{t=-4}^{t=+19} \beta_t \times EEA30\ Market(0/1) \times D_t + \gamma_c + \gamma_t + \varepsilon_{c,t},$$

where D_t stands for quarterly dummies before and after Brexit. We take the period from 2018 Q1 until 2023 Q4. This results in four quarters before the initial Brexit quarter in 2019 Q1, seven quarters in the Brexit window between the initial and final Brexit quarter and twelve quarters post Brexit window. *Ln(Number Listings)* is the natural logarithm of the number of bond listings in country *c* and quarter *t*. The vertical lines present 95% confidence intervals. Detailed variable definitions can be found in Table A1 of the Appendix.

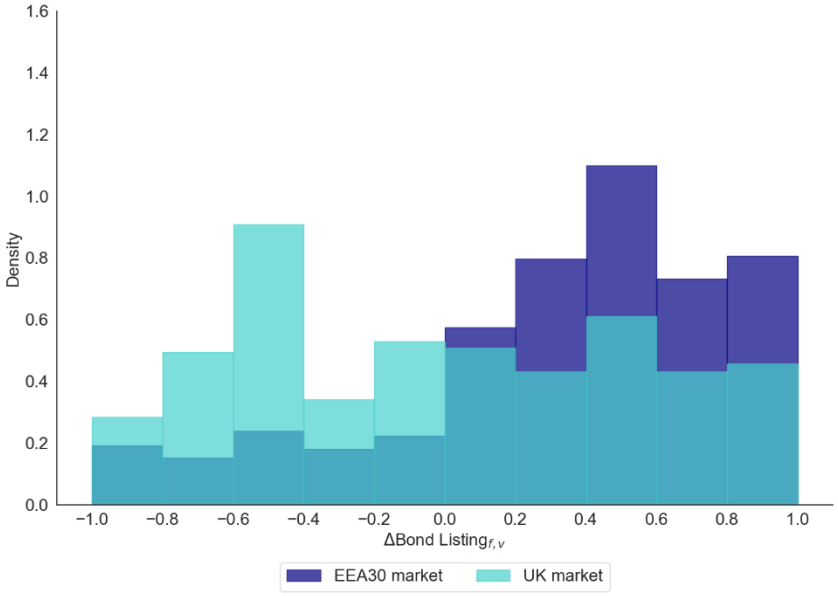

Figure 6: Distribution plot for Δ*Bond Listing* variable.

Notes: This figure presents the distribution for the Δ*Bond Listing* the dependent variable in regression equation (2). The variable ranges from -1 to 1 and quantifies the change in issuer presence at the issuer-trading venue level from the pre-Brexit to the post-Brexit period. Negative values indicate a reduction in the issuer's presence on trading venues following Brexit, whereas positive values signify an increase in the issuer's trading venue presence. We differentiate between two markets, the UK and the EEA30. The density for group zero stands at 23.29% in the UK market while it is 17.4% in the EEA30 market (not presented). Detailed variable definitions can be found in Table A1 of the Appendix.

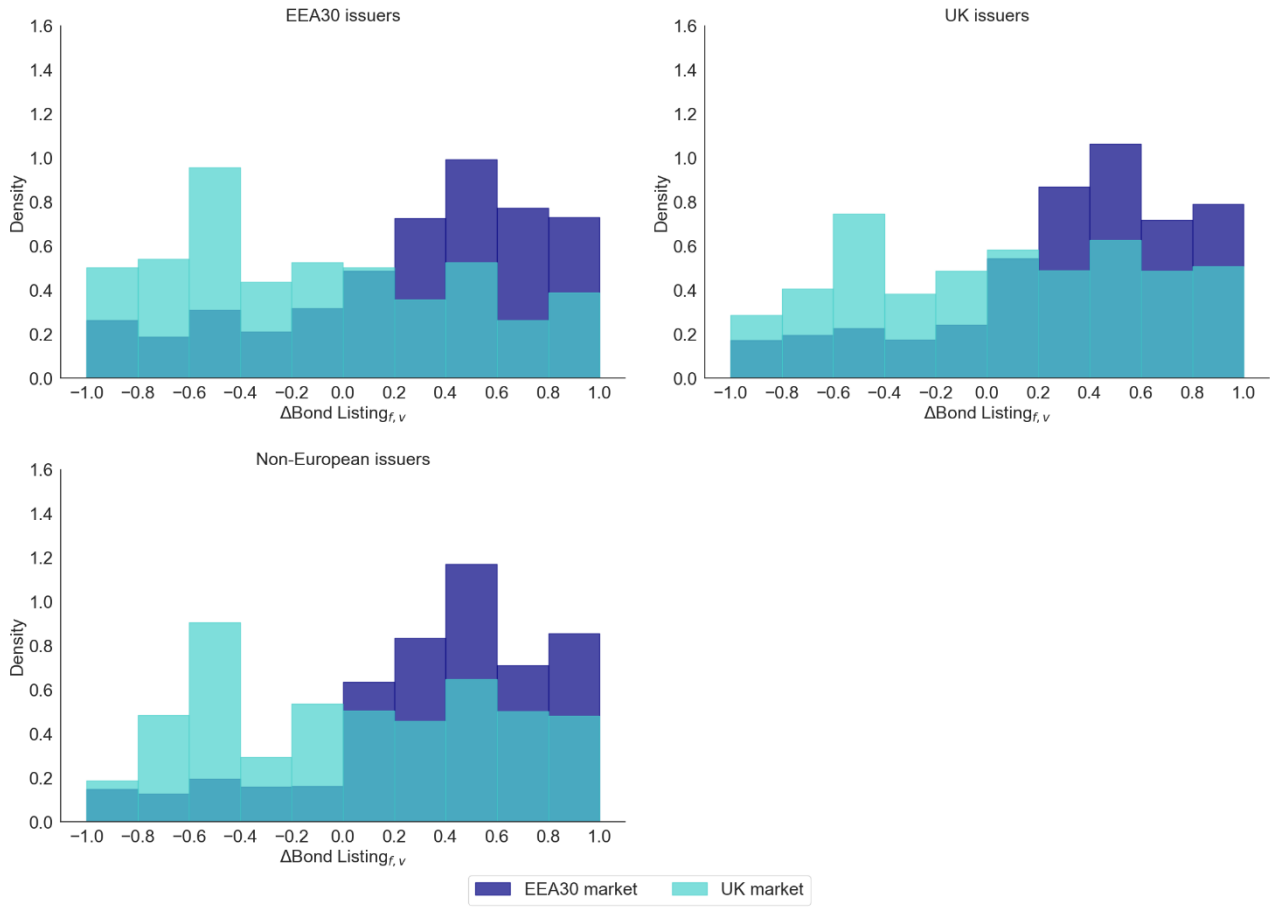

Figure 7: Distribution plot for Δ*Bond Listing* variable by issuer headquarter country.

Notes: This figure presents the distribution for the Δ*Bond Listing,* our dependent variable in regression equation (2). The variable ranges from -1 to 1 and quantifies the change in issuer presence at the issuer-trading venue level from the pre-Brexit to the post-Brexit period. Negative values indicate a reduction in the issuer's presence on trading venues following Brexit, whereas positive values signify an increase in the issuer's trading venue presence. We differentiate between two markets, the UK and the EEA30. We plot the distribution for issuers headquartered in the EEA30, the UK, and non-European issuers (not EEA30 or UK) separately. The zero change group for EEA30 issuers has a density of 18.24% on EEA30 venues and 21.11% on UK venues. For UK issuers, it is 16.08% and 31.58%, respectively, and for non-European issuers 16.97% and 23.18%, respectively. Detailed variable definitions can be found in Table A1 of the Appendix.

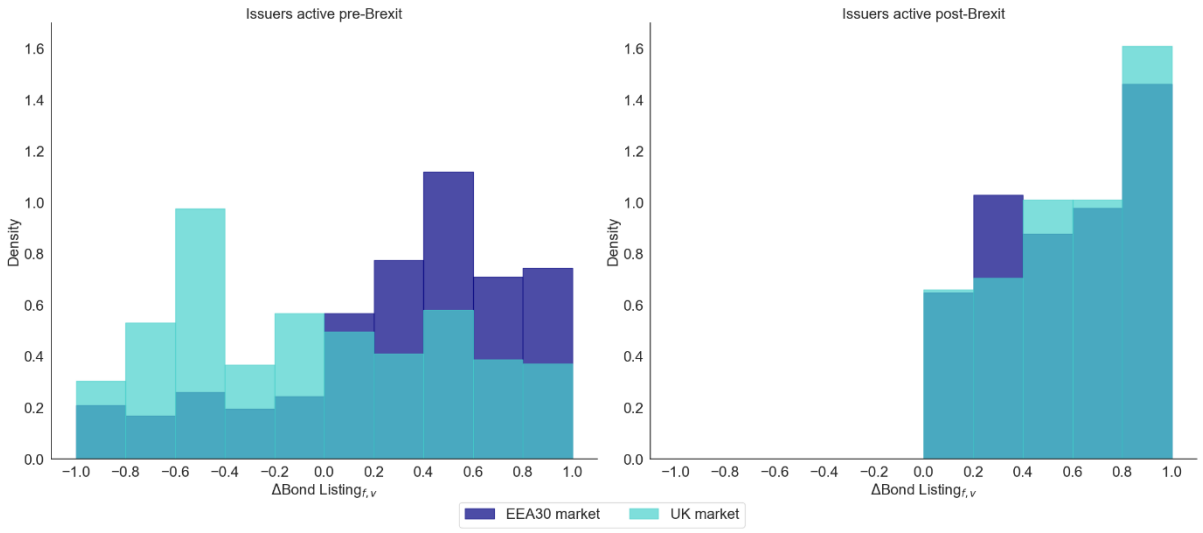

Figure 8: Distribution plot for Δ*Bond Listing* variable for firms active pre- compared to post-Brexit.

Notes: This figure presents the distribution for the Δ*Bond Listing*, the dependent variable for regression equation (2). The variable ranges from -1 to 1 and quantifies the change in issuer presence at the issuer-trading venue level from the pre-Brexit to the post-Brexit period. Negative values indicate a reduction in the issuer's presence on trading venues following Brexit, whereas positive values signify an increase in the issuer's trading venue presence. We differentiate between two markets, the UK and the EEA30. On the left-hand graph we show issuers already active on the bond market before Brexit. On the right-hand graph we show issuers newly listed on the market after Brexit. The pre-Brexit group has a density of 18.80% on EEA30 venues and 24.69% on UK venues (not presented). The post-Brexit group can only be observed post-Brexit. Detailed variable definitions can be found in Table A1 of the Appendix.

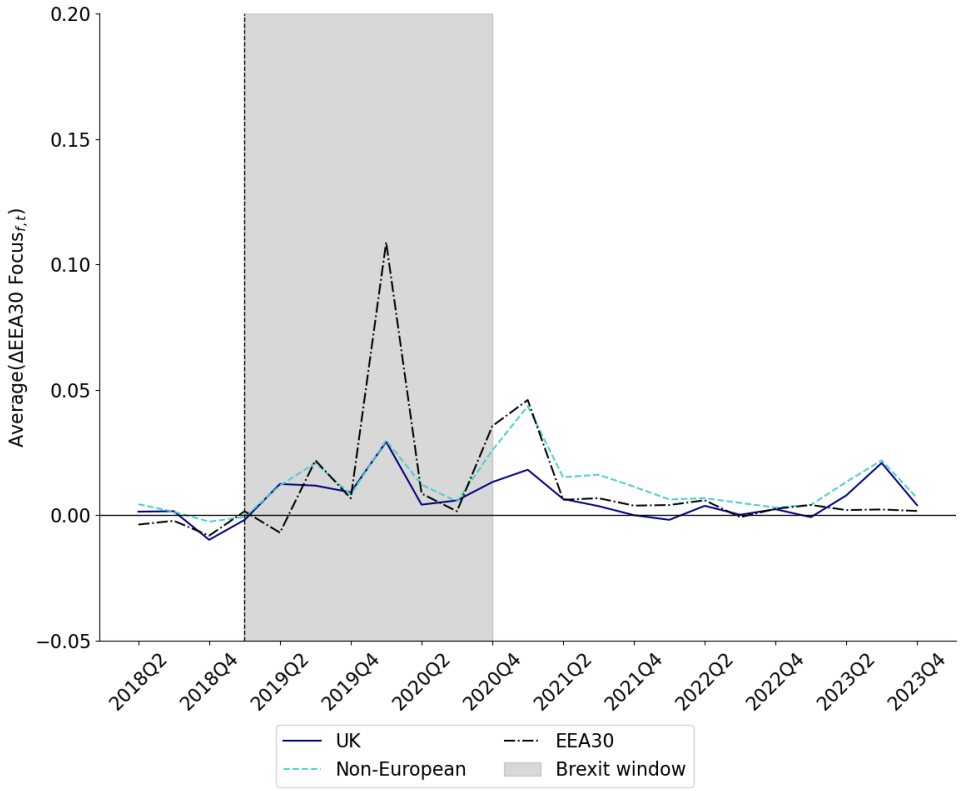

Figure 9: Change in firms' focus on the EEA30 market.

Notes: This table plots the average Δ*EEA30 Focus* over the period 2018Q2 to 2023Q3 by the issuer's headquarter group split into EEA30, UK and non-European issuers. Δ*EEA30 Focus* measures the change in the *EEA30 Focus* per issuer *f* from quarter t to quarter *t-1*. Detailed variable definitions can be found in Table A1 of the Appendix.

TABLES

Table 1: Comparison of the EBMD to selected commercial and publicly available data sources

Data sources	EBMD	Dealogic	Statistical Data Warehouse (ECB)	Deutsche Bundesbank
Availability	Public	Commercial	Public	Public
Level of aggregation	Daily, bond-trading venue data	Bond-level data	Aggregate Euro area dataset	Aggregate datasets for Germany
Time period	1 January 2018 to 31 December 2023*	From 1 January 1989	From 1 January 1990	From 1 January 2000
Updates	Monthly	New bond deals added regularly	Weekly updates of aggregated data with 3-month lag	Monthly
Geography	European Economic Area	Deals worldwide	Euro area	Germany
Type of debt instruments	Corporate bonds	Bond and syndicate loan deals	Debt instruments	Debt instruments
Industry information	Industry classification following SIC codes per bond	Industry classification per deal	Data aggregated at market level (differentiated by type of debt instruments)	Data aggregated at sector level
Source	https://trr266.wiwi.hu-berlin.de/shiny/ebmd/	https://dealogic.com/	https://sdw.ecb.europa.eu/browse.do?node=9691433	https://www.bundesbank.de/en/statistics/time-series-databases

Notes: This table compares the EBMD to selected commercial and public data sources on corporate bonds in Europe. Updated data was retrieved in December 2023.

*Currently the time period ends in December 2023, but regular updates are planned for the future.

Table 2: Characteristics of the European bond market

	Country of trading venue	Number of trading venues	Total bond listings	Percentage of total bond listings	Cum percentage of total bond listings	% of EEA30 firms	% of UK firms	% of international firms
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	United Kingdom	38	128,559	47.54	47.54	18.13	6.08	75.79
2	Germany	22	68,637	25.38	72.92	20.72	5.08	74.19
3	Netherlands	9	49,653	18.36	91.29	16.69	5.37	77.94
4	Italy	8	8,093	2.99	94.28	23.06	6.12	70.83
5	France	14	7,114	2.63	96.91	42.68	7.25	50.07
6	Ireland	4	3,110	1.15	98.06	54.92	9.10	35.98
7	Luxembourg	2	1,906	0.70	98.76	45.49	5.46	49.06
8	Spain	7	1,168	0.43	99.20	37.76	4.71	57.53
9	Norway	1	549	0.20	99.40	90.71	1.09	8.20
10	Austria	3	420	0.16	99.55	88.33	7.38	4.29
	Rest of Europe	42	1,205	0.45	100.00	97.59	1.58	0.83
	Total	150	270,414	100.00				

Notes: This table reports characteristics of the European corporate bond market in the period from 2018 until 2023. The top 10 countries (i.e., markets) based on the total number of bond listings are reported separately. Columns (1) and (2) show the total number of trading venues and bond listings, respectively. The next two columns show a country's share of the total bond listings and the cumulative share in the total bond listings. Columns (5)-(7) show the percentage of EEA30 firms, UK firms, and international firms based on the total number of bond listings in the respective country. Detailed definitions of the characteristics are presented in Table A1 of the Appendix.

Table 3: Market activity after Brexit: Aggregate data on the country-quarter level

	Ln(Number Listings)				
			Market segment split		
	Baseline	*Controlling for seasonality*	*RM*	*MTF*	*OTF*
	(1)	(2)	(3)	(4)	(5)
EEA30 Market(0/1) x Post Brexit(0/1)	0.398***	0.400***	-0.019	0.553***	0.178
	(14.65)	(14.98)	(-1.01)	(17.72)	(0.838)
Country FE	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes
Country x Quarter of Year FE	No	Yes	Yes	Yes	Yes
Observations	709	709	653	531	96
R-squared	0.987	0.987	0.996	0.976	0.978

Notes: This table presents the results of a difference-in-differences analysis, estimating weighted linear regressions on data aggregated at the country-quarter level spanning from Q1 2018 to Q4 2023. We regress *Ln(Number Listings)* on an *EEA30 Market(0/1) x Post Brexit(0/1)* interaction term, as well as market and time fixed effects. Countries are weighted based on the number of bond listings in the pre-Brexit period (2018 Q1 - 2019 Q1). Thereby, we ensure that countries with larger bond markets receive a larger weight. Column (1) shows the baseline effect for the EEA30 market after Brexit in comparison to the baseline group (the UK market). In column (2), we control for the seasonality in bond listings. In columns (3), (4) and (5), we split the sample by market segment into listings on RM, MTF and OTF. Countries can have trading venues where bonds are listed in all three segments or only in one or two, therefore the number of observations differs in the sample splits. The *EEA30 Market(0/1)* indicator equals one for countries located in the EEA30 market and zero for the UK market. *Post Brexit(0/1)* equals one in 2019 Q2 and after. We use robust standard errors. T-values are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Detailed variable definitions can be found in Table A1 of the Appendix.

Table 4: Market activity after Brexit: Differentiating initial and final Brexit effects

	Ln(Number Listings)				
			Market segment split		
	Baseline	*Controlling for seasonality*	*RM*	*MTF*	*OTF*
	(1)	(2)	(3)	(4)	(5)
EEA30 Market(0/1) x Post Brexit Initial(0/1)	0.279***	0.276***	-0.014	0.380***	0.216
	(8.20)	(7.63)	(-0.72)	(7.89)	(0.951)
EEA30 Market(0/1) x Post Brexit Final(0/1)	0.468***	0.466***	-0.022	0.645***	0.157
	(19.24)	(18.62)	(-1.09)	(24.90)	(0.685)
Market FE	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes
Market x Quarter of Year FE	No	Yes	Yes	Yes	Yes
Test for difference between *Post Brexit Initial* and *Post Brexit Final;* F-test p-value:	0.000	0.000	0.489	0.000	0.720
Observations	709	709	653	531	96
R-squared	0.988	0.988	0.994	0.986	0.960

Notes: This table presents the results of a difference-in-differences analysis, estimating weighted linear regressions on data aggregated at the country-quarter level spanning from Q1 2018 to Q4 2023. We regress *Ln(Number Listings)* on an *EEA30 Market(0/1) x Post Brexit Initial(0/1)* and an *EEA30 Market(0/1) x Post Brexit Final(0/1)* interaction term, as well as market and time fixed effects. Countries are weighted based on the number of bond listings in the pre-Brexit period (2018 Q1 - 2019 Q1). Thereby, we ensure that countries with larger bond markets receive a larger weight. Column (1) shows the baseline effect for the EEA30 market after Brexit in comparison to the baseline group (the UK market). In column (2), we control for the seasonality in bond listings. In columns (3), (4) and (5), we split the sample by market segment into listings on RM, MTF and OTF. Countries can have trading venues where bonds are listed in all three segments or only in one or two, therefore the number of observations differs in the sample splits. *EEA30 Market(0/1)* equals one for countries located in the EEA30 market and zero for the UK market. *Post Brexit Initial(0/1)* equals one for quarter 2019 Q2 until 2020 Q4 using the initial Brexit date on 29 March 2019. *Post Brexit Final(0/1)* equals one for quarter 2021 Q1 and after using the final Brexit date on 31 December 2020. We use robust standard errors. T-values are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Detailed variable definitions can be found in Table A1 of the Appendix.

Table 5: Market activity after Brexit: Differentiating issuer groups

	Ln(Number Listings)					
	EEA30		*UK*		*Non-European*	
	(1)	(2)	(3)	(4)	(5)	(6)
EEA30 Market(0/1) x Post Brexit(0/1)	0.297***		0.273***		0.451***	
	(9.18)		(13.07)		(15.11)	
EEA30 Market(0/1) x Post Brexit Initial(0/1)		0.146***		0.166***		0.330***
		(4.03)		(4.62)		(7.92)
EEA30 Market(0/1) x Post Brexit Final(0/1)		0.377***		0.331***		0.515***
		(12.68)		(9.35)		(18.14)
Market FE	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Market x Quarter of Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Test for difference between *Post Brexit Initial,* and *Post Brexit Final;* F-test p-value:		0.000		0.000		0.000
Observations	709	709	709	709	709	709
R-squared	0.985	0.986	0.982	0.986	0.987	0.984

Notes: This table presents the results of a difference-in-differences analysis, estimating weighted linear regressions on data aggregated at the country-quarter level spanning from Q1 2018 to Q4 2023. In columns (1), (3) and (5), we regress *Ln(Number Listings)* on an *EEA30 Market(0/1) x Post Brexit(0/1)* interaction term. In columns (2), (4) and (6), we regress *Ln(Number Listings)* on an *EEA30 Market(0/1) x Post Brexit Initial(0/1)* and an *EEA30 Market(0/1) x Post Brexit Final(0/1)* interaction term. We include market and time fixed effects in all specifications. Countries are weighted based on the number of bond listings in the pre-period (2018 Q1 – 2019 Q1). Thereby, we ensure that larger countries also receive a larger weight. Columns (1) and (2) show results for the subset of EEA30 issuers. Columns (3) and (4) show results for UK issuers and columns (5) and (6) for non-European issuers. The *EEA30 Market(0/1)* equals one for bond listings in the EEA30 countries and zero for bond listings in the UK. *Post Brexit(0/1)* equals one for quarter 2019 Q2 and after. One market is considered as one country. *Post Brexit Initial(0/1)* equals one for quarter 2019 Q2 until 2020 Q4 using the initial Brexit date on 29 March 2019. *Post Brexit Final(0/1)* equals one for quarter 2021 Q1 and after using the final Brexit date on 31 December 2020. We use robust standard errors. T-values are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Detailed variable definitions can be found in Table A1 of the Appendix.

Table 6: Market segment attractiveness post Brexit: Univariate analysis

Category	Pre-Brexit Bond listings p.q. (#)	EEA30 market share (%)	Post-Brexit Bond listings p.q. (#)	EEA30 market share (%)	Change Bond listings p.q. (%)	Change EEA30 market share (pp)	Contribution to change		
							Bond listings p.q. (%)	EEA30 market share (%)	Second order interaction term
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
EEA30 Issuer									
RM	2.39	97.22	2.51	98.09	4.89	0.87	-0.77	0.02	-0.01
MTF	13.83	52.52	19.51	70.92	41.11	18.40	-0.46	2.83	-0.16
OTF	8.33	19.86	11.98	30.11	43.76	10.25	-0.07	0.95	-0.04
UK Issuer									
RM	2.77	16.26	2.84	16.02	2.63	-0.24	-0.16	-0.01	0.00
MTF	21.33	45.27	29.04	61.37	36.17	16.10	-0.97	3.82	-0.35
OTF	7.09	15.88	10.27	23.24	44.91	7.36	-0.04	0.58	-0.02
Non-European Issuer									
RM	2.29	73.99	2.37	73.02	3.76	-0.97	-0.58	-0.02	0.01
MTF	24.24	44.18	45.80	63.08	88.94	18.90	3.12	5.09	1.34
OTF	7.68	16.13	10.31	22.93	34.24	6.80	-0.14	0.58	-0.06
Total	89.94	40.15	134.63	54.63	49.69	14.48	-0.08	13.84	0.71

Notes: This table presents results from a univariate analysis comparing market segment attractiveness in the EEA30 and UK markets before and after Brexit, spanning from 2018 Q1 to 2020 Q4 and from 2021 Q1 to 2023 Q4, respectively. Columns (1) and (3) detail data on the average bond listings per quarter (p.q.) and per issuer for the periods before and after Brexit's finalization in 2020 Q4 (labeled as Bond listings p.q.(#)). Columns (2) and (4) depict the percentage share of these listings in the EEA30 market (labeled as EEA30 market share (%)) Column (5) depicts the percentage change in bond listings post- versus pre-Brexit (Change Bond listings p.q. (%)), and column (6) the change in EEA30 market share measured in percentage points. Data is categorized by the headquarters of the issuer: EEA30, UK, and non-European, and is further divided by market segments: RM, MTF, or OTF. Additionally, the columns titled 'Contribution to change' split the changes in EEA30 market share into the number of bond listings by category (column (7)), shifts in the EEA30's market share within these categories (column (8)), and a second order interaction term (column (9)).

Table 7: Trading venue attractiveness post Brexit: Multivariate analysis

	ΔBond Listing								
				Market segment split			Issuer group split		
	Baseline	*Controlling for industry-country effects*	*Controlling for market segment effects*	*RM*	*MTF*	*OTF*	*EEA30*	*UK*	*Non-European*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
EEA30 Market(0/1)	0.279***	0.244***	0.289***	-0.036	0.334***	0.109***	0.337***	0.251***	0.271***
	(63.29)	(60.49)	(69.11)	(-0.47)	(71.03)	(13.29)	(44.82)	(16.75)	(51.06)
Issuer cluster FE	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Segment FE	No	No	Yes	No	No	No	Yes	Yes	Yes
Issuer cluster	2,371	2,371	2,371	1,003	6,471	2,352	1,042	90	1,239
Venues	150	150	150	40	84	26	144	75	77
Chi-squared test results	RM - MTF			-0.370**					
	MTF - OTF				0.225***				
	RM - OTF			-0.145					
	EEA30 - UK						0.086***		
	UK - Non-European							-0.019	
	EEA30 - Non-European						0.066***		
Observations	55,925	55,925	55,925	1,142	44,277	10,506	18,014	4,054	33,857
R-squared	0.078	0.287	0.319	0.640	0.337	0.276	0.356	0.251	0.200
Unconditional bond (0/1)	58%	58%	58%	67%	58%	57%	56%	58%	61%

Notes: This table depicts results of a difference-in-differences analysis, estimating linear regressions on data at the issuer-trading venue-quarter level over the Q1 2018 to Q4 2023 time period that is collapsed to a pre- and post-Brexit period, splitting at the final Brexit date in 2020 Q4. We regress the change in bond listings from pre- to post-Brexit (Δ*Bond Listing(0/1)*) on an *EEA30 Market(0/1)* dummy. The dependent variable Δ*Bond Listing(0/1)* is based on the pre-and post-Brexit difference of the indicator variable *Bond Listing(0/1)* that equals one if at least one bond was listed by issuer *f* on venue *v* in in quarter *t* and zero otherwise. The *EEA30 Market(0/1)* equals one for bond listings in the EEA30 countries and zero for bond listings in the UK. Column (1) presents baseline results, column (2) controls for industry effects, and column (3) additionally controls for market segment effects. In columns (4), (5) and (6) we split the sample by type of market segment into listings on RM, MTF and OTF. In columns (7), (8), and (9), we divide the sample by issuer types based on their headquarters countries, specifically categorizing issuers as EEA30, UK, and Non-European. Standard errors are clustered at issuer level. Results of chi-squared tests are prepared using seemingly unrelated estimation (SUE). The tests compare the coefficients of variable *EEA30 Market(0/1)* across the sample splits in columns (4) to (9). It assesses the statistical significance of differences observed between groups. T-values are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Detailed variable definitions can be found in Table A1 of the Appendix.

Table 8: Changes in Issuer's EEA30 bond market focus: First difference analysis

	ΔEEA30 Focus	
	Baseline	*Controlling for quarter FE*
	(1)	(2)
Intercept	0.013***	0.010***
	(16.53)	(21.64)
Post Brexit	-0.006***	
	(-6.73)	
HQ Country UK	-0.006***	-0.007***
	(-4.90)	(-5.46)
HQ Country non-European	-0.004***	-0.003***
	(-4.46)	(-3.33)
HQ Country UK x Post Brexit	0.005***	0.005***
	(2.82)	(3.20)
HQ Country non-European x Post Brexit	0.009***	0.008***
	(8.58)	(7.83)
Quarter FE	No	Yes
Observations	88,871	88,871
R-squared	0.001	0.036

Notes: This table presents results from first-difference regressions. We regress the Δ*EEA30 Focus* on a *Post Brexit* indicator and categorical variables for issuers headquarter country. Δ*EEA30 Focus* measures the change in the *EEA30 Focus* (measured as Bond listings on the EEA30 market divided by total bond listings) per issuer *f* from quarter *t* to quarter *t-1*. T-values are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Detailed variable definitions can be found in Table A1 of the Appendix.

APPENDIX

A Definition of variables

Table A: Variable description

Variable	Description	Source
Main dependent variables		
Ln(Number Listings)$_{c,t}$	The variable equals the natural logarithm of the number of bond listings on trading venues in a market m.	EBMD
Bond Listing(0/1)$_{f,v,t}$	The variable equals one if at least one bond has been listed from issuer *f* on trading venue *v* in quarter *t*.	EBMD
ΔBond Listing$_{f,v}$	The variable ranges between 1 and -1 and represents the change in the *Bond Listing(1/0)* variable at the issuer-trading venue level, collapsed to pre- and post-Brexit period. Per issuer-trading venue-quarter, we determine the *Bond Listing (1/0)*. Then for the pre- and post-period, we calculate the average (for example, pre: 12 quarters and bond listed in 6 quarters = 6/12= 0.5; Post: 12 quarters and 8 listings = 8/12=0.66). From this we calculate the change in the average between the pre- and post-period, here this equals an increase of: 0.66 - 0.5 = 0.16.	EBMD, own calculation
EEA30 Focus$_{f,t}$	The variable measures the focus of the bond issuer towards the EEA30 bond market, compared to the European market (EEA30 and UK) and is measures as bond listings on the EEA30 market per issuer *f* in quarter *t* divided by total bond listings of issuer *f* in quarter *t*: $Bond\ listings\ EEA30\ market_{ft} / Bond\ listings\ total_{ft}$	EBMD, own calculation
ΔEEA30 Focus$_{f,t}$	The variable measures the change in the $EEA30\ Focus_{ft}$ from quarter *t* to quarter *t*-1.	EBMD, own calculation
Main independent variables		
EEA30 Market(0/1)$_c$ / EEA30 Market(0/1)$_v$	The variable equals one if a bond is listed on a trading venue v that is located in an EEA30 country *c* and zero if the bond is listed on a UK trading venue.	EBMD
Post Brexit(0/1)$_t$	The variable equals one for quarters after 2020 Q4, and zero otherwise.	EBMD
Post Brexit Initial (0/1)$_t$	The variable equals one for quarters including 2019 Q2 until 2020 Q4, and zero otherwise.	EBMD
Post Brexit Final (0/1)$_t$	The variable equals one for quarters after 2020 Q4, and zero otherwise.	EBMD

[Table A1 continued.]

Other independent variables		
$Industry_f$	The variable uses the 3-digit SIC code to divide issuers into industries.	ORBIS
Market $Segment_v$	The variable captures the market segment of the trading venue and divides trading venues into three groups: EU regulated market (*RM*), multilateral trading facility (*MTF*), or Organised trading facility (*OTF*).	EBMD
Other variables		
HQ-$Country_f$	The variable captures the headquarter country of the issuer.	EBMD
HQ-$Group_f$	This is a categorical variable, that divides issuers by their headquarter country into three groups: EEA30 headquartered issuers (*EEA30*), UK headquartered issuers (*UK*) and non-European headquartered issuers (*non-European*).	EBMD
Number of trading venues	The variable equals the total number of trading venues reporting corporate bonds in the respective time period and country.	EBMD, own calculation
Bond listings	The variable equals the total number of bond - trading venue combinations in the respective time period and country.	EBMD, own calculation
% of EEA30 issuers	The variable equals the percentage of EEA30 headquartered bond issuers based on the total number of bond listings in the respective time period and country.	EBMD, own calculation
% of UK issuers	The variable equals the percentage of UK headquartered bond issuers based on the total number of bond listings in the respective time period and country.	EBMD, own calculation
% of foreign issuers	The variable equals the percentage of foreign headquartered bond issuers based on the total number of bond listings in the respective time period and country.	EBMD, own calculation

Notes: This table presents the definitions of variables used in our analyses and the source of each variable.

B Robustness tests

We conduct a set of robustness tests, excluding the largest MTF venue located in the UK, to ensure that our results are not driven by this venue dominating the UK market. Results remain comparable to those from our main set of tests. Table B1 and B2 present results for the market activity analysis. Figure B1 supports these findings. Table B3 and B4 show results for the market attractiveness analysis.

Table B1: Robustness test based on Table 3: - Excluding MTF trading venue "Market Axess"

	Ln(Number Listings)				
			Market segment split		
	Baseline	*Controlling for seasonality*	*RM*	*MTF*	*OTF*
	(1)	(2)	(3)	(4)	(5)
EEA30 Market(0/1) x Post Brexit(0/1)	0.186***	0.181***	-0.019	0.361***	0.178
	(8.98)	(8.79)	(-1.00)	(16.17)	(0.84)
Market FE	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes
Market x Quarter of Year FE	No	Yes	Yes	Yes	Yes
Observations	709	709	653	531	96
R-squared	0.986	0.987	0.994	0.984	0.960

Notes: This table presents the results of a difference-in-differences analysis, estimating weighted linear regressions on data aggregated at the country-quarter level spanning from Q1 2018 to Q4 2023. We exclude bond listings on the Market Axess MTF located in the UK. We regress *Ln(Number Listings)* on an *EEA30 Market(0/1) x Post Brexit(0/1)* interaction term, as well as market and time fixed effects. Countries are weighted based on the number of bond listings in the pre-Brexit period (2018 Q1 - 2019 Q1). Thereby, we ensure that countries with larger bond markets receive a larger weight. Column (1) shows the baseline effect for the EEA30 market after Brexit in comparison to the baseline group (the UK market). In column (2), we control for the seasonality in bond listings. In columns (3), (4) and (5), we split the sample by market segment into listings on RM, MTF and OTF. Countries can have trading venues where bonds are listed in all three segments or only in one or two, therefore the number of observations differs in the sample splits. The *EEA30 Market(0/1)* indicator equals one for countries located in the EEA30 market and zero for the UK market. *Post Brexit(0/1)* equals one in 2019 Q2 and after. We use robust standard errors. T-values are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Detailed variable definitions can be found in Table A1 of the Appendix.

Table B2: Robustness test based on Table 4 - Excluding MTF trading venue "Market Axess"

	Ln(Number Listings)				
			Market segment split		
	Baseline	*Controlling for seasonality*	*RM*	*MTF*	*OTF*
	(1)	(2)	(3)	(4)	(5)
EEA30 Market (0/1) x Post Brexit Initial (0/1)	0.134***	0.126***	-0.014	0.259***	0.216
	(5.70)	(5.30)	(-0.72)	(9.01)	(0.95)
EEA30 Market (0/1) x Post Brexit Final (0/1)	0.215***	0.210***	-0.022	0.416***	0.157
	(9.76)	(9.51)	(-1.10)	(18.20)	(0.68)
Market FE	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes
Market x Quarter of Year FE	No	Yes	Yes	Yes	Yes
Test for difference between *Post Brexit Initial* and *Post Brexit Final* F-test p-value:	0.000	0.000	0.489	0.000	0.720
Observations	709	709	653	531	96
R-squared	0.987	0.987	0.994	0.985	0.960

Notes: This table presents the results of a difference-in-differences analysis, estimating weighted linear regressions on data aggregated at the country-quarter level spanning from Q1 2018 to Q4 2023. We exclude bond listings on the Market Axess MTF located in the UK. We regress *Ln(Number Listings)* on an *EEA30 Market(0/1) x Post Brexit Initial(0/1)* and an *EEA30 Market(0/1) x Post Brexit Final(0/1)* interaction term, as well as market and time fixed effects. Countries are weighted based on the number of bond listings in the pre-Brexit period (2018 Q1 - 2019 Q1). Thereby, we ensure that countries with larger bond markets receive a larger weight. Column (1) shows the baseline effect for the EEA30 market after Brexit in comparison to the baseline group (the UK market). In column (2), we control for the seasonality in bond listings. In columns (3), (4) and (5), we split the sample by market segment into listings on RM, MTF and OTF. Countries can have trading venues where bonds are listed in all three segments or only in one or two, therefore the number of observations differs in the sample splits. *EEA30 Market(0/1)* equals one for countries located in the EEA30 market and zero for the UK market. *Post Brexit Initial(0/1)* equals one for quarter 2019 Q2 until 2020 Q4 using the initial Brexit date on 29 March 2019. *Post Brexit Final(0/1)* equals one for quarter 2021 Q1 and after using the final Brexit date on 31 December 2020. We use robust standard errors. T-values are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Detailed variable definitions can be found in Table A1 of the Appendix.

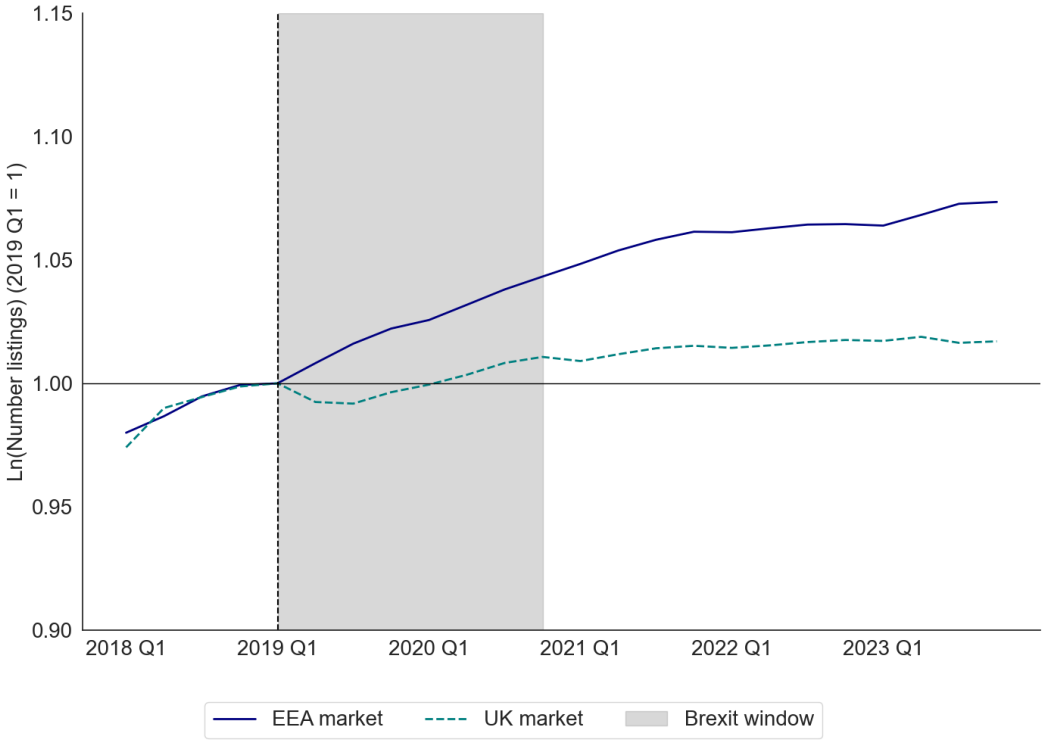

Figure B1: Development of the EEA30 and UK corporate bond market: Excluding Market Axess.

Notes: This figure compares the number of bond listings (*Ln(number listings)*) in the EEA30 bond market to the number of bond listings in the UK bond market over the 2018 Q1 to 2023 Q4 period. One UK MTF (Market Axess) is excluded from the UK sample. We index the variable to an average level of one in the quarter 2019 Q1. Detailed variable definitions can be found in Table A1 of the Appendix.

Table B3: Robustness test based on Table 6: Excluding MTF trading venue "Market Axess"

Category	Pre-Brexit Bond listings p.q. (#)	EEA30 market share (%)	Post-Brexit Bond listings p.q. (#)	EEA30 market share (%)	Change Bond listings p.q. (%)	Change EEA30 market share (%)	Contribution to change		
							Bond listings p.q. (%)	EEA30 market share (%)	Second order interaction term
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
EEA30 Issuers									
RM	2.39	97.22	2.51	98.09	4.89	0.87	-0.56	0.02	-0.01
MTF	14.63	61.79	18.07	76.73	23.44	14.94	-0.85	2.35	-0.21
OTF	8.33	19.86	11.98	30.11	43.76	10.25	0.11	0.92	0.06
UK Issuers									
RM	2.77	16.26	2.84	16.02	2.63	-0.24	-0.12	-0.01	0.00
MTF	20.92	53.23	26.29	68.17	25.67	14.94	-0.86	3.37	-0.24
OTF	7.09	15.88	10.27	23.24	44.91	7.36	0.09	0.56	0.04
Non-European Issuers									
RM	2.29	73.99	2.37	73.02	3.76	-0.97	-0.43	-0.02	0.01
MTF	26.77	58.11	41.05	71.06	53.36	12.95	2.23	3.73	0.50
OTF	7.68	16.13	10.31	22.93	34.24	6.80	-0.01	0.56	0.00
Total	92.87	47.62	125.69	58.84	35.34	11.22	-0.40	11.49	0.15

Notes: This table presents results from a univariate analysis comparing market segment attractiveness in the EEA30 and UK markets before and after Brexit, spanning from 2018 Q1 to 2020 Q4 and from 2021 Q1 to 2023 Q4, respectively. We exclude bond listings on the Market Axess MTF located in the UK. Columns (1) and (3) detail data on the average bond listings per quarter (p.q.) and per issuer for the periods before and after Brexit's finalization in 2020 Q4 (labeled as Bond listings p.q.(#)). Columns (2) and (4) depict the percentage share of these listings in the EEA30 market (labeled as EEA30 market share (%)) Column (5) depicts the percentage change in bond listings post- versus pre-Brexit (Change Bond listings p.q. (%)), and column (6) the change in EEA30 market share measured in percentage points. Data is categorized by the headquarters of the issuer: EEA30, UK, and non-European, and is further divided by market segments: RM, MTF, or OTF. Additionally, the columns titled 'Contribution to change' split the changes in EEA30 market share into the number of bond listings by category (column (7)), shifts in the EEA30's market share within these categories (column (8)), and a second order interaction term (column (9)).

Table B4: Robustness test based on Table 7: Excluding MTF trading venue "Market Axess"

	ΔBond Listing								
				Market segment split			Issuer split		
	Baseline	*Controlling for industry-country effects*	*Controlling for market segment effects*	*RM*	*MTF*	*OTF*	*EEA30*	*UK*	*Non-European*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
EEA30 Market (0/1)	0.214***	0.209***	0.263***	-0.036	0.311***	0.109***	0.320***	0.239***	0.241***
	(49.83)	(52.79)	(63.02)	(-0.47)	(65.73)	(13.29)	(40.10)	(16.30)	(47.21)
Issuer cluster FE	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Segment FE	No	No	Yes	No	No	No	Yes	Yes	Yes
Issuer cluster	1,920	1,920	1,920	615	1,854	1,164	959	87	874
Venues	149	149	149	40	83	26	143	74	76
Chi-squared test results	RM - MTF			-0.347**					
	MTF - OTF				0.202***				
	RM - OTF				-0.145				
	EEA30 - UK						0.081***		
	UK - Non-European							-0.002	
	EEA30 - Non-European							0.079***	
Observations	50,157	50,157	50,157	1,142	38,509	10,506	16,372	3,776	30,009
R-squared	0.046	0.246	0.277	0.640	0.292	0.276	0.375	0.219	0.216
Unconditional bond (0/1)	58%	58%	58%	67%	58%	57%	57%	58%	61%

Notes: This table depicts results of a difference-in-differences analysis, estimating linear regressions on data at the issuer-trading venue-quarter level over the Q1 2018 to Q4 2023 time period that is collapsed to a pre- and post-Brexit period, splitting at the final Brexit date in 2020 Q4. We exclude bond listings on the Market Axess MTF located in the UK. We regress the change in bond listings from pre- to post-Brexit (Δ*Bond Listing(0/1)*) on an *EEA30 Market(0/1)* dummy. The dependent variable Δ*Bond Listing(0/1)* is based on the pre-and post-Brexit difference of the indicator variable *Bond Listing(0/1)* that equals one if at least one bond was listed by issuer *f* on venue *v* in in quarter *t* and zero otherwise. The *EEA30 Market(0/1)* equals one for bond listings in the EEA30 countries and zero for bond listings in the UK. Column (1) presents baseline results, column (2) controls for industry effects, and column (3) additionally controls for market segment effects. In columns (4), (5) and (6) we split the sample by type of market segment into listings on RM, MTF and OTF. In columns (7), (8), and (9), we divide the sample by issuer types based on their headquarters countries, specifically categorizing issuers as EEA30, UK, and Non-European. Standard errors are clustered at issuer level. Results of chi-squared tests are prepared using seemingly unrelated estimation (SUE). The tests compare the coefficients of variable *EEA30 Market(0/1)* across the sample splits in columns (4) to (9). It assesses the statistical significance of differences observed between groups. T-values are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Detailed variable definitions can be found in Table A1 of the Appendix.

Data Appendix

Brexit and the Rise of European Corporate Bond Markets

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Appendix A: EBMD data sources

This Appendix describes the publicly available data sources used for compiling the European Bond Market Database (EBMD), which is a comprehensive database of non-financial corporate bond listings in Europe. We mostly rely on publicly available sources, conduct thorough data management and data quality checks, and then combine these sources into the EBMD. Appendix B provides details on the database's construction.

[Insert Figure A1 about here.]

Our primary data source is the Financial Instrument Reference Data System (FIRDS) published by the European Securities and Markets Authority (ESMA) (ESMA, n.d.). According to the Markets in Financial Instruments Directive (MiFID) II (2014/65/EU), each trading venue must report all listed financial instruments for each trading date from 1 January 2018 onwards. The ESMA FIRDS each day registers the information about these financial instruments listed on trading venues in the European Economic Area (EEA). The information is reported via the national competent authorities (NCA, which are the security market regulators of the EAA countries) to ESMA, which monitors data collection and publishes the data online (2017/585/EU). Figure A1 illustrates the ESMA FIRDS reporting process.

After Brexit (31 December 2020), trading venues in the UK are not required to report to ESMA anymore but instead report to the Financial Conduct Authority (FCA, 2024). Therefore, our second primary data source is the FIRDS provided by the FCA. Both registers include identical data points and the FCA continues to use ESMA's classifications for types of instruments and market segments. This allows us to combine both data sources and cover the UK trading venues also after 2020. In the following description we do not distinguish the two FIRDS sources if not explicitly necessary.

The FIRDS data is structured into full files containing current information on financial instruments and delta files containing information on deletions, modifications, or additions of financial instruments' information. We start the data downloads by obtaining data from the ESMA FIRDS's first full file published on 15 October 2017 and modify this information using the subsequent delta files.[1] We equally obtain the history of daily financial instrument data from the FCA FIRDS's first full file on 1 January 2021 and the subsequent delta files.[2]

Table A1, Panel A gives an overview of the data items available for instruments in the Classification of Financial Instruments (*CFI*) category "D". The *CFI* code consists of six alphabetical characters. The first character describes the overall category of the financial instrument that is further divided into specific groups using the subsequent characters. The *CFI* category "D" covers debt financial instruments, including corporate bonds. The unit of observation is the listing of a financial instrument on a trading venue, where the International Security Identification Number (*ISIN*) uniquely identifies a bond, the Legal Entity Identifier (LEI_{FIRDS}) uniquely identifies a bond issuer, and the Market Identifier Code (*VenueMic*) uniquely identifies a trading venue.

The FIRDS further reports the maturity (*MtrtyDt*), first trading (*FrstTradDt*) and termination date (*TermntnDt*) of a bond per trading venue. We also obtain the short description of a bond (*ShrtNm*), the nominal amount (*TtlIssdNmnlAmt*) and its currency (*NtnlCcy*), nominal value per unit (*NmnlValPerUnit*), and the debt seniority (*DebtSnrty*). *FxdIntrst* gives a fixed coupon rate, if available. In case of a floating coupon rate, the *ISIN* of the floating reference instrument (*FltgISIN*) is provided. Also, floating basis point spread (*FltgBsisPtSprd*), floating index (*FltgIndx*), floating name (*FltgNm*), floating unit (*FltgUnit*) and floating value (*FltgVal*)

[1]Example of an HTML request to receive data in JSON format from ESMA FIRDS: https://registers.esma.europa.eu/solr/esma_registers_firds_files/select?q=*&fq=publication_date:%5B2017-06-30T00:00:00Z+TO+2021-05-31T23:59:59Z%5D&wt=json&indent=true&start=0&rows=10000

[2]As the FIRDS from ESMA and FCA include identical data points, we mean both when referring to the FIRDS.

are reported. The *CmmdtyDerivInd* is an indicator that identifies commodity derivatives. The *IssrReq* is an indicator that identifies cases where an issuer requested a bond listing.

While data quality increases over time as trading venues improve their reporting, the bond listing data from the FIRDS can contain wrong, inconsistent, or missing values. We therefore perform data quality checks to remedy such inconsistencies and obtain a consistent set of characteristics per bond across the database. Specifically, we determine a bond's most current characteristics per trading venue as reported by the FIRDS-initial errors are likely to be corrected by the trading venue over time-and compare them across trading venues. We assign the characteristics to the bond that are most frequently reported across trading venues. In this way, we correct reporting inconsistencies of the following characteristics: nominal amount, currency, nominal value per unit, *CFI* code (characters 2-6), coupon rate, short description, and debt seniority.

Next, to obtain information about the trading venues, we complement the FIRDS data with data from the ESMA's *Market Register*[3] and FCA market lists[4]. We merge the two datasets using the *VenueMic* in FIRDS and the *ae_micLeiEsmaId* in the Market Register. In this way, we add information about the trading venue's name (*ae_entityName*), country (*ae_homeMemberState*), and type (*ae_entityTypeCode*). Table 1A, Panel B provides a detailed description of the Market Register's data.

[3]The Market Register refers to the MiFID/UCITS/AIFMD/TICOU entities register published by ESMA. It identifies entities by their type and covers trading venues such as RM, MTF and OTF. In addition, the Market Register covers management companies, investment firms, alternative investment fund managers, SME Growth Markets, systematic internalizer (SI) and data reporting services providers. At a point in time, ESMA only publishes active trading venues. Therefore, we stored historical information from years 2019, 2020 and 2021 and keep updating it on a regular basis. This allows us to follow location changes of trading venues. From 31 December 2020, ESMA stopped reporting information on active UK trading venues due to Brexit.

[4]The FCA publishes two lists with trading venue information. One PDF file with RM information and historical CSV files including MTF, OTFs and other types. Data points are similar to those included in ESMA's Market Register. For some trading venues the MIC code is missing which we add from the official ISO website ISO 20022 (2022).

Last, we obtain data from the Global Legal Entity Identifier Foundation (GLEIF) which allows us to reliably identify bond issuers. GLEIF provides and supports the use of the *LEI*, which identifies entities involved in financial transactions and allows identification of issuers' ownership structure (GLEIF, 2021). First, we use GLEIF's *ISIN-to-LEI Relationship files* to confirm the link between a bond and its issuer. These files include *ISIN* numbers assigned by the National Numbering Agencies (NNAs). The advantage of using the *ISIN-to-LEI Relationship files* is that the information stems from the original source that creates the *ISIN* at the request of the issuer. Second, we use GLEIF's *Golden Copy files*, which, on the first level, include data about a issuer's legal name, legal form and headquarter country, and, on the second level, contain data about the issuer's ownership structure that allow us to determine the ultimate parent of each bond issuer.

We focus on the ultimate parent of each bond as an issuer for two reasons. First, for research on corporate bonds, it is relevant to reliably identify the ultimate parent to obtain appropriate financial information. However, as noted by ESMA (2020a), trading venues were allowed to report the investment firm's *LEI,* or trading venue's *LEI* for bonds issued by non-EU issuers, in the first six months of reporting. While we expect that after June 2018 these matters should be resolved, in 2020, 1.23% of financial instruments reported in FIRDS still showed the wrong *LEI*. For bonds, wrongly reported *LEI* represents 30% of the total issued amounts. Second, in group structures, a subsidiary might issue a bond on behalf of the group. In such situations, the ultimate parent is usually the entity liable in case of default and decisions at issuance are made on consolidated financial information. Therefore, *LEI* of the ultimate parent is a more appropriate identifier of the issuer.

For each *ISIN* and accompanying *LEI* reported in FIRDS, we cross check the *LEI* reported in GLEIF's *ISIN-to-LEI Relationship files*. We either confirm that the *LEI* from FIRDS correctly identifies the issuer or, in the opposite case, take the *LEI* from GLEIF to identify the

issuer. Then, if information is available, we merge the *LEI* of the issuer to the *LEI* of the respective ultimate parent. The subsidiary-parent relationship information is obtained from GLEIF's Golden Copy files on LEI-LEI relationships. GLEIF publishes the data daily and covers changes in relationships, for example due to mergers. Such timely information is very suitable for us because ESMA also updates the FIRDS data daily. Finally, GLEIF also reports on the headquarter country of the issuer (*EntityHeadquartersCountry*).

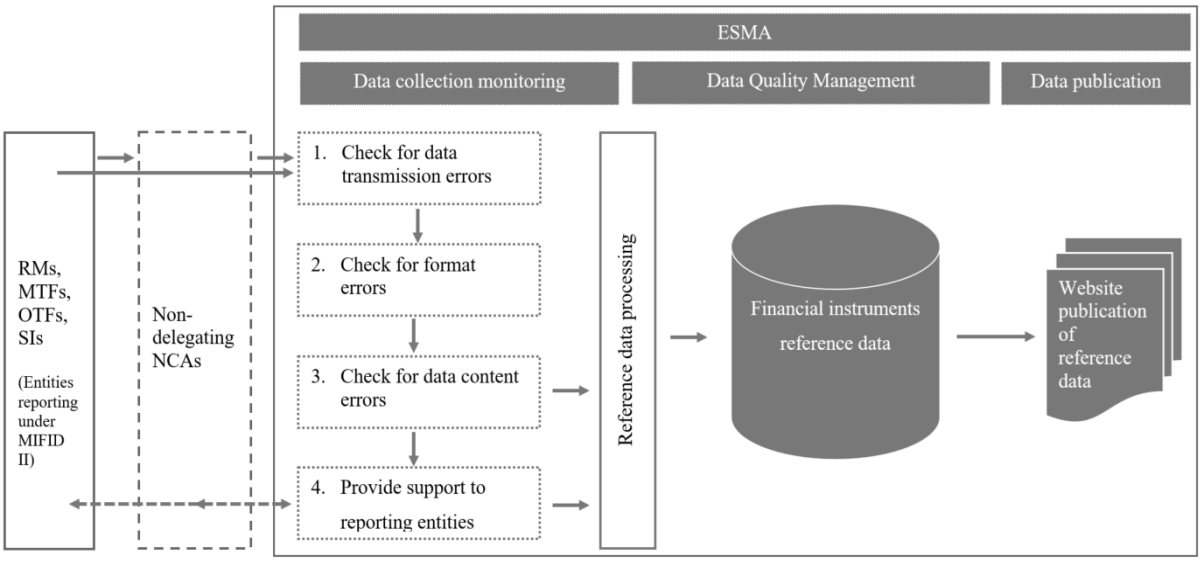

Figure A1: Data reporting process of the FIRDS and the ESMA's supervisory role.

Notes: This figure presents the data reporting process of the FIRDS and ESMA's supervisory role in the process of collecting and publishing secondary market data. Under MiFID II, trading venues in the European Economic Area (EEA) are required to report on all listed financial instruments. Trading venues are classified as regulated markets (RM), multilateral trading facilities (MTF), organized trading facilities (OTF) and systematic internalizer (SI). The trading venues report either via non-delegating national competent authorities (NCA) or directly to the ESMA. First, ESMA performs data collection monitoring which has four steps. Data obtained from steps 3 and 4 enter reference data processing. Second, ESMA performs data quality management, and the outcome is financial instruments reference data. Third, the data publication process consists of daily website publication of reference data. The graphic follows ESMA (2020b).

Table A1: Data, their description, and source

Panel A: Financial Instrument Reference Data System (FIRDS)

Variable	Description	Source
ISIN	Instrument identification code that identifies one bond.	FIRDS (ESMA/FCA)
LEI_{FIRDS}	LEI according to FIRDS (Legal entity identifier for the issuer of the instrument, as defined in ISO 17442); *Issr* in FIRDS raw data.	FIRDS (ESMA/FCA)
VenueMic	Market identifier code (MIC) of the TV in line with ISO 10383	FIRDS (ESMA/FCA)
CFI	Instrument classification code (*ClssfctnTp* in FIRDS raw data)	FIRDS (ESMA/FCA)
MtrtyDt	Maturity date of the bond.	FIRDS (ESMA/FCA)
FrstTradDt	Date of admission to trading or date of first trade of the bond.	FIRDS (ESMA/FCA)
TermntnDt	Termination date of the bond.	FIRDS (ESMA/FCA)
ShrtNm	Instrument Short Name of the bond.	FIRDS (ESMA/FCA)
NtnlCcy	National currency in which the notional amount is denominated.	FIRDS (ESMA/FCA)
CmmdtyDerivInd	Indication as to whether the financial instrument falls within the definition of commodities derivative under Article 2(1)(30) of Regulation (EU) No 600/2014)	FIRDS (ESMA/FCA)
DebtSnrty	Debt seniority category of the bond.	FIRDS (ESMA/FCA)
TtlIssdNmnlAmt	Total issued nominal amount of the bond.	FIRDS (ESMA/FCA)
TtlIssdNmnlAmt_EUR	Total issued nominal amount converted to Euro based on exchange rate on date of admission to trading or date of first trade	FIRDS (ESMA/FCA)
NmnlValPerUnit	Nominal value per unit of the bond.	FIRDS (ESMA/FCA)
FxdIntrst	Fixed coupon rate of the bond.	FIRDS (ESMA/FCA)
FltgISIN	Floating isin	FIRDS (ESMA/FCA)
FltgIndx	Floating index	FIRDS (ESMA/FCA)
FltgNm	Floating name	FIRDS (ESMA/FCA)
FltgUnit	Floating unit	FIRDS (ESMA/FCA)
FltgVal	Floating value	FIRDS (ESMA/FCA)
IssrReq	Indicator variable that takes the value of 1 if the issuer (LEI_{FIRDS}) requested the admission to trading and zero otherwise.	FIRDS (ESMA/FCA)
AdmssnApprvlDtByIssr	Date the admission to trading is approved by the issuer.	FIRDS (ESMA/FCA)
ReqForAdmssnDt	Date the request for admission to trading is made by the issuer.	FIRDS (ESMA/FCA)

[Table A1 continued]

Panel B: Market Register (ESMA MiFID/UCITS/AIFMD/TICOU entities)

Variable	Description	Source
ae_micLeiEsmaId	Market identifier code (MIC), LEI, or ESMA identifier of the trading venue	ESMA Market Register/ FCA Register Lists
ae_entityName	Name of the trading venue	ESMA Market Register/ FCA Register Lists
ae_entityTypeCode	MiFID/UCITS/AIFMD/TICOU entities: MIR: Regulated market MIT + MIE: Multilateral trading facility MIO: Organised trading facility MIF: Investment firm AIF: AIFM MIP: Approved publication arrangement MIA: Approved reporting mechanism MIS: Systematic internalizer UCI: UCITS management company	ESMA Market Register/ FCA Register Lists
ae_homeMemberState	Home member state of the trading venue.	ESMA Market Register/ FCA Register Lists

Panel C: Global Legal Entity Identifier Foundation (GLEIF)

Variable	Description	Source
LEI_{GLEIF}	Issuer legal entity identification code	GLEIF ISIN-to-LEI relationship files
ISIN	Instrument identification code in GLEIF ISIN-to-LEI Relationship files	GLEIF ISIN-to-LEI relationship files
$LEI_{GC\text{-}L1}$	Issuer legal entity identification code	GLEIF GCF - Level 1 data
LegalName	The name of the issuer.	GLEIF GCF - Level 1 data
EntityHeadquartersCountry	The headquarter country for the $LEI_{GC\text{-}L1}$	GLEIF GCF - Level 1 data
$LEI_{GC\text{-}SUB}$	Subsidiary's LEI in GLEIF GCF level 2 files (Originally: *StartNodeId*)	GLEIF GCF - Level 2 data
$LEI_{GC\text{-}UP}$	Parent's LEI in GLEIF GCF level 2 files (Originally: *EndNodeId*)	GLEIF GCF - Level 2 data
RelationshipType	Identifier for the relationship type that is either the direct, or the ultimate parent.	GLEIF GCF - Level 2 data
PeriodStartDate	The date the Relationship starts.	GLEIF GCF - Level 2 data
PeriodEndDate	The date the Relationship ends.	GLEIF GCF - Level 2 data
RelationshipStatus	Identifier for active or inactive relationship	GLEIF GCF - Level 2 data
Exception reason	The reason for not disclosing information on direct, or ultimate parent (e.g., No consolidating parent exists; Legal reasons; disseminated shareholders).	GLEIF GCF - Level 2 data

Notes: This table presents the description and source of raw data obtained from publicly available data sources, which are used for compiling the European bond market database (EBMD).

Appendix B: EBMD construction and coverage

This Appendix describes how we construct the EBMD using the datasets introduced in Appendix A. Table B1 shows the selection process of the final dataset.

[Insert Table B1 about here.]

We start by preparing the ESMA and FCA FIRDS separately. Taking all financial debt instruments (the *CFI* code category is "D"), the ESMA FIRDS includes over four million debt instruments and the FCA FIRDS nearly two million. However, the majority of these debt instruments are not classified as bonds (the *CFI* code equals "DB") and therefore excluded. From the group of bonds, we further exclude convertible bonds, bonds with warrants, bonds with a government, or state guarantee, and commodity derivatives, due to their specific features, and focus on plain vanilla bonds. We exclude bonds with a missing first trading date and without a unique last entry. This results in two prepared datasets including bond listings on European trading venues. ESMA FIRDS includes 341,296 bonds of 19,577 issuers and FCA FIRDS includes 120,707 bonds from 12,953 issuers. Next, we combine the ESMA and FCA FIRDS and drop duplicates that arise because ESMA FIRDS also covers UK trading venues until 2020. We keep the entry from the FCA FIRDS as this entry is newer and will be updated in the future. The combined sample includes 353,746 unique bonds from 19,891 unique issuers.

We use this sample and apply carefully selected data management processes and cleaning steps. We start by cross checking and correcting LEI identifiers of bond issuers based on GLEIF's *ISIN-to-LEI Relationship files* and *Golden Copy files* (as described in Appendix A). This leads to an increase in issuers (LEI codes) in the sample, as we are able to correctly identify the majority of bonds' issuers. In cases where correcting LEI identifiers is not successful, we exclude bond listings where the corresponding LEI_{EBMD} shows that the bond issuer is the market operator of the trading venue. Such inconsistencies in LEI_{EBMD} are due to

ESMA (2020) allowing trading venues to report their own (i.e., market operator's) LEI instead of the bond issuer's LEI, especially in the beginning of 2018.

Next, we keep only bond listings on the three types of trading venues defined by the EU law, i.e., regulated markets (RM), multilateral trading facilities (MFT), or organized trading facilities (OTF). Bond listings on markets of type "OTHER" are excluded. This excludes for example bond listings executed by systematic internalisers, or investment firms. 2,081 issuers have at least one bond on a market of type "OTHER". Five issuers have a bond only on market type "OTHER" and are dropped from the sample. When the issuer has bonds listed simultaneously on RM, MTF, or OTF, only the bond listing on market type "OTHER" is removed while the other bonds and bond listings of the issuer remain in the sample. The sample of bonds in FIRDS listed on European trading venues includes 727,172 bond listings (201,735 bonds listed by 20,414 issuers).

From this sample, we construct the EBMD that includes corporate bonds from 2018 onwards. We select bond listings from 1 January 2018 onwards because any listings before 2018 were reported by trading venues on a voluntary basis. The EBMD aims to offer secondary market data of corporate non-financial bonds (as opposed to bonds issued by financial institutions or governments). We identify corporate non-financial bond issuers using issuers' legal information from the Bureau van Dijk's (BvD) Orbis database. We amend the FIRDS dataset with issuers' legal information based on the LEI_{EBMD}. We use BvD Orbis, as it covers 99% of bond listings, 99% of bonds and 97% of issuers in the FIRDS dataset. We exclude bond issuers not covered by BvD Orbis. We rely on the first digit SIC code classification and exclude issuers with missing SIC code information, issuers in industry sectors 6 (finance, insurance, real estate) and 9 (public administration).

Lastly, in FIRDS the nominal amount is presented in the original currency of the bond. To make comparisons across securities possible, we convert the original nominal amount to

euro. We select the euro, as this is the currency of issuance for the majority of bonds in our dataset. We use the exchange rate on the date the bond is first listed on any trading venue. As reported in Table B1, Panel A, the final EBMD covers the period between 2018 and 2023 and includes 270,414 bond listings (relating to 44,752 unique bonds by 6,567 unique issuers).

[Insert Figure B1 about here.]

The quarterly development of bond listings, bonds and issuers covered in the EBMD is displayed in Figure B1. The EBMD reports all corporate bonds listed on a given day on the European market. Delistings and new listings of bonds influence the development and coverage of the EBMD. We observe a continuous increase in the number of bond listings from 2018 to 2023. Especially, we note that the number of bond listings increases from below 80,000 listings in 2018 to over 150,000 in 2023. After the final Brexit date in 2020 Q4 we report listings from FCA FIRDS separately. We show that the number of listings on European trading venues grows after Brexit. In contrast, the number of unique bonds decreases from over 20,000 in the first two years to roughly 15,000 in 2020 and shows only a weak upward trend afterwards. This indicates that instead of newly issued bonds being listed, the frequency of listings per bond increases (i.e., bonds are listed on average on more trading venues). The number of issuers increases in the first two years and drops substantially towards the end of 2019. We identify one MTF in the UK being responsible for terminating approximately 10,000 bonds from the market in 2019 Q4.[5]

[5]Anecdotal evidence supports the notion that market operators of trading venues list new bonds to attract investors and terminate bonds if the expected trading volume is not achieved. As the FIRDS only covers bonds that are listed on European trading venues, these bonds are not included in the EBMD anymore if they are not listed simultaneously on other venues.

Table B1 Construction of the European Bond Market Database (EBMD)

Panel A: Preparing FIRDS raw data

Preparing ESMA FIRDS raw data (2018 - 2023)	Bond listings	Bonds	Issuer
Full sample of debt securities (CFI category D in ESMA FIRDS)	7,972,499	4,102,494	27,312
- Elimination of debt securities not CFI code "DB"	-6,998,628	-3,732,179	-7,596
- Elimination of debt securities with CFI Code, indicating the bond is government guaranteed	-122,880	-28,952	-136
- Elimination of commodity derivatives	-39	-21	0
- Elimination of debt securities with missing first trading date	-72	-46	-3
- Elimination of debt securities with no unique last entry in ESMA FIRDS	-1	0	0
	850,879	341,296	19,577

Preparing FCA FIRDS raw data (2021 - 2023)	Bond listings	Bonds	Issuer
Full sample of debt securities (CFI category D in FCA FIRDS)	4,360,399	1,882,818	19,291
- Elimination of debt securities not CFI code "DB"	-3,619,440	-1,752,416	-6,215
- Elimination of debt securities with CFI Code, indicating the bond is government guaranteed	-106,375	-9,648	-120
- Elimination of commodity derivatives	-4	-2	0
- Elimination of debt securities with missing first trading date	-73	-45	-3
- Elimination of debt securities with no unique last entry in FCA FIRDS	0	0	0
	634,507	120,707	12,953

Combining ESMA and FCA FIRDS data	Bond listings	Bonds	Issuer
ESMA FIRDS	850,879	341,296	19,577
FCA FIRDS	634,507	120,707	12,953
Combined data	1,485,386	462,003	32,530
Elimination of duplicate entries (listings on UK venues before 2022 reported by ESMA FIRDS)	-549,735	-108,257	-12,639
Combined FIRDS bond data	935,651	353,746	19,891
FCA FIRDS (prev. ESMA FIRDS)	549,735	105,300	12,439
ESMA FIRDS	301,144	251,858	12,840
FCA FIRDS	84,772	40,842	5,900
Correcting LEI information			
Correcting reported LEI information using GLEIF data*	-	-	528
- Elimination of bond listings by market operators**	-185,403	-138,371	-
	750,248	215,375	20,419
- Elimination of bond listings not on trading venues (RM, MTF or OTF)***	-23,076	-13,640	-5
Sample of bonds in FIRDS listed on European trading venues	727,172	201,735	20,414

Panel B: Construction of the EBMD

	Bond listings	Bonds	Issuer
Sample of bonds in FIRDS listed on European trading venues	727,172	201,735	20,414
- Elimination of bond listings before 1 January 2018	-16,991	-2,131	-2,375
- Elimination of issuers not in BvD Orbis	-8,399	-2,950	-596
- Elimination of issuers with missing SIC code	-50,710	-17,337	-2,916
- Elimination of issuers classified as financial institutions (by SIC code 6)	-365,012	-131,270	-7,676
- Elimination of issuers classified as government entities (by SIC code 9)	-15,646	-3,295	-284
Total observations in EBMD (corporate bonds in FIRDS on European trading venues)	270,414	44,752	6,567

Notes: This table describes the steps taken to construct the EBMD.
*We use information from GLEIF's ISIN-to-LEI Relationship files and Golden Copy Relationship files to identify the correct parent issuer LEI. This adds new LEI codes to the sample, resulting in a change of the total number of LEI codes in the sample.
**We exclude bond listings where the market operator is named as issuer of the bond, as the correct issuer cannot be identified. The market operators are not included in the issuer count.
***Bond listings on markets of type "OTHER" are excluded. This excludes for example bond listings executed by systematic internalisers, or investment firms. 2,081 issuers have at least one bond on a market of type "OTHER". Five issuers have a bond only on market type "OTHER" and are dropped from the sample. When the issuer has bonds listed simultaneously on RM, MTF, or OTF, only the bond listing on market type "OTHER" is removed while the other bonds and bond listings of the issuer remain in the sample.

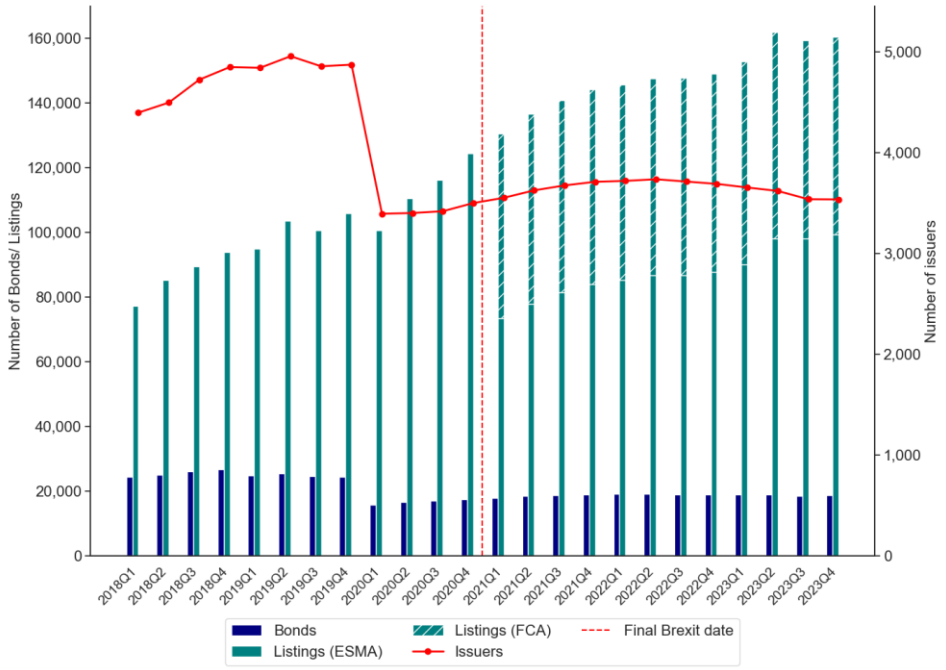

Figure B1: Development of bond listings, bonds, and issuers covered in the EBMD.

Notes: This figure shows the development of the number of bond listings, bonds, and issuers between 2018 and 2023 included in the EBMD. One bond listing is defined as one bond being listed on one trading venue. Bonds can be listed on several trading venues. Issuers are non-financial corporations that have a bond listed on a European trading venue. See appendix B for a description of the EBMD construction.

Appendix C: Trading venues covered in the EBMD

The EBMD includes corporate bonds listed on the three types of European trading venues, RM, MTF and OTF. We include trading venues in the EBMD that during any point in our time period have a corporate bond listed. Thus, the number of trading venues reduces during the construction of the EBMD.

[Insert Table C1 about here.]

In Table C1 we show during which steps of the EBMD's construction, trading venues are excluded from the database. Starting with the ESMA FIRDS, of the total of 312 trading venues[6], 40 trading venues are excluded, as they do not have any bonds (identified by *CFI* code DB) listed. Further, 22 trading venues are excluded, when we exclude bonds with a government guarantee. The FCA FIRDS includes 323 trading venues, of which 44 are excluded as they do not have bonds listed and 22 as the bonds listed are government guaranteed. After combining both data sources and excluding duplicates, 260 trading venues remain.

We exclude another 4 trading venues, as the bonds on these venues were listed by market operators (ESMA, 2020a). Then, 29 trading venues are not of type RM, MTF, or OTF and consequently dropped. Of the remaining 227 trading venues, five venues report bonds only before 2018 and one venue is excluded when selecting only issuers included in BvD Orbis. Lastly, 71 trading venues drop when eliminating bonds issued by firms with missing SIC code, SIC code 6 or 9. This is not surprising, as bonds by financial institutions and government entities make up a large part of bond listings in the European market. Some trading venues are specialized in offering bonds by these issuer groups and do not cover non-financial issuers. The EBMD includes 150 trading venues in 31 countries.

[6]Of the 503 trading venues included in ESMA's *Market Register,* 296 have debt listings. A large number of trading venues specializes in other types of securities (e.g., equities, structured products, or derivatives).

[Insert Table C2 about here.]

In Table C2, we compare the number of trading venues reported in FIRDS and those included in the EBMD by country. EBMD includes trading venues that have corporate bonds listed. In other words, we show how many trading venues in a country that offer debt securities also offer corporate bonds. We show that from the total sample of European trading venues targeting debt securities, over 50% offer corporate bonds. In Germany, 22 of 36 trading venues are included in the EBMD. We note that in Germany corporate bonds are listed primarily on MTF (coverage of over 90%), while only on a quarter of RMs has corporate bonds. In the UK, the EBMD includes 35% of trading venues while the share of MTFs and OTFs is also larger than that of RMs. We cover almost half of all Dutch trading venues, with two out of three RMs and OTFs and five out of 14 MTFs.

[Insert Figure C1 about here.]

In Figure C1, we report on the coverage of the EBMD, which catalogues trading venues across Europe engaged in the listing of corporate bonds, segmented into RM, MTF, OTF. Spanning from 2018 to 2023, the database reflects the dynamic nature of the market, capturing the emergence of new venues and the closure of existing ones. We observe an increase in the total number of trading venues, from 103 in 2018 to 123 by 2023. The MTF segment constitutes the majority of trading venues, exceeding 60 in most years, likely due to the segment's more lenient regulatory environment. Meanwhile, the RM and OTF segments see 31 to 36 and up to 21 venues reporting, respectively. Following Brexit in 2020, the UK's trading venues transitioned from ESMA to FCA oversight. The post-Brexit composition shows a significant proportion of MTFs (about 20%) and OTFs (around 50%) located in the UK, with a relatively small number of RMs. This distribution suggests that Brexit's repercussions could have a more pronounced effect on the MTF and OTF segments compared to RMs.

Table C1: Trading venue coverage

Panel A: Preparing FIRDS raw data

Preparing ESMA FIRDS raw data (2018 - 2023)	Trading venues
Full sample of debt securities (CFI category D in ESMA FIRDS)	312
- Elimination of debt securities not CFI code "DB"	-40
- Elimination of debt securities with CFI Code indicating that the bond is government guaranteed	-22
- Elimination of commodity derivatives	0
- Elimination of debt securities with missing first trading date	0
- Elimination of debt securities with no unique last entry in ESMA FIRDS	0
	250

Preparing FCA FIRDS raw data (2021 - 2023)	Trading venues
Full sample of debt securities (CFI category D in FCA FIRDS)	323
- Elimination of debt securities not CFI code "DB"	-44
- Elimination of debt securities with CFI Code indicating that the bond is government guaranteed	-22
- Elimination of commodity derivatives	0
- Elimination of debt securities with missing first trading date	0
- Elimination of debt securities with no unique last entry in FCA FIRDS	0
	257

Combining ESMA and FCA FIRDS data	Trading venues
ESMA FIRDS	250
FCA FIRDS	257
Combined data	507
Elimination of duplicate entries (listings on UK venues before 2022 reported by ESMA FIRDS)	-247
Combined FIRDS bond data	260
Correcting LEI information	
Correcting reported LEI information using GLEIF data*	-
- Elimination of bond listings by market operators**	-4
	256
- Elimination of bond listings not on trading venues (RM, MTF or OTF)***	-29
Sample of bonds in FIRDS listed on European trading venues	227

Panel B: Construction of the EBMD

Sample of bonds in FIRDS listed on European trading venues	227
- Elimination of bond listings before 1 January 2018	-5
- Elimination of firms not in BvD Orbis	-1
- Elimination of firms with missing SIC code	-2
- Elimination of firms classified as financial institutions (by SIC code 6)	-43
- Elimination of firms classified as government entities (by SIC code 9)	-26
Total observations in EBMD (corporate bonds in FIRDS on European trading venues)	150

Notes: This table presents the coverage of trading venues during the sample selection process.

Table C2: Comparison of number of trading venues in the ESMA and FCA market registers and EBMD

Market segment / Country of the trading venue	Total		RM		MTF		OTF	
	Market register	EBMD	Market register	EBMD	Market register	EBMD	Market register	EBMD
Austria	3	3	2	2	1	1	0	0
Belgium	7	4	1	1	6	3	0	0
Bulgaria	5	3	2	2	3	1	0	0
Croatia	2	1	1	1	1	0	0	0
Cyprus	2	1	1	0	1	1	0	0
Czech Republic	5	3	2	1	2	2	1	0
Denmark	2	2	1	1	1	1	0	0
Estonia	2	2	1	1	1	1	0	0
Finland	2	2	1	1	1	1	0	0
France	20	14	1	1	11	6	8	7
Germany	36	22	17	5	19	17	0	0
Greece	3	2	2	1	1	1	0	0
Hungary	2	1	1	0	1	1	0	0
Iceland	2	1	1	1	1	0	0	0
Ireland	6	4	1	1	5	3	0	0
Italy	17	8	5	1	12	7	0	0
Lichtenstein	0	0	0	0	0	0	0	0
Latvia	2	2	1	1	1	1	0	0
Lithuania	2	2	1	1	1	1	0	0
Luxembourg	2	2	1	1	1	1	0	0
Malta	3	3	2	2	1	1	0	0
Netherlands	20	9	3	2	14	5	3	2
Norway	2	1	2	1	0	0	0	0
Poland	6	4	3	2	3	2	0	0
Portugal	2	2	1	1	1	1	0	0
Romania	2	2	1	1	1	1	0	0
Slovakia	1	1	1	1	0	0	0	0
Slovenia	2	1	1	1	1	0	0	0
Spain	11	7	5	3	3	2	3	2
Sweden	6	3	2	2	4	1	0	0
United Kingdom	105	38	6	1	73	22	26	15

Notes: This table presents a comparison of the number of trading venues from ESMA's and FCA's Market Register and the EBMD, by trading venue country. We provide details for the trading venues of type RM, MTF, and OTF, as these market segments are included in the EBMD. The market register includes all trading venues reported by ESMA and FCA. The EBMD includes a subsample of trading venues having corporate bonds listed according to the EBMD's construction steps shown in Appendix B, Table B1, Panel A.

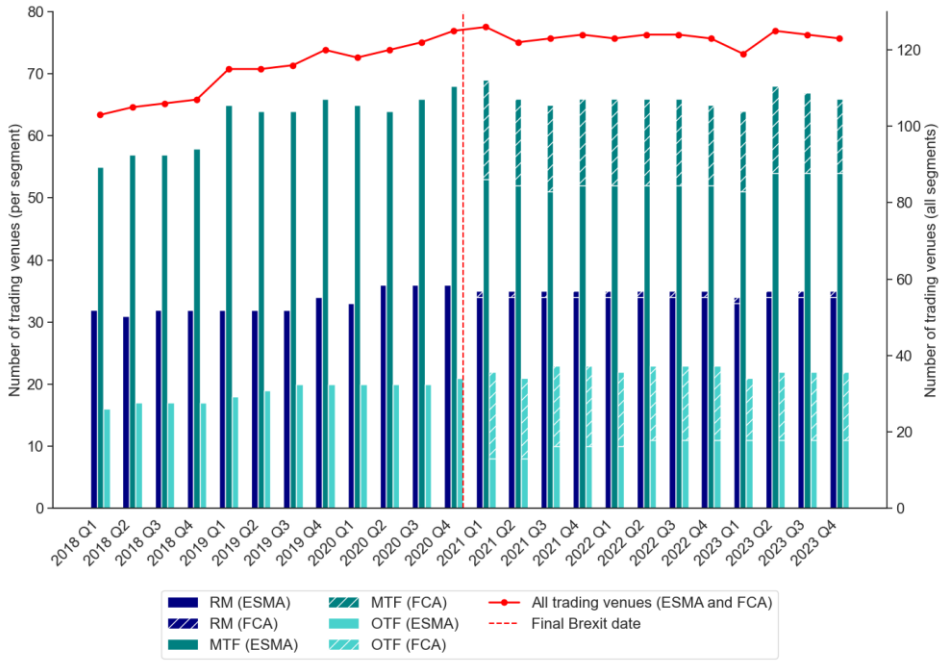

Figure C1: Development of trading venue coverage in the EBMD.

Notes: This figure reports the number of trading venues in the EBMD by market segment between 2018 and 2023. Trading venues are categorized by segment into RM, MTF and OTF. A trading venue is included in the EBMD if on a given day there one corporate bond is at least reported to FIRDS. See appendix B for a description of the EBMD construction.

Appendix D: Verification of EBMD coverage

We assess the coverage of bonds reported in the EBMD against the listings published on the Vienna Stock Exchange (Vienna SE) website[7]. This comparison helps verify the accuracy of the data management processes used to compile the EBMD from the initial FIRDS data. We specifically choose the Vienna SE for this analysis because, to our knowledge, it is the only stock exchange that provides historical lists of corporate bonds on its website. The Vienna SE annually publishes a list of primary corporate bond listings at each year's end and issues monthly lists of newly admitted bonds. However, these monthly listings encompass all bond types, not just corporate bonds. To assess the coverage, we use the list of all corporate bonds reported by the Vienna SE as of 31 December 2017 and supplement this with bonds from the monthly reports of newly admitted bonds from January 2018 to December 2021. Then, we utilize a subsample of the EBMD that includes bonds listed on the Vienna SE from 2018 to 2021.[8]

[Insert Table D1 about here.]

For the comparison we combine bonds included in any of the two sources (Vienna SE list and EBMD) and create a comprehensive list of bonds listed on the Vienna SE. Table D1 compares the number of bonds reported in the EBMD and those listed by the Vienna SE for a subsample period from 2018 to 2021, both before and after applying the sample selection steps detailed in Appendix B. Before sample selection, the EBMD dataset includes all types of debt securities, not just corporate bonds, while after sample selection, only corporate bonds identified through the EBMD filtering process remain.

[7]The list can be obtained at https://www.wienerborse.at/listing/anleihen/gelistete/neue-und-bestehende/ (accessed 5 June 2023).
[8]We rely on data from an earlier version of the EBMD that ended in 2021. The only changes that were made was adding data for additional years and adding data from the UK. The data for Vienna SE is not affected by those changes. Therefore, this subsample is still suitable to evaluate the EBMD's coverage.

Before sample selection, the total number of bonds across both datasets amounts to 24,901. The majority (52%) are reported exclusively in the EBMD, reflecting its broader initial scope, which includes various types of debt securities. Almost half (47%) of the bonds appear in both the EBMD and the Vienna SE dataset, confirming a significant overlap. In contrast, only 1% of bonds are reported solely by the Vienna SE. This low number strengthens confidence in the EBMD dataset, as it suggests that very few corporate bonds are missing from it. A closer inspection reveals that many of the bonds found only in the Vienna SE dataset are classified in the EBMD as structured products (CFI codes "EY" or "EM"), which are excluded from the final EBMD sample, as it focuses on plain vanilla bonds.

After applying the sample selection criteria, the number of bonds in the EBMD dataset drops significantly, narrowing the focus to corporate bonds. The final EBMD dataset contains 317 bonds, of which 83% are also reported in the Vienna SE list. This increase in overlap is expected, as the sample selection process removes non-corporate bonds, aligning the EBMD dataset more closely with the Vienna SE's focus. Only 17% of corporate bonds remain uniquely identified in the EBMD but are not found in the Vienna SE list. This further supports the comprehensiveness of the EBMD dataset in capturing corporate bond listings, as it provides a more extensive record than relying solely on manually collected stock exchange data. For the subsample of bonds listed exclusively by the Vienna SE, we are unable to assess the impact of the sample selection process, due to missing necessary data points. However, since the majority of these bonds carry a different CFI code that would lead to their exclusion from the sample under our criteria, the overall effect of this omission is likely to be negligible

Overall, this comparison confirms that the EBMD is a reliable and comprehensive source for analyzing corporate bond markets. The post-selection overlap of 83% indicates high alignment with the Vienna SE dataset, while the presence of additional bonds in the EBMD

suggests it captures a broader set of corporate bonds than the Vienna SE's manually curated lists.

Table D1: Comparison of the number of bonds reported by EBMD and Vienna SE

	(1)		(2)		(3)		(4)	
	EBMD		Vienna SE		EBMD and Vienna SE		Overall sum	
	Bonds (#)	%	Bonds (#)	%	Bonds (#)	%	Bonds (#)	%
Before sample selection steps	12,959	52.0	316	1.0	11,626	47.0	24,901	100.0
After sample selection steps	54	17.0	-	-	263	83.0	317	100.0

Notes: This table presents a comparison of bond listings between the EBMD and the Vienna SE for the period from 2018 to 2021. The first row details the listings before the implementation of sample selection steps, outlined in Appendix B. The second row shows the results after applying these sample selection procedures to both the EBMD data and the data from the Vienna SE list. Column (1) displays the number of bonds reported exclusively in the EBMD, while column (2) shows those reported only in the Vienna SE list. Bonds that appear in both the EBMD and Vienna SE list are captured in column (3). The totals for the number of bonds from these three categories are summed in column (4) to provide an overall count. For each group we present the absolute number of bonds (bonds (#) and the percentage to the overall sum.

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Lighting the Green: The Role of Green Bond Sections in the European Market*

Pia Stoczek†

Abstract

This study analyzes the role of green bond sections (GBS) in the European corporate bond market, focusing on whether they can assist investors in addressing greenwashing challenges. The listing on a GBS is tied to requirements relating to textual disclosures and external review mechanisms. Arguably, the listing signals that the green bond adheres to those requirements whose compliance is monitored by the trading venue operator, thereby reducing information asymmetry. Thus, this study investigates the relationship between listing a corporate green bond on a GBS and information asymmetry proxied with the bid-ask spread. Findings show that the listing on GBS is, on average, associated with reduced information asymmetry. Further, the association is more pronounced for bonds that are smaller, unrated or high yield, as well as bonds on GBS with higher listing requirements. Lastly, the study provides evidence for a relationship not mediated by textual disclosure characteristics. The study contributes to the ongoing debate about harmonizing requirements in the green bond market.

Keywords: Green bonds, Liquidity, Green bond sections, Disclosure, Climate finance

***JEL classification**s: G12, G15, Q56*

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1 INTRODUCTION

"Stock exchanges play a pivotal role in bringing together issuers and investors and can drive the development of sustainable market-based solutions."
(High-Level Expert Group on sustainable finance, 2017)

The green bond market is widely recognized as a pivotal element in securing long-term financing that is critical for transitioning towards a sustainable economy (OECD, 2017). Broadly, the term green bond refers to use-of proceeds debt instruments with the specific purpose of financing sustainable (or green) investments. Although the corporate green bond market[1] in Europe has expanded considerably, growing from below 500 green bond listings in 2018 to over 4,000 in 2023[2], it confronts a number of challenges. Among these are the lack of a universally accepted definition of what qualifies as "green" and the absence of standardized global regulations (Deschryver & Mariz, 2020). Consequently, investors encounter adverse selection when trying to differentiate truly green bonds from greenwashed ones. This difficulty in verifying the environmental integrity of green bonds is what I term investors' "greenwashing challenge". As a response, the market has seen the emergence of different mechanisms to support investors by verifying the voluntary disclosures and environmental benefits of the bond.

In this study, I analyze the role of green bond sections (GBS) introduced on trading venues[3] across Europe to support green bond investors with their greenwashing challenge by reducing information asymmetry. With the aim of promoting green bonds, Oslo Boers was the first trading venue operator to launch a dedicated GBS in 2015. Supported by the UN's Sustainable Stock Exchanges Initiative (SSE), several European trading venues followed their lead (e.g., Luxembourg Stock Exchange (LuxSE)), to accelerate the growth of the green bond market. They started to develop green bond guidelines, promote transparency, foster market

[1]This study focuses on the corporate green bond market, where "corporate" refers to non-financial firms.
[2]Own calculation based on data from the European Bond Market Database (EBMD) and LSEG.
[3]Trading venues are regulated and authorized marketplaces where securities are traded.

education as well as dialogue and collaboration with market participants (SSE, 2017). The green bonds by Evonik are for example listed on the "Luxembourg Green Exchange", the GBS of LuxSE.

This study investigates whether corporate green bonds listed on a GBS exhibit lower information asymmetries than those not listed on a GBS. The listing on a GBS is tied to a set of requirements relating to textual disclosures and external review mechanisms set by the trading venue. These can include, for example, publishing a green bond framework or obtaining a second-party opinion (SPO). Thus, the listing on a GBS could signal to investors that the green bond adheres to specific requirements monitored by the trading venue. If the listing supports investors with their greenwashing challenge and reduces information asymmetry, this should be reflected in higher liquidity (Diamond & Verrecchia, 1991). However, most investors are institutional and might not need an additional signal or rely on the monitoring capabilities of trading venues. Consequently, whether the listing on a GBS reduces information asymmetry is an empirical question that has not been investigated previously.

To investigate this question, I conduct a comprehensive analysis using data at the trading venue level from the European Bond Market Database (EBMD), developed by Franke et al. (2025). This dataset is enhanced by integrating commercial data on corporate green bonds from the London Stock Exchange Group (LSEG), alongside issuer financial data sourced from Orbis. Additionally, I augment the dataset with two types of manually collected information to provide a richer analysis context. First, I meticulously gather details on which trading venues include a GBS, focusing on the specific disclosure requirements imposed. This allows me to differentiate the level of the imposed disclosure requirements on GBS. Second, I hand-collect data on textual disclosures and external review mechanisms directly at the bond level. My final dataset comprises 12,379 bond-month observations amounting to 482 corporate green bonds by 221 corporate issuers between 2018 and 2023.

I use the bid-ask spread to proxy for information asymmetries. If GBS support investors with their greenwashing challenge and reduce information asymmetries, this should be reflected in lower bid-ask spreads on the secondary market (Copeland & Galai, 1983; Dorfleitner et al., 2023; Glosten & Milgrom, 1985; Lebelle et al., 2022). To identify bonds listed on a GBS, I rely on the primary trading venue of the bond. I identify this venue in three steps, considering the issuer's involvement in the listing and the earliest listing date. Furthermore, I classify bonds as listed on a GBS from the month when the primary trading venue officially introduces the GBS. Hence, I construct a binary indicator to compare bonds listed on a GBS in a given month to those not listed on a GBS.

Relying on a linear regression model, I begin by investigating the association between the listing on a GBS and the bid-ask spread. The results show that the listing on a GBS is on average associated with a reduction in the bid-ask spread by 0.09 to 0.13 percentage points, depending on the specification, compared to the base group of bonds not listed on a GBS. At the lower bound, this translates into an economically meaningful reduction of 14% compared to the sample mean. This primary finding indicates that GBS can be useful to reduce information asymmetry and support investors with their greenwashing challenge. Next, I investigate whether the association is equally pronounced for bonds generally characterized by higher versus lower information asymmetries. I conduct analyses on two distinct sample splits: comparing large versus small bond issues, and investment grade (IG) bonds against high yield (HY) and unrated bonds. The results are consistent across both comparisons. The findings indicate that GBS are associated with a significantly higher average reduction in information asymmetries for smaller bond issues. Additionally, the group comprising HY and unrated bonds exhibited a larger average reduction in information asymmetries. However, this difference was not statistically significant when compared to the reduction observed in IG bonds.

Second, as the GBS vary with respect to their disclosure requirements, I construct a disclosure score to measure the level of requirements. I use this score to divide GBS into those with higher and lower requirements. Thus, I expect the association to be on average more negative for GBS with high disclosure requirements compared to those with low requirements. I split the GBS indicator into a high and low indicator and compare them to the baseline group of no GBS. I find a significantly negative association between GBS listing and information asymmetries for high and low sections. The association is significantly stronger for the high GBS group, confirming the notion that higher requirements can reduce information asymmetries significantly more. After adding controls, the low GBS coefficient is insignificant.

Lastly, I provide evidence on the use of disclosure characteristics and external review mechanisms of corporate green bonds for the European market. I find generally high use of green bond frameworks and at-issuance external reviews, both of which are forward-looking formats. Also, post-issuance reporting, that shows the actual state of the investment, is provided for over 65% of bonds. Results from two-sided t-tests support the notion that bonds on GBS provide on average more often a framework and external reviews. Further, I find that the textual disclosures are on average easier to comprehend, captured by the commonly used Gunning Fog Index. Lastly, I find that textual disclosures are on average longer. I use the readability measure for the framework and green bond report and the average length of the textual disclosures to conduct a mediator analysis. With this analysis, I investigate whether the direct association between listing on GBS and reduced information asymmetries is mediated by a change in the characteristics of the textual disclosures. On the one hand, an observed mediating relationship could provide evidence that the GBS listing influences textual disclosure characteristics. On the other hand, not observing a relationship could strengthen the notion that it is indeed the listing itself that is relevant to investors. My findings provide no evidence for a mediating relationship. This is in line with a direct relationship between the GBS listing and the reduction of

information asymmetries, acknowledging that there might be other factors mediating the relationship.

Firstly, my study contributes to the understanding of the mechanisms used to support investors with their greenwashing challenge that are pertinent to market growth (Dinh et al., 2023; Dorfleitner et al., 2023; Lebelle et al., 2022). Dinh et al. (2023) provide evidence that external reviews serve as governance mechanisms to mitigate greenwashing risks. The authors also show that at-issuance, external reviews in the form of SPO are not related to the investment greenness of the bond, while certifications are, though they are noted to be underutilized in the market. Lu (2023) is the only study that considers stock exchanges with GBS and argues that next to external reviews, they can act as a commitment device, however, not investigating any pricing implications. Lebelle et al. (2022) show that the readability of issuance disclosure is related to lower information asymmetries for a sample of international equity-listed issuers. In their 2023 study, Dorfleitner et al. study the relationship between the characteristics of at-issuance external reviews and information asymmetry using different proxies for liquidity for a mixed sample with primarily municipal and rated issuers. The authors call for more extensive research on the factors that may affect green bond liquidity. This study explores how an external party, like the trading venue operator, that sets disclosure requirements and monitors adherence can assist investors in addressing their greenwashing challenges. By studying the listing on a GBS, I provide novel evidence of how trading venue operators contribute to reducing information asymmetries.

Secondly, by incorporating the different levels of disclosure requirements into the analysis, I provide evidence that a higher regulated environment can counteract investors greenwashing challenges and foster market development. This is particularly interesting in times when regulators such as the European Union (EU) plan to introduce new standards for green bonds (e.g., the European Green Bond Standard) but keep them voluntary. Previous

evidence suggests a link between the disclosure requirements on stock exchanges and financial market development (Frost et al., 2006). However, there is no evidence for bond markets or non-financial reporting. Deschryver and Mariz (2020), using survey data, particularly identify the lack of harmonized global standards and the risk of greenwashing as some of the barriers that hinder green bond market growth. The discussion by Brückbauer et al. (2023) highlights the heterogeneity in current practices by external parties such as SPO providers and across the currently used standards (e.g., the standard by the International Capital Markets Association (ICMA)). This evidence complements existing research by highlighting the active role of trading venue operators in facilitating transparency. My findings suggest that while harmonizing green bond reporting could be beneficial, adding more voluntary standards might not be the ideal approach. Instead, market participants may prefer a more formalized mechanism, one that the primary venue of the green bond currently provides.

Lastly, I provide new insights into corporate green bond's textual disclosures and external review mechanisms on the European market. By investigating the mediating role of the textual disclosure's readability, I contribute more broadly to studies investigating the relation between textual characteristics and information asymmetry (Debener et al., 2023; Lang & Stice-Lawrence, 2015; Li, 2008). For example, Debener et al. (2023) provide evidence that prospectuses' textual quality and quantity affect the pricing of asset-backed securities. Their evidence suggests that investors prefer standardized and short prospectuses.

The paper proceeds as follows. Section 2 outlines the hypothesis. Section 3 provides institutional details while section 4 presents the methodology, data and sample. Section 5 provides the tests on the relationship between GBS listing and information asymmetries. Section 6 provides descriptives on the disclosure characteristics and the mediator analysis. Section 7 concludes.

2 HYPOTHESIS DEVELOPMENT

Investors in the corporate green bond market frequently encounter adverse selection, stemming from issues related to accurately assessing the environmental benefits of the bonds. Even institutional investors face these greenwashing challenges due to disclosures being voluntary and issuers having difficulties to credibly signal their commitment to transparent reporting standards (Berg et al., 2022; Pope et al., 2023). Previous literature establishes a link between information asymmetries and liquidity, where a reduction in information asymmetries leads to an increase in liquidity (Glosten & Milgrom, 1985). In particular, disclosure of public information should reduce information asymmetries and thus be reflected in higher liquidity (Diamond & Verrecchia, 1991).

The listing on a GBS potentially signals that green bonds adhere to certain disclosure standards and hence relates to reduced information asymmetries. This is achieved through standardized and transparent listing criteria and the monitoring role of the trading venue operator. Primarily, inclusion in a GBS signals compliance, indicating that the green bond aligns with prevailing market standards. Furthermore, such listing may also signal the existence of continuous, environmental reporting, as the costs of non-compliance increase. Venue operators act as monitors and non-compliance could, in the worst case, lead to a de-listing[4]. This can reduce information asymmetries because investors can make better informed decisions and thus might be more willing to allocate capital towards green bonds listed on a GBS.

Thus, I hypothesize that a GBS listing is, on average, associated with a reduction in information asymmetries. Nonetheless, the extent of disclosure requirements varies across different GBS, with some having minimal or no stipulations. Consequently, I propose that the association between GBS listing and reduced information asymmetries will be more

[4]A number of trading venues list this option on their website. See for example the guidelines of Vienna stock exchange at https://www.wienerborse.at/listing/anleihen/vienna-esg-segment/.

pronounced in contexts where GBS impose higher disclosure requirements, thereby strengthening the credibility of the assessment.

However, a reduction in information asymmetries hinges on investors rendering the listing as an informative signal. Corporate green bonds that are publicly traded might already be transparent and have an investor base that they are catering to. Thus, the GBS listing may not provide any new information. Moreover, the independence of trading venue operators is subject to debate as they face competition among themselves and create revenues from listing fees and increased trading activity associated with bond listings (Amira & Muzere, 2011). Thus, whether the listing on a GBS is associated with a reduction in information asymmetries is an empirical question.

Lastly, it remains to be examined how the GBS is associated with a reduction in information asymmetries. One explanation is that the GBS is associated with characteristics of green bond textual disclosures. Through knowledge diffusion, the trading venue operator might influence textual disclosures of the green bonds, thereby leading to a reduction in information asymmetries. Oslo Boers, for example, offers courses and seminars on ESG topics (Oslo Boers, 2025). Thus, I formulate my main hypothesis as follows:

Hypothesis: *The listing of a corporate green bond on a GBS is, on average, associated with a reduction in information asymmetry.*

3 INSTITUTIONAL DETAILS

GBS are specialized sections designated for green bonds. Oslo Boers was the first trading venue operator to introduce a GBS in 2015. Since then, several operators across the European market followed, such as Luxembourg stock exchange, Vienna stock exchange or the Frankfurt stock exchange. These sections underscore the market's dedication to sustainable finance and should enhance the access to green bonds, thus attracting a wider array of investors who prioritize

environmental impact. After a green bond is issued it can be listed on a trading venue for trading in the secondary market. In order to be placed on a GBS, the green bond has to be listed on a trading venue of type regulated market (RM) or multilateral trading facility (MTF).[5] Essentially, a GBS is a dedicated list on the trading venue's website, where green bonds are listed that fulfill specific requirements. Thus, the GBS does not constitute a separate trading venue.

The requirements for listing on GBS include at-issuance and post-issuance textual disclosures and the use of external review mechanisms established by the market. Importantly, requirements are set by the trading venue operator and can vary across GBS. Further, the required documents can be published on the GBS, or a link to the issuer website can be provided. Some trading venues also have an exclusion clause when requirements are not met.

[Insert Figure 1 about here.]

Figure 1 depicts the timeline for publication of documents around the green bond issue (at-issuance) and when green bond proceeds are invested (post-issuance). First, before the bond's issuance, a framework (GBF) can be published under which all future green bonds fall. The framework can be aligned with green bond standards or guidelines such as ICMA's Green Bond Principles (GBP), or the Climate Bond Standard (CBS) by the Climate Bonds Initiative (CBI). This alignment can be externally reviewed and confirmed by a SPO. Further, a use-of proceeds certification provided by the CBI can be obtained for the bond. This certifies that the investments are consistent with the 1.5°C limit in the Paris agreement. Second, a green bond report can be published after the issuance that includes information on the allocation of the green bond proceeds and the environmental impact of the financed projects. The supplementary materials provide an example for an allocation and impact report. The green bond report can be

[5]I refer to Franke et al. (2025) for a detailed outline of the differences between the trading venue segments.

assured by a third-party. This assurance can take the form of a limited assurance or reasonable assurance, where a reasonable assurance is more comprehensive.

4 METHODOLOGY AND DATA

4.1 Identification of primary trading venue

To investigate the association between the listing of a corporate green bond on a GBS and information asymmetries, I identify the primary trading venue of the bond. My assumption is that any information provided by the primary venue-i.e., the primary venue's GBS-is most relevant to the investors. The primary venue's importance is underscored by literature on investors' home bias, which suggests that investors prefer securities within familiar contexts and regulatory frameworks (Krebbers et al., 2022; Obstfeld & Rogoff, 2000; Oehler et al., 2008; Van Campenhout & Vanpée, 2017). Based on whether the primary venue has a GBS, bonds are split into two groups.

[Insert Figure 2 about here.]

The process for identifying the primary trading venue is illustrated in Figure 2 and involves three steps, considering both the issuer's actions and the timing between the issue date and the listing date. First, I consult the EBMD, which includes an indicator variable (*IssrReq*) that denotes whether the issuer requested a listing on the trading venue. If this indicator is present, I designate that venue as the primary one. Next, I compare the issue date with the listing dates across venues. A venue whose listing date matches the issue date is selected as the primary venue. If the above criteria do not clearly identify a primary venue, I then select the venue that has the earliest listing date as the primary venue. It is important to note that I only consider whether a bond is initially listed on a GBS, ignoring any subsequent listings on GBS. This approach relies on the investors' focus on the primary venue. This approach should bias the

estimates against finding any effect when majority of bonds are listed on any GBS, although not the "primary" one.

4.2 Measuring information asymmetries

Previous literature addresses the relationship between information asymmetries and the liquidity of a traded security (Copeland & Galai, 1983; Diamond & Verrecchia, 1991; Glosten & Milgrom, 1985). The consensus is that a reduction in information asymmetries translates into an increase in the securities liquidity. I proxy information asymmetries with the relative bid-ask spread. This is a price-based measure, where narrower spreads indicate higher liquidity (Hameed et al., 2019). Hong and Warga (2000) find the bid-ask spread to be suited as a measure of liquidity. However, I acknowledge that there are concerns that price-based measures might not be a good proxy for liquidity in illiquid markets (Hameed et al., 2019). The measure might also capture an increase in visibility and a broader investor base, a potential confounding factor that I cannot control for. Still, the measure has been used in previous studies on green bonds as a proxy for information asymmetries and results coincided with other liquidity measures (Dorfleitner et al., 2023; Lebelle et al., 2022).[6]

I calculate the bid-ask spread based on the monthly average of daily bid-ask spreads. I use daily quoted bid and ask prices to calculate the daily mid-price as follows:

$$MidPrice_{i,d} = \frac{AskPrice_{i,d} + BidPrice_{i,d}}{2}$$

Then, I use the mid-price to calculate the daily spread and finally the average monthly $BA\ spread_{it}$ for bond i in month t. For ease of interpretation of the results, I multiply the average monthly spread by 100:

[6]Other measures of liquidity, such as the LOT liquidity, the percentage of zero trading days, and trading volumes, could not be used due to limited data access. See Lesmond et al. (1999), or Corwin and Schultz (2012) for a review.

$$BA\ spread_{i,t} = \frac{\sum_{d=1}^{n} \frac{AskPrice_{i,d} - BidPrice_{i,d}}{MidPrice_{i,d}}}{n} \times 100$$

4.3 Data and sample

European corporate bond market data stems from the EBMD, as published by Franke et al. (2025). This database records corporate bonds traded on EEA30 market venues from 2018 to 2023, specifically identifying those listed on venues with a green section. Green bond data such as bond characteristics (issue amount, maturity etc.) and quoted bid and ask prices are sourced separately from LSEG. For the pricing data, I exclude observations where bid or ask prices are below one, as this indicates the bond is trading at a deep discount which could hint at the issuer being in financial distress. Further, I follow prior literature and exclude quotes with bid-ask spreads that are negative or zero (Dorfleitner et al., 2023).

Initially, bonds flagged as green by LSEG are selected based on their ISIN, which uniquely identifies each bond. The LSEG dataset is then cleaned by removing duplicates and entries with missing identifiers such as the issuer name, yielding 11,276 green bonds. These green bonds are cross-referenced with the EBMD, which records 44,752 unique ISINs and exclusively includes non-financial firms (i.e., firms classified outside of SIC codes 6 or 9) and plain vanilla bonds.[7] The matching process results in a final sample of 808 corporate green bonds issued by 348 non-financial firms and listed on European trading venues between 2018 and 2023. In the analysis, I focus exclusively on green bonds from non-financial issuers, to ensure the sample is homogenous and comparable.[8] Restricting the sample to only green bonds, mitigates potential selection bias associated with firms' decisions to issue green bonds initially.

[7]The EBMD includes rigorous steps to filter and prepare the data. The Data Appendix to Franke et al. (2025) includes an extensive description of the EBMD.

[8]Financial institutions differ from non-financial firms in their business model and are therefore commonly excluded from the analyses. Fatica et al. (2021) demonstrate that financial institutions issuing green bonds are unique, as they do not show a pricing premium at issuance.

Further data on the characteristics of these bonds is compiled from LSEG and additional issuer industry and financial information is sourced from Orbis.

Data on GBS was collected manually. The starting point formed the list of trading venues included in the EBMD. The focus is on trading venues pertaining to RM or MTF, as a listing on either market segment is required for a bond to be included in the GBS. Information on the introduction month of the GBS, the name, and the disclosure requirements are collected from trading venue websites and supported by data from the SSI and CBI. A comprehensive description of the collected data points per trading venue is provided in the supplementary materials.

Lastly, textual disclosures and information on external review mechanisms were manually collected for the 808 green bonds in the initial sample by the primary researcher and a research assistant. The documents collected include green bond frameworks, certifications, SPO, post-issuance green bond reports, and external assurances. The process began with an internet search using the issuer's name to gather all relevant green bond documentation, which was then archived by the research assistant. In cases where the issuer's website did not provide the needed documents, alternative sources were employed, including Google, websites of stock exchanges, SPO providers, and LSEG, which also provides publicly available links to green bond-related documents. The primary researcher offered guidance during the initial data collection phase, addressing any contradictory or inconsistent search results.

The documents were aligned with the individual bonds based on their publication month and year, using textual analysis tools. Based on the separation into at-issuance (Framework, SPO, Certification) and post-issuance (Green bond report, external assurance) textual disclosures and external review mechanisms, the bonds issue month was used as an anchor.

This method guarantees that documentation is directly related to the bond.[9] The primary researcher meticulously reviewed all green bonds and their corresponding documentation to verify the accuracy of the matching. In instances of missing documentation, she also rechecked the previously mentioned sources to confirm no public availability or add any missing documents. Special attention was given to green bond reports to ascertain whether they pertained specifically to the bond in question[10] and included detailed allocation and impact reporting.

For the empirical analysis, bonds with missing pricing data and data on control variables at the bond and issuer level are excluded. A limited number of bonds defined as in distress by LSEG are also excluded. Further singleton observations in the country, industry and month-year fixed effect groups are excluded to mitigate potential bias in the standard errors of the multivariate analysis (Breuer & deHaan, 2024). This results in a final sample of 482 bonds by 221 issuers.[11] The sample selection steps are presented in Appendix B, Table B1.

Additionally, the EBMD data only enables the identification of the trading venue. Therefore, I assume that green bonds listed on the trading venue are also listed on the GBS. As this is a rather strong assumption, I support this by manually cross-checking a subset of trading venues. The comparison in presented in Appendix E. My assumption is strengthened by the fact that in the checked subset, 90%-100% of bonds within my sample are also listed on the respective GBS. For a small fraction of bonds, I cannot confirm the trading venue, because they have matured and there is no historical information available.

[9]As trends in green bond textual disclosures change over time, some issuers start to provide a green bond framework and SPO for later issuances but not for earlier ones. By matching the publication month and issuance month, I ensure to only match a framework to those bonds that are issued after the framework has been published.
[10]Notably, while issuers often publish annual green bond reports, detailed information about a specific bond is often only provided in the report following its issuance. Subsequent reports tend to focus on newer issuances. I only match a green bond report and assurance report to the bond if it specifically relates to the bond.
[11]While this sample seems small at first sight, previous literature on (corporate) green bonds analyzes samples of similar size (e.g., Dinh et al., 2023; Franke and Katzer, 2024; Lebelle et al., 2022).

[Insert Table 1 about here.]

Table 1 offers insights into the corporate green bond market in Europe prior to the sample selection process. These figures provide a comparison of the green bond market against the conventional bond market. Notably, 46 of the potential 130 trading venues are equipped with a GBS, suggesting the potential significance of further research into GBS. In terms of overall bond listings[12], the United Kingdom, Germany, and the Netherlands play prominent roles in the green bond market.

The corporate green bond market, while still in its nascent stages, makes up 2.5% of total bond listings. This share varies significantly across different countries, reflecting different stages of growth. The UK, serving as a significant financial center, has 38 trading venues and holds a major portion of bond listings totaling 128,559. However, the growth in its green bond market remains modest, with a market share of only 2%. On the other hand, countries like Germany and the Netherlands, though smaller overall, display comparable green bond shares of 2.53% and 2.85%, respectively. The Nordic countries, particularly Norway and Sweden, show high engagement in the green bond market, with shares of 15.66% and 11.43%.

[Insert Figure 3 about here.]

Figure 3 illustrates the development of the corporate green bond market from 2018 to 2023. Despite its smaller scale compared to the conventional bond market, the steady growth observed over the five-year period underlines the growing relevance of green bonds as an investment option. This trend is supported by the increasing implementation of GBS, which are contributing to a higher share of bond listings on GBS.

[12]A bond listing refers to one bond listed on a trading venue. A bond can be listed on multiple trading venues at the same time.

[Insert Table 2 about here.]

Moving from an overview of bond listings to a more detailed look at individual bonds, Table 2 details the number of bonds in both the initial and final samples, broken down by issuer industry and region. According to Table 2, Panel A, the utilities sector-which includes Transportation, Communications, Electric, Gas, and Sanitary Services-forms the largest group of bonds. This sector is followed by the manufacturing and services industries. From a regional perspective, the largest number of bonds are issued by European firms, with issuers from Asia and North and Central America also representing significant portions.

[Insert Table 3 about here.]

Finally, Table 3 presents an overview for the primary trading venues identified. In the subset of trading venues with a GBS, the largest trading venue is Market Axess but also Frankfurt, Oslo and Luxembourg stock exchange are among the largest five primary venues. In comparison, Bloomberg MTF is the largest venue in the group without a GBS.

5 GBS LISTING AND INFORMATION ASYMMETRY

5.1 Descriptives

[Insert Table 4 about here.]

Summary statistics at the bond-month level for the variables used in the empirical analysis are presented in Table 4, Panel A. Variable definitions are provided in Appendix A. Values of continuous variables are winsorized at 1% and 99%. The total panel dataset comprises 12,379 observations from 2018 to 2023. The average bid-ask spread is 0.61% (median of 0.52%).[13] On

[13]Mean and median in my sample are slightly higher than those in the green bond sample by Lebelle et al. (2022) who have a mean of 0.48% (SD: 0.42%). However, the authors only consider green bonds of international issuers with listed equity, who might generally have a better information environment and experience lower information asymmetries. Studies on the US conventional bond market report lower average spreads (0.44) (e.g., Schestag et al., 2016), but one needs to consider that the conventional bond market in the US is more developed compared to the European bond market and particularly the green bond market is in its early stages.

average 54% of bond-month observations are on a GBS. The natural logarithm of the issued amount averages at 20.01.

For comparison, summary statistics on bond level are presented in Table 4, Panel B. Bond size is similar, indicating even distribution across the panel in terms of bond size. The actual average issued amount is approximately $637,97 million, suggesting substantial bond issuances. Majority of bonds are senior bonds (72%), with higher priority in case of bankruptcy. 63.3% of bonds are rated, reflecting a significant portion that is subject to formal credit assessment.

[Insert Table 5 about here.]

Summary statistics for bond and issuer characteristics that are listed on a GBS versus those that are not (*GBS listing)* are presented in Table 5. Panel A is at bond level. 242 bonds are listed on a GBS while 240 are not. The bonds do not differ significantly in size, with bonds on GBS being slightly smaller (mean difference: -0.046). Bonds on a GBS are characterized by higher proportion of senior bonds (mean difference: 0.091, t-statistic significant at 1% level) and are more often rated (mean difference: 0.205, t-statistic significant at 1% level). In Table 5, Panel B, issuer characteristics are presented at the bond-year level, as issuer financial data is matched to the bonds at the year level. Issuers on a GBS are slightly larger in size (mean difference: 0.173, t-statistic significant at 5% level) and have higher leverage ratio (mean difference: 0.039, t-statistic significant at 1% level). These differences, however, are not large in magnitude, which provides confidence that results in the empirical tests are not driven by unobserved issuer characteristics. Profitability and liquidity ratio are not used as controls in the empirical analysis and displayed for comparison. Further, issuers in the two groups do not differ significantly in terms of their profitability (measures as return on assets (ROA)) and their current liquidity ratio (measured as current assets/current liabilities). Additional summary statistics for the control

variables used in the regression analysis on bond-month level are also presented in Panel C. The table reports two-sided t-test results that support the choice of control variables.

[Insert Table 6 about here.]

Table 6 depicts the correlation matrix including the variables in the empirical analysis. In line with the notion of GBS reducing information asymmetries in the market and fostering liquidity, the bid-ask spread (*BA spread*) is negatively associated with the listing on GBS (*GBS listing*). Overall variables show relatively small levels of correlation, mitigating multicollinearity concerns in the multivariate regression analyses.

5.2 Research design

Using the $BA\ spread_{it}$ as the dependent variable, I estimate the following linear regression model:

$$BA\ spread_{i,t} = \beta_0 + \beta_1 GBS\ listing_{i,t} + \sum_b \beta_b Bond_{i,t}^b + \sum_j \beta_j Issuer_{i,t}^j + Month\_YearFE_t + IndustryFE_k + CountryFE_c + \varepsilon_{i,t} \quad (1)$$

Observations are at the bond-month level. $GBS\ listing_{i,t}$ is an indicator variable that takes the value of one if bond i is listed on a green section in month t and zero otherwise. The coefficient of interest, β_1, captures the association between the listing on a green section and the bid-ask spread for the treatment group in comparison to the baseline group. $Bond_{i,t}^{\ b}$ are a set of bond characteristics and $Issuer_{i,t}^{\ j}$ a set of issuer characteristics. I include a set of bond and issuer-specific characteristics that can influence the bid-ask spread following previous literature (Alexander et al., 2000; Lebelle et al., 2022). At the bond level I control for the size of the bond using the natural logarithm of the issued amount ($Bond\ size_{i,t}$) as larger bonds typically have lower information asymmetry. I add an indicator for whether the bond is senior ($Senior_{i,t}$) or rated ($Rating_{i,t}$). Senior bonds and rated bonds have typically lower information asymmetry. Then, I control for the interest rate risk with the natural logarithm of months to maturity (*Interest*

rate risk$_{i,t}$) and for the age of the bond (Bond ag*e*$_{i,t}$) with the natural logarithm of months from issuance. Lastly, I include bond price volatility measured as the ratio of the difference between the highest and lowest prices to the monthly average price of the individual bonds traded each month. At the issuer level I include a control for issuer size (*Issuer size*$_{j,y}$) measured as the natural logarithm of total assets, as larger firms are characterized by lower information asymmetry. Further, I include the leverage ratio (*Leverage*$_{j,y}$) using the debt to asset ratio to control for issuer's debt capacity. Issuer-level controls are matched using the most recent annual financial statement data available for the month.

Lastly, I incorporate month-year fixed effects (*Month_YearFE*$_t$) to account for any temporal trends in green bond listings. I include country fixed effects (*CountryFE*$_c$), to account for the impact of varying regulatory environments on information asymmetry in the market and the likelihood of bonds being listed in a green section. Industry fixed effects (*IndustryFE*$_k$), based on the two-digit SIC code, are used to control for unobserved industry characteristics that may influence both the decision to list a green bond on a primary venue with a GBS and the level of information asymmetries. To address potential issues of heteroscedasticity and autocorrelation, I employ robust standard errors clustered by trading venue.

5.3 Results

[Insert Table 7 about here.]

Table 7 presents the results. In column (1) I investigate the relationship between *GBS listing* and *BA spread* within the country and month-year groups. The coefficient of *GBS listing* is negative and statistically significant at the 1% level. This indicates that the listing on a GBS is associated with an average reduction in the bid-ask spread by 0.11 percentage points compared to the baseline group. Moreover, the economic magnitude of this association is meaningful. This reduction represents approximately 14% of the mean bid-ask spread in the sample (0.61%), highlighting the association of a GBS listing with a reduction in information asymmetries. In

column (2) I add the control variables. Bond size, seniority and issuer size are significantly negatively associated with the bid-ask spread. Bond age, rating and leverage are insignificant. Volatility and interest rate risk are significantly positively associated. In column (3) and (4) I estimate the model with fixed effects for time, country and industry. Across all specifications, I find a negative relationship between the *GBS listing* and *BA spread* (significant at 1% level). The magnitude of this relationship varies between 0.09 and 0.13 percentage points.[14] These findings support my main hypothesis that the listing on a GBS could be beneficial for reducing information asymmetries among investors.

[Insert Table 8 about here.]

In the next step I conduct a comparative analysis of bonds that exhibit varying levels of information asymmetries, specifically differentiating between those with higher and lower asymmetries. In particular, the listing on a GBS might be more beneficial for green bonds that experience higher information asymmetry. Therefore, I first split the sample by the issue size into large and small issues. Smaller issues are generally related to higher levels of information asymmetries, compared to large issues, as issuers tend to be smaller and less transparent. I perform a median split and divide bonds by their size into groups with issuance amounts above and below $500 million. The results are presented in Table 8, Panel A. In line with the expectations, for smaller bonds the listing on GBS is associated with a stronger reduction in the bid-ask spread by 0.05 percentage points more (significant at the 5% level). Both coefficients for smaller and larger issues are significant at the 1% level.

[14]I perform a set of robustness tests that are detailed in Appendix D. These include the exclusion of observations without variation in *GBS listing* within the fixed effect structures (Breuer and deHaan, 2024). Further, I exclude the largest trading venue in my sample and sample dominating countries. I also include issuer and venue state fixed effects. Results remain robust to those adjustments. In untabulated tests, I first, use the natural logarithm of *BA spread* and second, exclude larger values of bid-ask prices above 2%. I, further include controls for the SPO provider and whether the bond has an external review. The modifications also result in a negative and significant association, but of lower magnitude.

Then, I consider the credit rating of the green bond and split the sample into investment grade and unrated or high-yield bonds. Unrated and high-yield bonds are characterized by higher information asymmetry. The results in Table 8, Panel B confirm the notion that particularly unrated and high-yield bonds drive the results. The coefficient in this subsample shows that GBS is associated with an average reduction of 0.21 percentage points compared to the baseline group. The coefficient for IG bonds shows that GBS is associated with an average reduction of 0.06 percentage points. However, the coefficients are not significantly different from each other (p-value of 0.398).

5.4 High versus low GBS

I construct a disclosure score (*Disclosure score*) on trading venue level based on the disclosure requirements set out for GBS. The score provides a concise overview of transparency and adherence to standards across trading venues for green bonds. It can range between zero (no requirements) to 10 (high requirements). Among others, it assesses the necessity of a regulatory framework, adherence to strict transparency guidelines, and both pre- and post-issuance reviews. The score also evaluates the availability of detailed reports on fund allocation and impact, and whether trading venues make these documents easily accessible. More details are provided in Appendix C.

Based on the disclosure score I perform a median split on the independent variable *GBS listing*$_{i,t}$. *GBS listing high*$_{i,t}$ includes trading venues with a GBS with a disclosure score above or equal to 5 while *GBS listing low*$_{i,t}$ includes those below. I estimate the following regression model:

$$\begin{aligned} BA\ spread_{i,t} = {} & \beta_0 + \beta_1 GBS\ listing\ high_{i,t} + \beta_2 GBS\ listing\ low_{i,t} + \\ & \textstyle\sum_b \beta_b Bond_{i,t}^b + \sum_j \beta_j Issuer_{i,t}^j + Month\_YearFE_t + \\ & IndustryFE_k + CountryFE_c + \varepsilon_{i,t} \end{aligned} \tag{2}$$

BA spread, bond and issuer controls, as well as fixed effects are the same as for equation (1). The coefficients of interest are β_1 which captures the association for low requirement GBS as compared to no GBS in the base group and β_2 which captured the association for high requirement GBS.

[Insert Table 9 about here.]

The results are presented in Table 9. Column (1) and (2) present results for the baseline with country and month-year, as well as industry fixed effects. Coefficients indicate that low GBS are associated with an average reduction in the bid-ask spread of around -0.13 percentage points (significant at 10% level). In comparison, high GBS show coefficients between -0.18 to -0.19 percentage points (significant at 1% level). Including control variables in columns (3) and (4) increases the difference between the coefficient for low and high GBS. The results indicate that high GBS are on average associated with a higher reduction in information asymmetries.[15]

6 THE MEDIATING ROLE OF DISCLOSURE CHARACTERISTICS

Disclosures within the corporate green bond market play an essential role due to the lack of unified regulations and reporting requirements. In this section, I investigate the characteristics of such disclosures. I use the previously described manually collected data on green bond textual disclosures.

[Insert Table 10 about here.]

Summary statistics on disclosure characteristics split by GBS are presented in Table 10.[16] Results from two-sided t-tests suggest that bonds on a GBS show higher at-issuance

[15]I also conduct sensitivity tests and exclude countries and industries without variation in the independent variable. Details are provided in Appendix D.

[16]Within the sample of 482 corporate green bonds, for 322 a framework is published and for 314 a green bond report. The mean (SD) raw Gunning Fog Index is 15.08 (2.06) for the framework and 14.44 (4.87) for the green bond report. Lebelle et al. (2022) and Dinh et al. (2023) show similar values for the textual disclosures in their sample. In comparison, Debener et al. (2023) who investigate prospectuses for asset backed securities that are characterized by higher share of legal terms within the text report a higher average of 23.73. Further the average

disclosure (defined as one if a framework and external review are published at issuance) and more often have an external review (defined as one if at issuance or post issuance an external review is obtained). I measure readability using the inverse of the Gunning Fog Index, which is commonly used.[17] Thus, higher values indicate that the text is easier to comprehend. Assuming no disclosure is the lowest level, summary statistics show that frameworks on bonds on a GBS tend to be easier to read, while reports do not differ significantly. This is in line with previous literature arguing that investors prefer easy to read documentation. Further, I investigate the length of the reports using the natural logarithm of the number of words and number of pages. I use the average length of the framework and green bond report per bond. Disclosures of bonds on a GBS are on average longer, which is indicated by more words and pages.

[Insert Figure 4 about here.]

Next, I conduct a mediator analysis using a structural equation model (SEM)[18] to examine whether textual disclosure characteristics mediate the relationship between listing on a GBS and information asymmetry. I include the readability of the framework, the report and the average length of disclosure as potential mediators.[19] A mediator analysis investigates whether a variable, termed a mediator, explains the relationship between an independent variable and a dependent variable. Figure 4 presents the pathways of the mediator analysis, where path (c) presents the direct relationship studied in section 5. Path (a) presents the first indirect relationship between the independent variable (*GBS listing*) and the mediators (*Disclosure length (Words)*, *Framework readability* and *Report readability*) and path (b) presents the second indirect relationship between the mediators and the dependent variable (*BA*

length in words (pages) is 3,643 (12.05) for the framework and 2,863 (11.42) for the report, indicating that reports are on average longer than frameworks.

[17]Results are similar when using the Flesh Kincaid Index.

[18]SEM have been used in accounting studies before (see for example Giese et al. (2024), Deumes et al. (2012)).

[19]I conduct the SEM using the "gsem" command in STATA, due to my independent variable being an indicator.

Spread). If the disclosure characteristics act as mediators, it would suggest that the GBS is associated with lower information asymmetry via an improvement of the textual disclosures. Further, I include the same model specifications for the first and second step as specified in equation (1). In the first step, the SEM estimates the association between the *GBS listing* and each of the three textual disclosure characteristics. In the second step, the full model is estimated including the independent variable and the mediators.

[Insert Table 11 about here.]

Results are presented in Table 11. I do not find evidence that readability of the framework or report act as a mediator for the association between the listing on GBS and my proxy for information asymmetries. I also do not find support for an association with the length of the disclosures. In fact, while the coefficients for the association between a GBS listing and disclosure characteristics are positive they are not significant.[20] Conditional on this analysis, I still find a negative and statistically significant association of *GBS listing* on the bid-ask spread. The size of the coefficient is comparable to the baseline finding in Table 7 (0.11 percentage points) and the statistical significance remains unchanged.[21] This finding strengthens the direct negative relation between the GBS listing and information asymmetries, although acknowledging that there might be other mediators which could be at play, that are not scope of this analysis.

7 CONCLUSION

In this study, I examine the association between the listing on a GBS and the reduction of information asymmetries, proxied with the bid-ask spread. This study specifically addresses the corporate green bond market in Europe. I posit that a green bond's inclusion on a GBS signals

[20]One explanation could be that typical readability measures, such as the Gunning Fog Index, do not effectively capture the characteristics of the textual disclosures. This is due to such disclosures being rather short and including more tables than text.

[21]I also conduct the SEM without control variables. Further, I also estimate the mediator analysis following the approach by Baron and Kenny (1986). See Zhao et al. (2010) for a discussion. Results remain similar.

adherence to specific disclosure rules set by the trading venue operator. Moreover, the trading venue operator actively oversees the compliance of issuers. Consequently, this listing should be linked to reduced information asymmetries and enable investors to make informed investment decisions.

Consistent with my main hypothesis, I observe a negative association between the GBS listing and information asymmetries, proxied for with the bid-ask spread. The results are more pronounced for green bonds with generally higher information asymmetry-i.e., smaller bonds and high-yield or unrated bonds. Further, my results show that the association is primarily driven by listings on GBS with higher requirements for textual disclosures, external review mechanisms and de-listing rules. Lastly, I investigate the mediating role of textual disclosures for the negative relationship between GBS listing and information asymmetry. My results do not suggest that disclosure characteristics mediate the relationship.

The findings of this study should be interpreted considering certain empirical limitations. Firstly, this research employs only a single proxy to measure information asymmetry. Incorporating multiple proxies could potentially reinforce the robustness of the results. Secondly, the decision to list on a GBS may be influenced by unobserved factors not accounted for in this analysis that are associated with bid-ask spreads. Employing a matching approach could help control for these unobservable variables. These aspects present opportunities for further investigation in future research. Additionally, future research can extend the mediating relationship between GBS and information asymmetries.

In summary, this study contributes to the ongoing discussion surrounding the challenges of greenwashing related to green bonds. It provides evidence that trading venue operators can support investors by introducing standardized requirements and monitoring adherence to these requirements, thereby improving the integrity of the green bond market.

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FIGURES

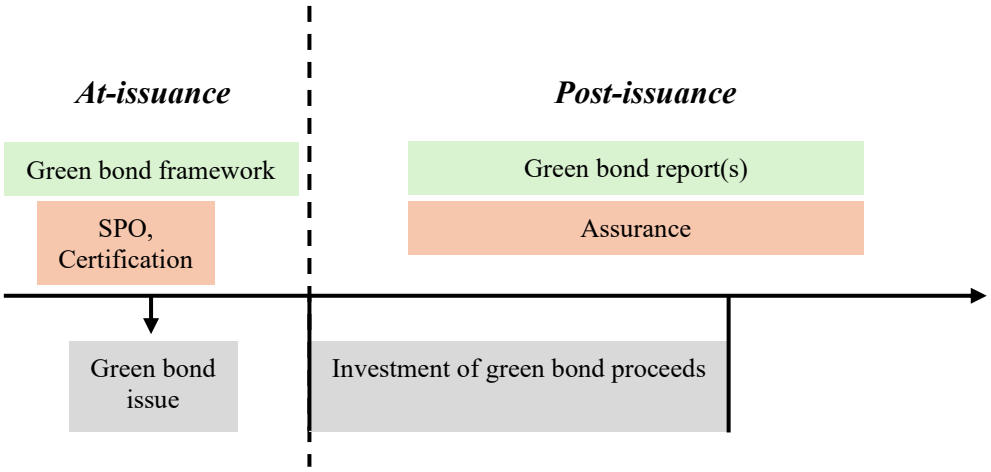

Figure 1: Timeline of green bond textual disclosures and external review mechanisms.

This figure depicts the at-issuance and post-issuance textual disclosures for green bonds and the respective external review mechanisms. A green bond framework is typically published before the issuance of the bond or with the issuance. The at-issuance external review (SPO or certification) is obtained with the framework or bond issuance. Green bond report(s) are published once green bond proceeds are being invested. External assurance can be obtained for the use-of-proceeds reporting part and/or the impact reporting.

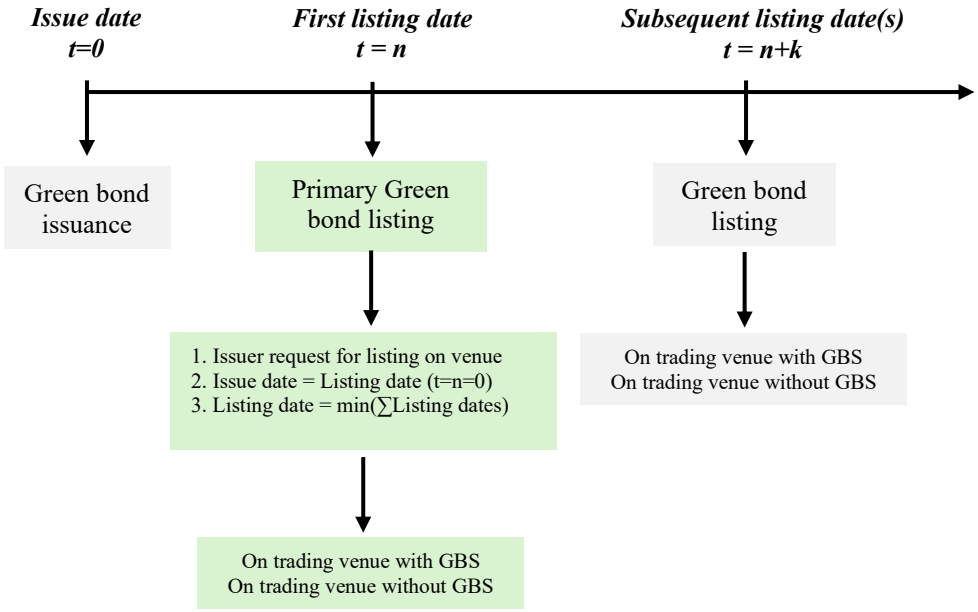

Figure 2: Timeline for identification of primary trading venue and GBS.

Notes: This figure illustrates the timeline used to determine each bond's primary trading venue. Per bond, I identify the issue date (*t=0)* from the LSEG database. Further, I identify the first listing date per trading venue from the EBMD and whether the listing on the venue was requested by the issuer (*IssrReq* identifier in EBMD). In case the issuer requested the listing, or the listing date is on the same date as the issue date (*t=n=0*), I select the respective trading venue as the primary venue. In case these steps do not lead to the identification of the primary venue, I select the venue with the earliest listing date *(t=n)*. Once the primary trading venue is established, it is then evaluated to determine if it has a GBS. The assumption is that the information from the primary trading venue should be the strongest. Any subsequent listings (at *t=n+k*) are not considered.

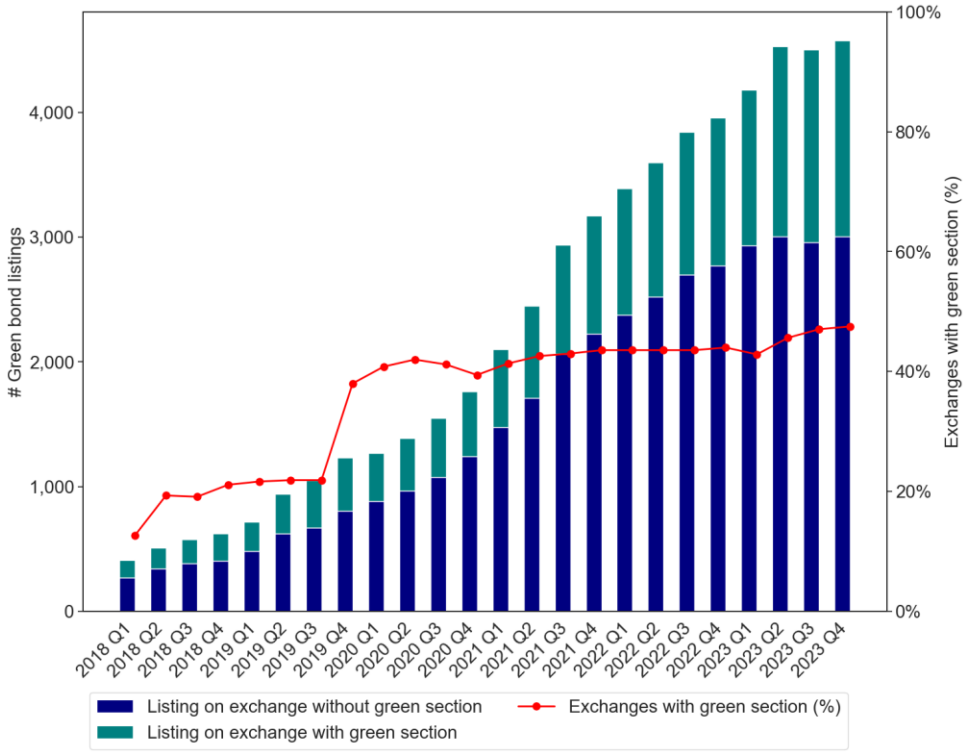

Figure 3: Development of green bond listings and GBS.

This figure depicts the development of the European corporate green bond market between 2018 and 2023. Quarters are presented on the x-axis. The left y-axis presents the number of green bond listings, whereas green bond listings are split into those on trading venues with a GBS and listings on other venues. The right y-axis depicts the ratio of venues with GBS.

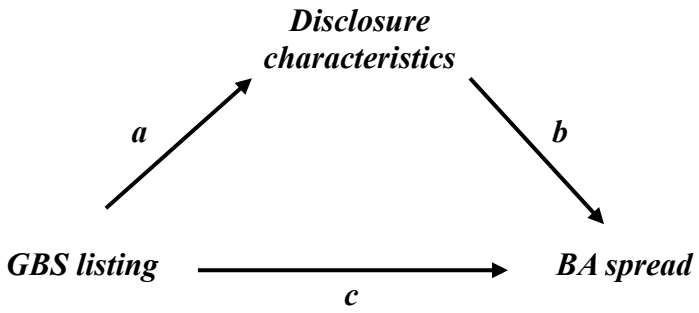

Figure 4: Pathways mediator analysis.

This figure depicts the pathways tested in the mediator analysis. The direct pathway (c) leads from the independent variable (*GBS listing)* to the dependent variable (*BA spread*). The first indirect pathway (a) leads from the independent variable (*GBS listing)* to the mediator variables summarized by *Disclosure characteristics*. These include *Readability (Framework), Readability (Report)* and *Disclosure Length (Words).* Variable definitions are provided in Appendix A.

TABLES

Table 1: Descriptive statistics of the European corporate green bond market

Country of trading venue	Number of trading venues	Number of trading venues with GB section	Total bond listings	Total Green bond listings	Share of green bond listings to total listings	Cumulative % of green bond listings	% of Euro area firms with green bond listing
United Kingdom	38	3	128,559	2,640	2.05	39.04	33.00
Germany	22	7	68,637	1,736	2.53	25.67	43.00
Netherlands	9	2	49,653	1,414	2.85	20.91	29.00
France	14	3	7,114	317	4.46	4.69	59.00
Italy	8	2	8,093	214	2.64	3.16	35.00
Ireland	4	2	3,110	162	5.21	2.40	55.00
Norway	1	1	549	86	15.66	1.27	5.00
Luxembourg	2	2	1,906	63	3.31	0.93	61.00
Spain	7	4	1,168	49	4.20	0.72	86.00
Sweden	3	2	245	28	11.43	0.41	6.00
Austria	3	3	420	21	5.00	0.31	100.00
Hungary	1	0	70	10	14.29	0.15	10.00
Rest of Europe	18	15	531	22	4.14	0.30	71.43
Total	130	46	270,055	6,762			

Notes: This table reports characteristics of the European corporate green bond market in the period from 2018 until 2023. The top 12 countries based on the total number of green bond listings are reported separately. Columns (1) and (2) show the total number of trading venues and number of trading venues with a GB section, respectively. Trading venues of type RM and MTF are considered. The next three columns show total bond listings, total green bond listings and the percentage share of green bond listings to total listings. The last column shows the percentage of Euro area firms, based on the total number of green bond listings in the respective country. Detailed definitions of the characteristics are presented in Table A of the Appendix.

Table 2: European corporate green bond market

Panel A: By issuer industry

	# Bonds	
Industry	Initial sample	Final sample
Agriculture, Forestry, and Fishing	64	40
Mining	83	50
Manufacturing	108	77
Transportation, Communications, Electric, Gas, and Sanitary Services	429	264
Wholesale Trade	34	22
Services	90	29
Total	808	482

Panel B: By issuer region & major countries

	# Bonds	
Region	Initial sample	Final sample
Africa	**6**	**0**
Asia	**222**	**109**
China	48	10
Hong Kong	26	10
India	21	10
Korea	84	48
Japan	60	19
Europe	**355**	**215**
Austria	19	6
Germany	18	11
Norway	104	73
Spain	35	20
Sweden	35	19
United Kingdom	30	24
North and Central America	**182**	**136**
United States	160	124
South America	**19**	**9**
Oceania	**24**	**13**
Total	808	482

Notes: This table presents the green bonds in the initial and final sample. Panel A presents green bonds by the issuer's industry, and Panel B presents green bonds by the issuer's region and major countries. The sample period is from 2018 to 2023, comprising green bonds by non-financial issuers listed on the European market. Industry classification is based on one-digit SIC codes extracted from Orbis.

Table 3: Primary trading venues in final sample

Panel A: Green bond listings on trading venues with a green section

	VenueMic	VenueName	# Bonds	Amount issued ($ million)
1	MAEL	Marketaxess Europe MTF	110	90,343
2	MANL	Marketaxess NL B.V.	49	27,120
3	FRAB	Frankfurter Wertpapierboerse (Freiverkehr)	28	15,275
4	XOSL	Oslo Boers Main Market	23	11,600
5	XLUX	Bourse De Luxembourg	19	10,875
	Rest		13	29,573

Panel B: Green bond listings on trading venues without a green section

	VenueMic	VenueName	# Bonds	Amount issued ($ million)
1	BMTF	Bloomberg Multilateral Trading Facility	69	34,477
2	BTFE	Bloomberg Trading Facility B.V.	55	28,295
3	LIQF	Liquidnet Europe Fixed Income	24	13,194
4	LEUF	Liquidnet EU Fixed Income MTF	14	15,650
5	BVUK	Bondvision UK	13	6,975
	Rest		65	24,125

Notes: This table presents the largest primary trading venues. Panel A shows the five largest primary trading venues with a GBS, while Panel B presents those without a GBS. The number of unique green bonds is presented, for which the venue was identified as the primary venue, and the total issued amount of those bonds. The remaining venues are aggregated under "Rest". In total 19 trading venues in the final sample have a GBS and 13 do not.

Table 4: Summary statistics for bond and issuer characteristics

Panel A: At bond-month level

	N	Mean	SD	Min	0.25	Median	0.75	Max
BA spread	12,379	0.616	0.521	0.100	0.300	0.400	0.800	7.200
GBS listing	12,379	0.545	0.498	0.000	0.000	1.000	1.000	1.000
Bond size	12,379	20.011	0.657	17.728	19.807	20.030	20.367	21.822
Senior(0/1)	12,379	0.732	0.443	0.000	0.000	1.000	1.000	1.000
Rating(0/1)	12,379	0.670	0.470	0.000	0.000	1.000	1.000	1.000
Interest rate risk	12,379	4.600	1.168	2.303	3.871	4.382	4.820	7.970
Bond age	12,379	2.824	0.865	0.000	2.398	2.944	3.434	4.394
Volatility	12,379	2.971	3.930	0.000	0.900	1.900	3.800	50.700
Issuer size	12,379	9.747	1.734	4.623	8.564	10.000	10.907	12.783
Leverage	12,379	0.472	0.176	0.091	0.358	0.467	0.603	0.933

Panel B: At bond level

	N	Mean	SD	Min	0.25	Median	0.75	Max
GBS listing	482	0.502	0.501	0.000	0.000	1.000	1.000	1.000
Bond size	482	20.015	0.730	17.728	19.673	20.030	20.377	21.822
Senior(0/1)	482	0.728	0.445	0.000	0.000	1.000	1.000	1.000
Rating(0/1)	482	0.633	0.483	0.000	0.000	1.000	1.000	1.000

Notes: This table presents summary statistics for the variables used in the regression analysis on the full sample. Panel A presents statistics at the bond-month level for bond and issuer characteristics. Panel B presents statistics at the bond level only including bond characteristics. All variables are winsorized at the 1st and 99th percentiles. Detailed variable definitions can be found in Appendix A.

Table 5: Summary statistics for bond and issuer characteristics split by GBS indicator

Panel A: Bond characteristics at the bond level

	GBS listing=1						*GBS listing*=0						
	N	Mean	SD	Min	Median	Max	N	Mean	SD	Min	Median	Max	Diff
Bond size	242	19.988	0.575	17.728	20.030	21.822	240	20.042	0.858	17.728	20.030	21.822	-0.046
Senior(0/1)	242	0.653	0.477	0.000	1.000	1.000	240	0.804	0.398	0.000	1.000	1.000	0.091**
Rating(0/1)	242	0.653	0.477	0.000	1.000	1.000	240	0.525	0.500	0.000	1.000	1.000	0.205**

Panel B: Issuer characteristics at the bond-year level

	GBS listing=1						*GBS listing*=0						
	N	Mean	SD	Min	Median	Max	N	Mean	SD	Min	Median	Max	Diff
Issuer size	652	9.787	1.690	4.623	10.050	12.783	599	9.566	1.777	4.623	9.831	12.783	0.222**
Leverage	652	0.482	0.165	0.091	0.476	0.933	599	0.451	0.191	0.091	0.443	0.933	0.030**
Profitability	647	0.028	0.046	-0.104	0.027	0.270	594	0.034	0.052	-0.104	0.028	0.270	-0.006
Liquidity ratio	652	1.206	0.670	0.160	1.028	4.358	594	1.208	0.703	0.160	1.075	4.358	-0.002

Panel C: Variables used in the analysis at bond-month level

	GBS listing=1						*GBS listing*=0						
	N	Mean	SD	Min	Median	Max	N	Mean	SD	Min	Median	Max	Diff
BA spread	6,745	0.594	0.420	0.100	0.500	4.400	5,634	0.642	0.620	0.100	0.400	7.200	-0.048***
Bond size	6,745	20.020	0.538	17.728	20.030	21.822	5,634	20.000	0.776	17.728	20.030	21.822	0.019
Senior(0/1)	6,745	0.618	0.486	0.000	1.000	1.000	5,634	0.869	0.337	0.000	1.000	1.000	-0.251***
Rating(0/1)	6,745	0.750	0.433	0.000	1.000	1.000	5,634	0.575	0.494	0.000	1.000	1.000	0.175***
Interest rate risk	6,745	4.798	1.301	2.303	4.489	7.970	5,634	4.363	0.931	2.303	4.248	7.970	0.435***
Bond age	6,745	2.852	0.849	0.000	2.996	4.394	5,634	2.790	0.882	0.000	2.944	4.394	0.062***
Volatility	6,745	3.008	3.514	0.000	2.100	50.700	5,634	2.927	4.376	0.000	1.800	50.700	0.082***
Issuer size	6,745	9.834	1.672	4.623	10.129	12.783	5,634	9.643	1.799	4.623	9.874	12.783	0.191***
Leverage	6,745	0.484	0.162	0.091	0.476	0.933	5,634	0.457	0.191	0.091	0.444	0.933	0.027***

Notes: This table presents summary statistics for the bond and issuer characteristics split by the *GBS listing* indicator. Panel A presents statistics at the bond level, only including bond characteristics, where a bond is either listed on a GBS during the period from 2018 to 2023 or not. Panel B presents statistics at the bond-year level only including issuer characteristics, where a bond is either listed on a GBS in a year or not. Panel C presents statistics at the bond-month level for the variables used in the empirical analysis. All variables are winsorized at the 1st and 99th percentiles. Detailed variable definitions can be found in Appendix A.

Table 6: Correlation matrix for variables used in the regression analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) *BA spread*	1									
(2) *GBS listing*	-0.046*	1								
(3) *Bond size*	-0.227*	0.015*	1							
(4) *Senior*	-0.149*	-0.282*	-0.151*	1						
(5) *Rating*	-0.098*	0.186*	0.204*	-0.117*	1					
(6) *Interest rate risk*	0.290*	0.186*	0.148*	-0.458*	0.308*	1				
(7) *Bond age*	-0.042*	0.036*	0.013*	0.012*	0.023*	-0.099*	1			
(8) *Volatility*	0.243*	0.010*	-0.030*	-0.037*	0.175*	0.237*	-0.023*	1		
(9) *Issuer size*	-0.324*	0.055*	0.456*	-0.128*	0.479*	0.247*	0.088*	0.039*	1	
(10) *Leverage*	0.097*	0.076*	0.057*	-0.109*	0.184*	0.169*	0.116*	0.142*	-0.021*	1

Notes: This table depicts the pairwise Pearson correlation matrix for the variables used in the regression analysis. All variables are winsorized at the 1st and 99th percentiles. * indicate significance at the 5% significance level or higher. Detailed variable definitions can be found in Appendix A.

Table 7: The association between listing on GBS and information asymmetry

	BA spread			
	(1)	(2)	(3)	(4)
GBS listing	-0.111***	-0.130***	-0.099***	-0.115***
	(0.035)	(0.024)	(0.031)	(0.026)
Bond size		-0.062*		-0.087**
		(0.031)		(0.038)
Senior		-0.049**		-0.039
		(0.023)		(0.027)
Rated		-0.114		0.010
		(0.073)		(0.048)
Interest rate risk		0.134***		0.141***
		(0.019)		(0.018)
Bond age		-0.029		-0.008
		(0.021)		(0.021)
Volatility		0.022***		0.021***
		(0.005)		(0.005)
Issuer size		-0.063***		-0.065**
		(0.016)		(0.026)
Leverage		0.161		0.196
		(0.098)		(0.194)
Constant	0.677***	1.978***	0.670***	2.291***
	(0.024)	(0.619)	(0.020)	(0.715)
Industry FE	No	No	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
Month-Year FE	Yes	Yes	Yes	Yes
Observations	12,379	12,379	12,379	12,379
R-squared	0.330	0.460	0.382	0.494

Notes: This table presents results of estimating linear regression models on a panel dataset of bond-month observations between 2018 and 2023. I regress the *BA spread* on a *GBS listing* indicator. In column (1) I include country and month-year fixed effects. In column (2) I add control variables for bond and issuer characteristics. The specification in column (3) includes industry, country and month-year fixed effects. In column (4) I add controls to the specification of column (3). *BA spread* is calculated as the ratio of the difference between ask and bid prices to the mid-price of the two per bond and day and then averaged over the month (in %). *GBS listing* is an indicator that is equal to one if bond *i* is listed on a GBS in month *t* and zero otherwise. Robust standard errors clustered at the trading venue level are reported in parenthesis. All variables are winsorized at the 1st and 99th percentiles. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Detailed variable definitions can be found in Appendix A.

Table 8: The association between listing on GBS and information asymmetry - The role of high information asymmetry

Panel A: Median split along bond size

	BA spread	
	Large issues	*Small issues*
	(1)	(2)
GBS listing	-0.073**	-0.129***
	(0.032)	(0.031)
Test for differences in GBS (p-value)	0.040	
Controls	Yes	Yes
Industry FE	Yes	Yes
Country FE	Yes	Yes
Month-Year FE	Yes	Yes
Observations	5,086	7,293
R-squared	0.611	0.517

Panel B: Sample split into IG versus high yield & unrated bonds

	BA spread	
	IG	*HY & Unrated*
	(1)	(2)
GBS listing	-0.060***	-0.215**
	(0.021)	(0.091)
Test for differences in GBS (p-value)	0.398	
Controls	Yes	Yes
Industry FE	Yes	Yes
Country FE	Yes	Yes
Month-Year FE	Yes	Yes
Observations	8,296	4,083
R-squared	0.633	0.538

Notes: This table presents results from sample splits estimating linear regression models on a panel dataset of bond-month observations between 2018 and 2023. I regress the *BA spread* on the *GBS listing* indicator. In Panel A, I split bonds along the median in *bond size* into large and small issues. Controls included are *Senior, Rated, Interest rate risk, Bond age, Volatility, Issuer size* and L*everage*. In Panel B, the sample is split into IG bonds in one subsample and high-yield (HY) and unrated bond in the other subsample. Controls included are B*ond size, Senior, Interest rate risk, Bond age, Volatility, Issuer size* and *Leverage*. *BA spread* is calculated as the ratio of the difference between ask and bid prices to the mid-price of the two per bond and day and then averaged over the month (in %). *GBS listing* is an indicator that is equal to one if bond *i* is listed on a GBS in month *t* and zero otherwise. Robust standard errors clustered at the trading venue level are reported in parenthesis. A constant is included but not reported. All variables are winsorized at the 1st and 99th percentiles. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Detailed variable definitions can be found in Appendix A.

Table 9: The association between listing on GBS and information asymmetry - High vs. low disclosure GBS

	BA spread			
	(1)	(3)	(2)	(4)
GBS listing low	-0.062*	-0.061*	-0.039*	-0.034
	(0.032)	(0.034)	(0.023)	(0.025)
GBS listing high	-0.162***	-0.194***	-0.168***	-0.196***
	(0.044)	(0.044)	(0.041)	(0.055)
Bond size		-0.059*		-0.085**
		(0.031)		(0.036)
Senior		-0.026		-0.001
		(0.021)		(0.024)
Rating		-0.131*		-0.113*
		(0.072)		(0.064)
Interest rate risk		0.147***		0.162***
		(0.019)		(0.019)
Bond age		-0.019		0.000
		(0.021)		(0.020)
Volatility		0.021***		0.019***
		(0.005)		(0.005)
Issuer size		-0.062***		-0.056**
		(0.015)		(0.023)
Leverage		0.156		0.235
		(0.097)		(0.172)
Constant	0.677***	1.824***	0.672***	2.083***
	(0.022)	(0.618)	(0.018)	(0.683)
F-test (p-value) for difference *GBS_low(0/1)* and *GBS_high(0/1)*	0.051	0.023	0.003	0.011
Industry FE	No	No	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
Month-Year FE	Yes	Yes	Yes	Yes
Observations	12,379	12,379	12,379	12,379
R-squared	0.334	0.465	0.387	0.501

Notes: This table presents results of estimating linear regression models on a panel dataset of bond-month observations between 2018 and 2023. I regress the *BA spread* on a *GBS listing low* and *GBS listing high* indicator. In column (1) I include country and month-year fixed effects. In column (2) I add controls for bond and issuer characteristics. Column (3) includes country, industry and month-year fixed effects. Column (4) estimates the model from (3) including control variables. *BA spread* is calculated as the ratio of the difference between ask and bid prices to the mid-price of the two per bond and day and then averaged over the month (in %). *GBS listing low* is an indicator that is equal to one if bond *i* is listed in month *t* on a GBS with below median *Disclosure Score* and zero otherwise. *GBS listing high* is an indicator that is equal to one if bond *i* is listed in month *t* on a GBS with equal or above median *Disclosure Score* and zero otherwise. *Disclosure score* ranges from 0 to 10 with a median of 5 (split across the 19 trading venues in the sample). Robust standard errors clustered at the trading venue level are reported in parenthesis. All variables are winsorized at the 1st and 99th percentiles. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Detailed variable definitions can be found in Appendix A. The *Disclosure Score* is explained in Appendix C.

Table 10: Differences in disclosure characteristics and external review mechanisms

	GBS listing = 1						GBS listing = 0						
	N	Mean	SD	Min	Median	Max	N	Mean	SD	Min	Median	Max	Diff.
Aggregated indicators													
At-issuance high disclosure	242	0.640	0.481	0.000	1.000	1.000	240	0.517	0.501	0.000	1.000	1.000	0.124**
Post-issuance high disclosure	242	0.558	0.498	0.000	1.000	1.000	240	0.521	0.501	0.000	1.000	1.000	0.037
External Review	242	0.835	0.372	0.000	1.000	1.000	240	0.742	0.439	0.000	1.000	1.000	0.093**
Readability													
Readability (Framework)	242	4.833	3.082	0.000	6.248	9.843	240	4.186	3.416	0.000	6.068	9.166	0.647**
Readability (Report)	242	3.880	3.680	0.000	5.055	13.550	240	3.553	3.884	0.000	0.000	12.129	0.327
Length													
Disclosure length (Words)	242	6.209	3.879	0.000	8.363	10.063	240	5.164	4.143	0.000	7.944	9.656	1.045**
Disclosure length (Pages)	242	2.153	1.416	0.000	2.773	4.454	240	1.722	1.454	0.000	2.303	4.259	0.431**

Notes: This table presents summary statistics for the disclosure characteristics and external review mechanisms split by the *GBS listing* indicator. Statistics are presented at the bond level where a bond is either listed on a GBS during the period from 2018 to 2023 or not. Detailed variable definitions can be found in Appendix A.

Table 11: Structural equation model – Mediator analysis for textual characteristics

	Pathway		
Disclosure length (Words)	←	*GBS listing*	0.029
			(0.029)
Framework readability	←	*GBS listing*	0.063
			(0.237)
Report readability	←	*GBS listing*	0.009
			(0.228)
Controls			Yes
Industry FE			Yes
Country FE			Yes
Month-Year FE			Yes
BA spread	←	*GBS listing*	-0.117***
			(0.024)
Controls			Yes
Industry FE			Yes
Country FE			Yes
Month-Year FE			Yes

Notes: This table presents the estimates of the structural equation model for the mediator analysis. First the relationship between the GBS and the three textual characteristics is estimated. Second, the full model is estimated including *GBS listing*, *Readability (Framework), Readability (Report)* and *Disclosure length (Words)*. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. A constant is included but not reported. Standard errors are clustered at the trading venue level and presented in parenthesis. The sample and controls are equivalent to those in the main equation (1) of Table 7. The sample period is from 2018 to 2025 with 12,379 bond-month observations. Detailed variable definitions can be found in Appendix A.

APPENDIX

A Variable definitions

Table A: Definitions of variables

Variable	Definition	Source
Main dependent and independent variables		
GBS listing$_{i,t}$	The variable is an indicator that is equal to one if bond *i* is listed on a GBS in month *t* and zero otherwise.	Manual collection
GBS listing high$_{i,t}$	The variable is an indicator that is equal to one if bond *i* is listed on a GBS with above median *Disclosure score* in month *t* and zero otherwise. The *Disclosure score* is explained in Appendix C.	
GBS listing low$_{i,t}$	The variable is an indicator that is equal to one if bond *i* is listed on a GBS with below median *Disclosure score* in month *t* and zero otherwise. The *Disclosure score* is explained in Appendix C.	
BA spread$_{i,t}$	The variable is the bid-ask spread as the ratio of the difference between ask and bid prices to the mid-price of the two per bond *i* and day *d* averaged over the month *t*.	LSEG
Bond characteristics		
Bond size$_i$	Variable measuring the size of the bond as the natural logarithm of the total issued amount in USD.	LSEG
Senior$_i$	Indicator that takes value of one if bond is senior and zero otherwise.	EBMD
Rated$_i$	Indicator that takes value of one if bond has an IG rating.	LSEG
Interest rate risk$_i$	Variable measured as natural logarithm of the time until maturity.	LSEG
Bond age$_i$	Variable measured as natural logarithm of the time from issuance.	LSEG
Volatility$_{i,t}$	Variable measured as the ratio of the difference between the highest and lowest prices to the monthly average price of the individual bonds traded each month.	LSEG
VenueMic$_i$	Variable that identifies the primary trading venue where the bond is listed.	EBMD
Issuer characteristics		
Issuer size$_j$	Variable that measures issuer size as natural logarithm of total assets.	Orbis
Leverage$_j$	Variable that measures the level of leverage of the issuer calculated as long-term debt/assets ratio.	Orbis
Profitability$_j$	This variable measures the profitability of the issuer as the return on assets (ROA).	Orbis
Liquidity ratio$_j$	This variable measures the liquidity of the issuer as the ratio of current assets to current liabilities.	Orbis
Industry$_j$	Industry classification following the 2-digit SIC code.	Orbis
Green bond textual disclosure characteristics and external review mechanisms		
At-issuance high disclosure$_i$	An indicator variable that takes the value of one if for a green bond a framework and an external review in the form of a SPO or certificate is available and zero otherwise.	Manual collection

[*Table A continued.*]

Post-issuance high disclosure$_i$	An indicator variable thatthat takes the value of one if for a green bond a green bond report and an external review in the form of an assurance report (limited or reasonable) is available and zero otherwise.	Manual collection
External Review$_i$	An indicator variable that measures whether for a green bond an external review is obtained in the form of a SPO or certificate or assurance report.	Manual collection
Readability (Framework)$_i$ / Readability (Report)$_i$	The variable is a proxy for the readability of the green bond report (Report) and green bond framework (Framework). It considers average sentence length and percentage of complex words (typically a word with more than three syllables) and thereby estimates the years of formal education needed to understand the text on the first reading. Higher scores indicate material that is more difficult to read. It typically ranges from 6 (few years of full-time education needed) to 20+ (many years of full-time education needed). For better interpretability, the inverse is calculated (1/Gunning Fog Index), thus higher values mean better readability. For better interpretability it is multiplied by 100.	Textual analysis
Disclosure length (Words)$_i$	The variable is a proxy for the length of a green bond framework measured as the natural logarithm of the absolute number of words.	Textual analysis
Disclosure length (Pages)$_i$	The variable is a proxy for the length of a green bond framework measured as the natural logarithm of the absolute number of pages.	Textual analysis
Other variables:		
Number of trading venues	The variable equals the total number of trading venues reporting corporate bonds in the respective time period and country.	EBMD, own calculation
Number of trading venues with GB section	The variable equals the total number of trading venues reporting corporate green bonds in the respective time period and country.	EBMD, own calculation
Total bond listings	The variable equals the total number of bond - trading venue combinations in the respective time period and country.	EBMD, own calculation
Total Green bond listings	The variable equals the total number of green bond - trading venue combinations in the respective time period and country.	EBMD, own calculation
Share of green bond listings to total listings	The variable equals the ratio of total bond listings to total green bond listings in the respective time period and country.	EBMD, own calculation
% of European firms with green bond listing	The variable equals the percentage of EEA30 headquartered green bond issuers based on the total number of bond listings in the respective time period and country.	EBMD, own calculation
% of non-European firms with green bond listing	The variable equals the percentage of bond issuers headquartered outside the EEA30 area based on the total number of bond listings in the respective time period and country.	EBMD, own calculation

Notes: This table presents the definitions of variables used in the analyses and the source of each variable.

B Sample selection

Table B: Sample selection

	Bonds	Issuers
Green bonds in LSEG	11,276	2,790
Corporate bonds in the EBMD	44,752	6,568
Corporate green bonds on European trading venues (Initial sample)	**808**	**370**
- Bonds with missing bond-level data	-16	-5
- Bonds with missing firm-level data	-56	-26
- Bonds with missing pricing data	-217	-81
- Distressed bonds	-27	-34
- Singleton observations	-10	-3
Dataset pricing analysis (final sample)	**482**	**221**

Notes: This table presents the sample selection steps taken to create the sample of corporate green bonds used in the empirical analysis. The final sample includes 482 bonds by 221 issuers which are used to create a panel dataset on the bond-month level ranging from 2018 to 2023. The panel dataset includes 12,379 observations (the maximum would be 31,140 bond-months). This indicates that a bond is in the dataset for on average 25 months. The bonds are listed across 32 trading venues.

C Disclosure Score

I summarize the disclosure requirements of the different GBS in the *Disclosure score* to facilitate an analysis. The components of the disclosure score are presented in Table C2. I follow the possible voluntary textual disclosures and external review mechanisms available for green bonds and also rely on the disclosure score at the bond level created by Dinh et al. (2023). Thus, the disclosure score incorporates whether a framework is required, whether this framework has to follow specific standards or guidelines and whether these guidelines are limited to standards requiring a high level of transparency. Further, I consider whether an external review at-issuance is required. Post-issuance, I consider whether a green bond report is required, and whether specific information on the allocation of proceeds and impact reporting is required. I also consider the requirements for assurance of the green bond report. Then, I consider specifically for the trading venue, whether documents on the green bonds are provided on the website or whether a link to the issuer website is provided. Lastly, I consider whether the GBS has an exclusion statement that clearly specifies that a green bond is removed from the GBS in case the requirements are not fulfilled.

Table C: Components of the *Disclosure strictness score*

Component	Description
Framework	1 point if the trading venue requires a framework to be published, 0.5 points if framework is recommended, 0 points if no framework is required.
Standard for Framework	1 point if the trading venue specifies a list of standards for the framework to be published, 0 points if no standards are specified. Examples for standards are ICMA GBP, or ASEAN GBS.
ICMA, CBI or EU Taxonomy	1 point if the trading venue *only* allows reporting following ICMA's GBP, CBS by the CBI, or the EU Taxonomy. 0 points if no standard is specified, or other standards allowed.
At-issuance external review	1 point if the trading venue requires an at-issuance external review such as a certificate or SPO to be published, 0.5 points if an at-issuance review is recommended, 0 points if no at-issuance external review is required.
Post-issuance reporting	1 point if the trading venue requires post issuance reporting to be published, 0.5 points if post issuance reporting is recommended, 0 points if no post issuance reporting is required.
Post-issuance allocation report	1 point if the trading venue requires post issuance allocation report to be published, 0.5 points if post issuance allocation report is recommended, 0 points if no post issuance allocation report is required.
Post-issuance impact report	1 point if the trading venue requires post issuance impact report to be published, 0.5 points if post issuance impact report is recommended, 0 points if no post issuance impact report is required.
Post-issuance external review	1 point if the trading venue requires post issuance report to be externally reviewed, 0.5 points if post issuance report is recommended, 0 points if no post issuance external review is required.
Publication of documents on trading venue's website	1 point if the trading venue makes documents publicly available on the website, 0.5 if a link to the firm's website is provided and 0 points if none of the above applies.
Exclusion statement	1 point if the trading venue specifically publishes an exclusion statement in the guidelines, that bonds will be excluded from the GBS in case of non-compliance.

Notes: This table presents the components of the *Disclosure score* developed to quantify the level of disclosure requirements that trading venues impose on green bonds listed on a GBS. The score ranges between a minimum of zero and a maximum of ten.

D Robustness tests

To assess the robustness of my findings in my main tables (Table 7 and Table 9), I perform a set of robustness tests. The tables are present below. First, following the suggestion in Breuer and deHaan (2024) I exclude countries and industries where I do not have variation in the independent variable *GBS listing*. In my regression model, I am employing country and industry effects and low variation within these groups might impact the results. First, I remove countries, followed by industries. Results reported in Table D1, Panel A show similar coefficients than in Table 7, indicating that these groups are not substantially different from the rest of the sample. Further, in Table D1, Panel B, I replace country and industry fixed effects with issuer fixed effects. The coefficients reduce approximately in half but are still significant at 1% to 10% levels depending on the specification. The reduction can be explained by less variation. Lastly, I include fixed effects for the state of the trading venue to control for overall bond market development. Results remain robust to the inclusion of venue state fixed effects. I also perform a set of robustness tests excluding the largest trading venue (Market Axess) and countries that dominate the sample such as the US, Korea and Norway. Results remain robust (see Table D2 Panel A-C).

Table D1: Robustness tests Table 7: Addressing fixed effects and variation in *GBS listing*

Panel A: Excluding countries and industries without variation in *GBS listing*

	BA spread			
	(1)	(2)	(3)	(4)
GBS listing	-0.106***	-0.125***	-0.097***	-0.108***
	(0.036)	(0.024)	(0.032)	(0.024)
Controls	No	Yes	No	Yes
Industry FE	No	No	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
Month-Year FE	Yes	Yes	Yes	Yes
Observations	11.272	11.272	11.272	11.272
R-squared	0.298	0.432	0.346	0.463

Panel B: Issuer fixed effects

	BA spread			
	Full sample		*Excluding issuers without variation in GBS listing*	
	(1)	(2)	(3)	(4)
GBS Listing	-0.074**	-0.059**	-0.070**	-0.051*
	(0.030)	(0.026)	(0.031)	(0.026)
Controls	No	Yes	No	Yes
Issuer FE	Yes	Yes	Yes	Yes
Month-Year FE	Yes	Yes	Yes	Yes
Observations	12,378	12,378	6,950	6,950
R-squared	0.609	0.670	0.500	0.600

[*Table D1 continued.*]

Panel C: Trading venue state fixed effects

	BA spread	
	(1)	(2)
GBS listing	-0.091**	-0.089***
	(0.035)	(0.029)
Controls	No	Yes
Venue state FE	Yes	Yes
Country FE	Yes	Yes
Month-Year FE	Yes	Yes
Observations	12.379	12.379
R-squared	0.340	0.469

Notes: This table presents results for robustness test for the results in Table 7 by estimating linear regression models on a panel dataset of bond-month observations between 2018 and 2023. I regress the *BA spread* on the *GBS listing* indicator. In Panel A, I exclude countries and industries without variation in the independent variable. In Panel B, issuer fixed effects are included. In Panel C, trading venue state fixed effects are included. *BA spread* is calculated as the ratio of the difference between ask and bid prices to the mid-price of the two per bond and day and then averaged over the month (in %). *GBS listing* is an indicator that is equal to one if bond *i* is listed on a GBS in month *t* and zero otherwise. Robust standard errors clustered at the trading venue level are reported in parenthesis. A constant is included but not reported. All variables are winsorized at the 1st and 99th percentiles. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Detailed variable definitions can be found in Table A of the Appendix.

Table D2: Robustness tests Table 7: Excluding large trading venue and countries

Panel A: Exclude trading venue Market Axess (MAEL)

	BA spread		
	(1)	(2)	(4)
GBS listing	-0.141***	-0.134***	-0.138***
	(0.041)	(0.041)	(0.035)
Controls	No	No	Yes
Industry FE	No	Yes	Yes
Country FE	Yes	Yes	Yes
Month-Year FE	Yes	Yes	Yes
Observations	9,812	9,812	9,812
R-squared	0.317	0.383	0.489

Panel B: Excluding dominant countries: US, South Korea (KR) and Norway (NO)

	BA spread		
	US excluded	KR excluded	NO excluded
	(1)	(2)	(3)
GBS listing	-0.172***	-0.127***	-0.126***
	(0.038)	(0.031)	(0.026)
Controls	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Country FE	Yes	Yes	Yes
Month-Year FE	Yes	Yes	Yes
Observations	8,819	11,092	10,828
R-squared	0.505	0.470	0.529

Notes: This table presents results for robustness test for the results in Table 7 by estimating linear regression models on a panel dataset of bond-month observations between 2018 and 2023. I regress the *BA spread* on the *GBS listing* indicator. In Panel A, I exclude the largest trading venue with a GBS in my sample. In Panel B, I exclude countries that dominate the sample (United States (US), Korea (KR) and Norway (NO). *BA spread* is calculated as the ratio of the difference between ask and bid prices to the mid-price of the two per bond and day and then averaged over the month (in %). *GBS listing* is an indicator that is equal to one if bond *i* is listed on a GBS in month *t* and zero otherwise. Robust standard errors clustered at the trading venue level are reported in parenthesis. A constant is included but not reported. All variables are winsorized at the 1st and 99th percentiles. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Detailed variable definitions can be found in Table A of the Appendix.

Table D3: Robustness test Table 9: Excluding Countries and industries without variation in *GBS listing*

	BA spread			
	(1)	(2)	(3)	(4)
GBS listing low	-0.164***	-0.101***	-0.139***	-0.090***
	(0.049)	(0.036)	(0.039)	(0.027)
GBS listing high	-0.160**	-0.132**	-0.190**	-0.170***
	(0.074)	(0.064)	(0.069)	(0.055)
Controls	No	Yes	No	Yes
Industry FE	No	No	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
Month-Year FE	Yes	Yes	Yes	Yes
Observations	11,841	11,841	11,841	11,841
R-squared	0.210	0.406	0.309	0.457

Notes: This table presents results for robustness tests for the results in Table 9 estimating linear regression models on a panel dataset of bond-month observations between 2018 and 2023. I regress the *BA spread* on a *GBS listing low* and *GBS listing high* indicator. Specifically, countries and industry without variation in the independent variable are excluded. In column (1) I include country and month-year fixed effects. In column (2) I add controls for bond and issuer characteristics. Column (3) includes country, industry and month-year fixed effects. Column (4) estimates the model from (3) including control variables. *BA spread* is calculated as the ratio of the difference between ask and bid prices to the mid-price of the two per bond and day and then averaged over the month (in %). *GBS listing low* is an indicator that is equal to one if bond *i* is listed in month *t* on a GBS with below median *Disclosure Score* and zero otherwise. *GBS listing high* is an indicator that is equal to one if bond *i* is listed in month *t* on a GBS with equal or above median *Disclosure Score* and zero otherwise. *Disclosure score* ranges from 0 to 10 with a median of 5 (split across the 19 trading venues in the sample). Robust standard errors clustered at the trading venue level are reported in parenthesis. A constant is included but not reported. All variables are winsorized at the 1st and 99th percentiles. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Detailed variable definitions can be found in Table A of the Appendix. The *Disclosure Score* is explained in Appendix C.

E Manual checks of green bond listings

Table E: Manually confirmed green bond listings on GBS

Country	VenueMic	VenueName	# Green bonds in final dataset	# Green bonds identified to be currently placed on GBS	# Previously delisted green bonds	% of correctly identified green bonds on GBS
Luxembourg	XLUX	Bourse De Luxembourg	15	12	2	93%
Luxembourg	EMTF	Euro MTF	25	20	3	92%
Netherlands	XAMS	Euronext Amsterdam N.V.	2	2	0	100%
Norway	XOSL	Oslo Boers Main Market	66	64	0	97%
Ireland	XMSM	Euronext Dublin	9	9	0	100%
France	XPAR	Euronext Paris Sa	3	3	0	100%
France	XMLI	Euronext Access	2	2	0	100%
Belgium	MLXB	Euronext Access Brussels	1	1	0	100%

Note: This table presents support for the identification strategy of green bonds on GBS. First, the number of green bonds in the dataset is presented. Second, the subset of those bonds that are placed on the GBS as manually coded. Bonds that were already delisted at this point but are still in the dataset are excluded. Lastly, the percentage share of correctly identified green bonds on a GBS is presented. Data for Luxembourg trading venues is obtained from the website at https://www.luxse.com/search, data on the remaining trading venues that belong to Euronext is obtained from a list published by Euronext at https://live.euronext.com/en/products/fixed-income/esg-bonds?field_type_value=2057 (both websites were accessed on 15 February 2025).

Supplementary materials

Lighting the Green: The Role of Green Bond Sections in the European Market

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Supplementary material A: Examples of green bond disclosures

Extract of the allocation and impact report from Evonik's green bond report 2023[1]

Amount of Proceeds allocated to Eligible Green Projects

As of December 31, 2023, Evonik has allocated €170 million to Eligible Green Projects to finance new projects with capital expenditures in 2023, thereof:

1. €81 million were allocated to capital expenditures related to projects of "**Next Generation Technologies**"
2. €89 million were allocated to capital expenditures related to projects of "**Next Generation Solutions**"

Thereby Evonik has, together with expenditures allocated in 2023 (please see the "Evonik Green Bond Allocation and Impact Report 2022"), completed the allocation of €750 m proceeds of its green senior bond issued in 2022.

Allocation 2023

GBP/GLP Category	Eligibility Criteria	Allocation Amount (in € m)
Eco-efficient products acting as low carbon transition enablers and sustainability enablers in various industries	**Next Generation Solutions** Capex	89
	Next Generation Solutions RD&I Opex	-
Energy Efficiency	**Next Generation Technologies** Capex	81
	Expenditure related to additional measures to increase energy efficiency	-
Renewable Energy	Expenditure related to sourcing of renewable energy	-
Total Eligible Green Projects		**170**

Evonik has set scope 1 and 2 targets and put in place a wide range of measures to reduce GHG emissions by ongoing development of production processes and infrastructure ("**Next Generation Technologies**"). In 2023 Evonik invested €81 million in "**Next Generation Technologies**" projects. The proceeds from the green senior bond were allocated to capital expenditures for these projects.

One example of such kind of projects is the construction of a new facility in Singapore for carbon-neutral production of alkoxide catalysts, which are primarily used in biodiesel production and in synthesis applications in the pharmaceutical and agricultural industries. In future, alkoxide catalysts will also play a bigger role in the circular economy through their use in the chemical recycling of PET plastics. Another example is the expansion of production capacity for MetAMINO® (DL-methionine) in Singapore.

[1]Access full report at https://www.evonik.com/de/investor-relations/bonds-rating/green-finance/green-finance.html (accessed 5 January 2025).

Sustainability impacts of "Next Generation Solutions" and "Next Generation Technologies"

GBP/GLP Category	UN SDG	Sustainability impact metric	Impact result
Eco-efficient products acting as low carbon transition enablers and sustainability enablers in various industries		Sales of all "**Next Generation Solutions**" in 2023: • Amount • Percentage of total sales[1]	 **~€ 6.1 billion** **43%**
		CO_2e avoided by using selected "**Next Generation Solutions**" sold in 2023:	**48.2 million metric tons CO_2e**
Energy Efficiency		Scope 1 and Scope 2 CO_2e emissions to be annually avoided from 2026 through investments into "**Next Generation Technologies**" currently being implemented:	**170,000 metric tons CO_2e p.a. from 2026**

[1] The sustainability analysis covers all external sales of our chemicals manufacturing divisions. Consequently, the Technology & Infrastructure division is not part of the scope.

Supplementary material B: Details on the introduction of green bond sections

In order to be listed on a GBS on the European market the green bond has to be listed on a trading venue. One trading venue operator such as Luxembourg stock exchange can, for example, operate two trading venues one RM and one MTF. This listing ensures that the bond fulfills all regulations with respect to market transparency, regulation and investor protection, set out by the European Securities and Markets Authority (ESMA). In addition, the trading venue operator can introduce a GBS and thereby set further requirements specifically for use-of-proceeds green bonds.

[Insert Table B1 and Figure B1 about here.]

Trading venues on the European market are heterogenous with respect to the disclosure requirements set upon green bonds listed on their GBS. I manually collect information on whether a trading venue has a GBS and the strictness of the disclosure requirements. I use the list of trading venues provided in the EBMD by Franke et al. (2025). Table B1 provides an overview of the trading venues with a GBS. First, the table presents some basic information on the trading venue such as the country where the trading venue is located, the *VenueMic* which is the unique market identifier code (MIC) for a trading venue following ISO 20022, the name of the venue, and the market type. Further, specific information on the GBS is provided. This includes the name of the GBS, the launch month of the GBS, details on the disclosure requirements in the form of a *Disclosure Score* and the source where the information was collected from. In Figure B1, I provide visually an overview of the introduction of GBS across European trading venues from 2015 until 2023.

Table B1: List of trading venues with GBS and disclosure strictness score

Country	VenueMic	VenueName	market_type	GBS	GBS Launch Month	Disclosure score	Source
Austria	WBGF	Wiener Boerse AG Geregelter Freiverkehr	RM	Vienna ESG Segment	2018-03	10	https://www.wienerborse.at/uploads/u/cms/files/emittenten/anleihen/regelwerk-vienna-esg-segment.pdf
Austria	WBDM	Wiener Börse AG	MTF	Vienna ESG Segment	2018-03	10	https://www.wienerborse.at/uploads/u/cms/files/emittenten/anleihen/regelwerk-vienna-esg-segment.pdf
Austria	WBAH	Wiener Börse AG	RM	Vienna ESG Segment	2018-03	10	https://www.wienerborse.at/uploads/u/cms/files/emittenten/anleihen/regelwerk-vienna-esg-segment.pdf
Belgium	MLXB	Euronext Access Brussels	MTF	ESG Bonds Platform	2019-11	5	https://www.euronext.com/en/list-products/bonds/esg-bonds
Belgium	XBRU	Euronext Brussels	RM	ESG Bonds Platform	2019-11	5	https://www.euronext.com/en/list-products/bonds/esg-bonds
Belgium	ALXB	Euronext Growth Brussels (Alternext)	MTF	ESG Bonds Platform	2019-11	5	https://www.euronext.com/en/list-products/bonds/esg-bonds
Denmark	FNDK	First North Denmark	MTF	Sustainable Debt	2018-05	8	https://www.nasdaq.com/solutions/listing-of-sustainable-bonds https://www.nasdaq.com/docs/2024/04/25/Nasdaq-Sustainable-Bond-Criteria.pdf
Denmark	XCSE	Nasdaq Copenhagen A/s	RM	Sustainable Debt	2018-05	8	https://www.nasdaq.com/solutions/listing-of-sustainable-bonds https://www.nasdaq.com/docs/2024/04/25/Nasdaq-Sustainable-Bond-Criteria.pdf
Estonia	FNEE	Nasdaq OMX Tallinn Aktsiaselts	MTF	Sustainable Debt	2018-05	8	https://www.nasdaq.com/solutions/listing-of-sustainable-bonds https://www.nasdaq.com/docs/2024/04/25/Nasdaq-Sustainable-Bond-Criteria.pdf
Estonia	XTAL	Nasdaq Tallinn Aktsiaselts	RM	Sustainable Debt	2018-05	8	https://www.nasdaq.com/solutions/listing-of-sustainable-bonds https://www.nasdaq.com/docs/2024/04/25/Nasdaq-Sustainable-Bond-Criteria.pdf
Finland	FNFI	First North Finland	MTF	Sustainable Debt	2018-05	8	https://www.nasdaq.com/solutions/listing-of-sustainable-bonds https://www.nasdaq.com/docs/2024/04/25/Nasdaq-Sustainable-Bond-Criteria.pdf
Finland	XHEL	Nasdaq Helsinki Oy	RM	Sustainable Debt	2018-05	8	https://www.nasdaq.com/solutions/listing-of-sustainable-bonds https://www.nasdaq.com/docs/2024/04/25/Nasdaq-Sustainable-Bond-Criteria.pdf
France	XMLI	Euronext Access	MTF	ESG Bonds Platform	2019-11	5	https://www.euronext.com/en/list-products/bonds/esg-bonds
France	ALXP	Euronext Growth Paris	MTF	ESG Bonds Platform	2019-11	5	https://www.euronext.com/en/list-products/bonds/esg-bonds

Country	VenueMic	VenueName	market_type	GBS	GBS Launch Month	Disclosure strictness score	Source
France	XPAR	Euronext Paris Sa	RM	ESG Bonds Platform	2019-11	5	https://www.euronext.com/en/list-products/bonds/esg-bonds
Germany	FRAV	Frankfurter Wertpapierboerse (Freiverkehr - Off Book))	MTF	Segment für Green Bonds	2018-11	6,5	https://www.boerse-frankfurt.de/wissen/wertpapiere/anleihen/green-bonds https://www.boerse-frankfurt.de/anleihen/green-bonds
Germany	FRAB	Frankfurter Wertpapierboerse (Freiverkehr)	MTF	Segment für Green Bonds	2018-11	6,5	https://www.boerse-frankfurt.de/wissen/wertpapiere/anleihen/green-bonds
Germany	FRAU	Frankfurter Wertpapierboerse (Regulierter Markt - Off-book)	RM	Segment für Green Bonds	2018-11	6,5	https://www.boerse-frankfurt.de/wissen/wertpapiere/anleihen/green-bonds
Germany	FRAA	Frankfurter Wertpapierboerse (Regulierter Markt)	RM	Segment für Green Bonds	2018-11	6,5	https://www.boerse-frankfurt.de/wissen/wertpapiere/anleihen/green-bonds
Germany	FRAW	Frankfurter Wertpapierboerse (Scale Off-book)	MTF	Segment für Green Bonds	2018-11	6,5	https://www.boerse-frankfurt.de/wissen/wertpapiere/anleihen/green-bonds
Germany	FRAS	Frankfurter Wertpapierboerse (Scale)	MTF	Segment für Green Bonds	2018-11	6,5	https://www.boerse-frankfurt.de/wissen/wertpapiere/anleihen/green-bonds
Germany	XETU	Frankfurter Wertpapierboerse Xetra (Regultiertermarkt Off-book)	RM	Segment für Green Bonds	2018-11	6,5	https://www.boerse-frankfurt.de/wissen/wertpapiere/anleihen/green-bonds
Greece	ENAX	Hellenic Exchanges - Athens Stock Exchange Sa	MTF	ATHEX BONDS GREENet	2019-10	7,5	https://www.athexgroup.gr/web/guest/athex-bonds-greenet https://www.athexgroup.gr/documents/10180/6359829/Resolution+ATHEX+BONDS+GREENet+Final.pdf/86a84bdf-b8b1-40a2-9626-cbac549b51e6
Greece	XATH	Hellenic Exchanges - Athens Stock Exchange Sa (cash Market)	RM	ATHEX BONDS GREENet	2019-10	7,5	https://www.athexgroup.gr/web/guest/athex-bonds-greenet https://www.athexgroup.gr/documents/10180/6359829/Resolution+ATHEX+BONDS+GREENet+Final.pdf/86a84bdf-b8b1-40a2-9626-cbac549b51e6
Iceland	XICE	Nasdaq Iceland Hf.	RM	Sustainable Debt	2018-05	8	https://www.nasdaq.com/solutions/listing-of-sustainable-bonds https://www.nasdaq.com/docs/2024/04/25/Nasdaq-Sustainable-Bond-Criteria.pdf
Ireland	XMSM	Euronext Dublin	RM	ESG Bonds Platform	2019-11	5	https://www.euronext.com/en/list-products/bonds/esg-bonds

Country	VenueMic	VenueName	market_type	GBS	GBS Launch Month	Disclosure strictness score	Source
Ireland	XEYE	The Irish Stock Exchange Plc Global Exchange Market	MTF	ESG Bonds Platform	2019-11	5	https://www.euronext.com/en/list-products/bonds/esg-bonds
Italy	ETLX	Borsa Italiana S.P.A.	MTF	Green and Social bonds list	2017-03	4	https://www.borsaitaliana.it/obbligazioni/greenbondsbridge/accediallalista.en.htm
Italy	MOTX	Borsa Italiana S.P.A. - Mot	RM	Green and Social bonds list	2017-03	4	https://www.borsaitaliana.it/obbligazioni/greenbondsbridge/accediallalista.en.htm
Latvia	XRIS	Nasdaq Riga As	RM	Sustainable Debt	2018-05	8	https://www.nasdaq.com/solutions/listing-of-sustainable-bonds https://www.nasdaq.com/docs/2024/04/25/Nasdaq-Sustainable-Bond-Criteria.pdf
Latvia	FNLV	Nasdaq Riga As (first North Latvia)	MTF	Sustainable Debt	2018-05	8	https://www.nasdaq.com/solutions/listing-of-sustainable-bonds https://www.nasdaq.com/docs/2024/04/25/Nasdaq-Sustainable-Bond-Criteria.pdf
Lithuania	XLIT	Nasdaq Vilnius, Ab	RM	Sustainable Debt	2018-05	8	https://www.nasdaq.com/solutions/listing-of-sustainable-bonds https://www.nasdaq.com/docs/2024/04/25/Nasdaq-Sustainable-Bond-Criteria.pdf
Lithuania	FNLT	Nasdaq Vilnius, Ab (first North Lithuania)	MTF	Sustainable Debt	2018-05	8	https://www.nasdaq.com/solutions/listing-of-sustainable-bonds https://www.nasdaq.com/docs/2024/04/25/Nasdaq-Sustainable-Bond-Criteria.pdf
Luxembourg	XLUX	Bourse De Luxembourg	RM	Luxembourg Green Exchange	2016-09	9	https://www.luxse.com/discover-lgx/how-to-join-lgx?tab=0
Luxembourg	EMTF	Euro MTF	MTF	Luxembourg Green Exchange	2016-09	9	https://www.luxse.com/discover-lgx/how-to-join-lgx?tab=0
Malta	IFSM	Institutional Financial Securities Market	RM	Malta Stock Exchange Green Market	2021-02	7,5	https://www.greenfinanceplatform.org/policies-and-regulations/malta-stock-exchange-green-market
Malta	XMAL	Malta Stock Exchange	RM	Malta Stock Exchange Green Market	2021-02	7,5	https://www.greenfinanceplatform.org/policies-and-regulations/malta-stock-exchange-green-market
Netherlands	XAMS	Euronext Amsterdam N.V.	RM	ESG Bonds Platform	2019-11	5	https://www.euronext.com/en/list-products/bonds/esg-bonds
Netherlands	MANL	MarketAxess NL B.V.	MTF	Green Bond Trading	2020-01	0	https://www.marketaxess.com/trade/green-bonds
Norway	XOSL	Oslo Boers Main Market	RM	ESG Bonds Platform	2015-01	5	https://www.euronext.com/en/list-products/bonds/esg-bonds
Poland	WMTF	Warsaw Stock Exchange	MTF	Warsaw Sustainable Segment	2023-06	2,5	https://gpwcatalyst.pl/declarations
Poland	WBON	Warsaw Stock Exchange	RM	Warsaw Sustainable Segment	2023-06	2,5	https://gpwcatalyst.pl/declarations

Country	VenueMic	VenueName	market_type	GBS	GBS Launch Month	Disclosure strictness score	Source
Portugal	ENXL	Euronext Access Lisbon	MTF	ESG Bonds Platform	2019-11	5	https://www.euronext.com/en/list-products/bonds/esg-bonds
Portugal	XLIS	Euronext Lisbon	RM	ESG Bonds Platform	2019-11	5	https://www.euronext.com/en/list-products/bonds/esg-bonds
Spain	MARF	Mercado Alternativo De Renta Fija	MTF	ESG Bonds	2019-10	0	https://www.bolsasymercados.es/bme-exchange/en/Listing/Fixed-Income/esg-bonds
Spain	SEND	Mercado De Renta Fija, AIAF	RM	ESG Bonds	2019-10	0	https://www.bolsasymercados.es/bme-exchange/en/Listing/Fixed-Income/esg-bonds
Spain	XDRF	Mercado De Renta Fija, AIAF	RM	ESG Bonds	2019-10	0	https://www.bolsasymercados.es/bme-exchange/en/Listing/Fixed-Income/esg-bonds
Spain	MERF	Mercado Electrã³nico De Renta Fija, MERF	RM	ESG Bonds	2019-10	0	https://www.bolsasymercados.es/bme-exchange/en/Listing/Fixed-Income/esg-bonds
Sweden	FNSE	Nasdaq First North Sweden	MTF	Sustainable Debt	2018-05	8	https://www.nasdaq.com/solutions/listing-of-sustainable-bonds https://www.nasdaq.com/docs/2024/04/25/Nasdaq-Sustainable-Bond-Criteria.pdf
Sweden	XSTO	Nasdaq Stockholm Ab	RM	Sustainable Debt	2015-06	8	https://www.nasdaq.com/solutions/listing-of-sustainable-bonds https://www.nasdaq.com/docs/2024/04/25/Nasdaq-Sustainable-Bond-Criteria.pdf
United Kingdom	XLOM	London Stock Exchange Non-aim MTF	MTF	Sustainable Bond Market (SBM)	2015-06	8	https://docs.londonstockexchange.com/sites/default/files/documents/sbm_application_terms_and_conditions_effective_as_at_19_february_2021_1.pdf https://docs.londonstockexchange.com/sites/default/files/documents/sustainable-bond-market-issuer-application.pdf
United Kingdom	XLON	London Stock Exchange Regulated Market	RM	Sustainable Bond Market (SBM)	2015-06	8	https://docs.londonstockexchange.com/sites/default/files/documents/sbm_application_terms_and_conditions_effective_as_at_19_february_2021_1.pdf https://docs.londonstockexchange.com/sites/default/files/documents/sustainable-bond-market-issuer-application.pdf
United Kingdom	MAEL	MarketAxess Europe MTF	MTF	Green Bond Trading	2020-01	0	https://www.marketaxess.com/trade/green-bonds

Note: This table presents trading venues in Europe that introduced a GBS.

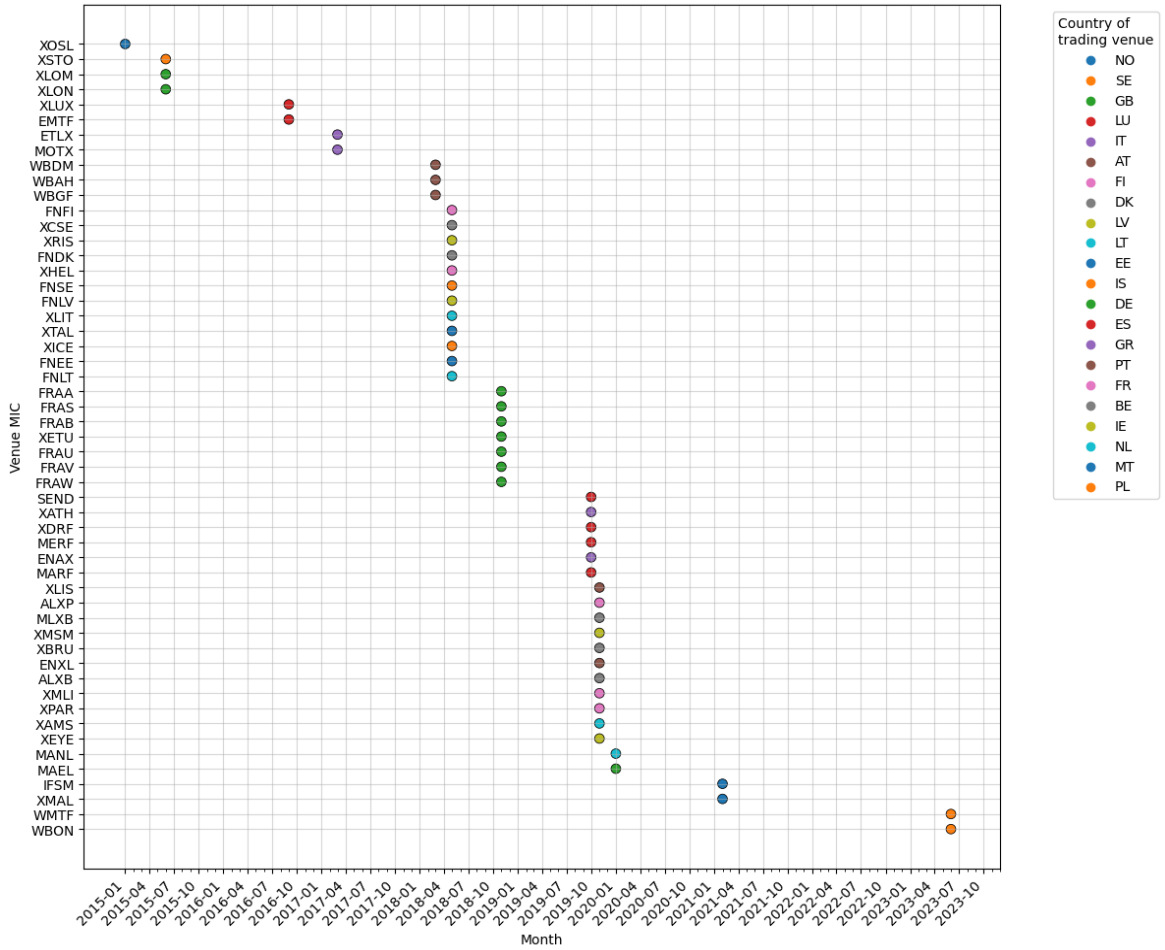

Figure B1: Timeline for introduction of GBS on trading venues located in the European market.

This figure depicts the timeline when trading venues across the EEA introduced GBS. The specific month of the introduction (x-axis), the venue's VenueMic (y-axis) and the countries are highlighted using the right legend.

Controlled risk-taking and corporate QE: Evidence from the Corporate Sector Purchase Programme*

Alexander Liss† Boaz Noiman‡ Pia Stoczek§

Abstract

We examine risk-taking by lending syndicates as a response to central banks' corporate quantitative easing (QE) targeting non-financial firms, specifically within the European Central Bank's Corporate Sector Purchase Programme (CSPP). This setting allows us to investigate how syndicates adjust to decreased credit demand from CSPP-eligible borrowers in environments characterized by higher risk and lower returns. Our analysis reveals that these syndicates engage in "controlled" risk-taking by directing capital towards first-time and non-relationship borrowers, especially in the leveraged loan sector, while implementing mechanisms to manage increased risk. Our study explores controlled risk-taking across four dimensions. Firstly, we observe adjustments in loan contracting terms, such as stricter collateral requirements and cross-default clauses, coupled with reductions in loan sizes and maturities. Secondly, our findings indicate that syndicate size and the intensity of relationships within syndicates increase. Thirdly, we highlight the influence of the borrower country's debt enforcement regime on lending decisions. Lastly, we report no significant changes in loan spreads. These results suggest that following corporate QE, syndicates actively utilize risk mitigation mechanisms, demonstrating a cautious approach to managing elevated risks rather than excessive risk-taking.

Keywords: Loan contracting, Relationship lending, Unconventional monetary policy, Quantitative easing

JEL classification: E52, E60, G12, G21, G28, G30 .

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1 INTRODUCTION

With interest rates at zero bound in many economies, central banks shifted their focus to unconventional monetary policies. New policy tools, including corporate quantitative easing (QE) programs where central banks acquire corporate bonds in the open market, have directly affected bank lending behavior through portfolio rebalancing (Grosse-Rueschkamp et al., 2019). Within the rebalancing process, lenders actively seek new lending opportunities in a search for yield by extending credit to new and riskier borrowers.[1] To mitigate potential risks, lenders have multiple ex-ante and ex-post mechanisms (Diamond, 1991). If lenders fail to implement these risk mitigation mechanisms, their actions are typically characterized as excessive risk-taking (Agur & Demertzis, 2012).[2]

In this paper, we present a nuanced examination of lenders' risk-taking behaviors after corporate QE by investigating various risk-mitigation mechanisms, a concept we define as "controlled" risk-taking. Controlled risk-taking occurs when lenders, in pursuit of higher yields, extend credit to new and riskier borrowers while simultaneously implementing mechanisms to manage their risk exposure. Ideally, when lenders engage in controlled risk-taking, the effects of monetary policy are transmitted in the intended manner. This concept stays in contrast to excessive risk-taking (Agur & Demertzis, 2012), where lenders do not adopt risk-reducing mechanisms for riskier borrowers (Ioannidou et al., 2015; Jiménez et al., 2014). Controlled risk-taking suggests that the lenders' risk exposure resulting from monetary policy interventions is less severe, thereby alleviating some concerns over financial instability.

[1]The channel through which monetary policy encourages increased risk-taking by financial institutions is described differently across the literature. In the context of conventional monetary policy, this channel is typically known as the "risk-taking channel of monetary policy", in which lower policy rates incentivize lenders to change their risk appetite (Borio & Zhu, 2012; Jiménez et al., 2014). Under unconventional monetary policies, such as corporate QE programs, this channel is termed the "portfolio rebalancing channel" or the "capital structure channel" Grosse-Rueschkamp et al. (2019).

[2]While the willingness of lenders to take on more risk may contribute to economic growth, Bernanke (2013), Stein (2013), and Rajan (2013) have raised concerns about the implications of relaxed monetary policies on financial stability.

To investigate controlled risk-taking, we focus on an important corporate QE intervention by the European Central Bank (ECB), the Corporate Sector Purchase Programme (CSPP).[3] Starting in 2016, the CSPP involves central bank purchases of investment-grade corporate bonds to boost credit supply and market liquidity. The program's main premise is that as firms with bond market access raise more capital through bond issuances, private lenders reallocate loans to those without such access. Consequently, the CSPP lowers bond yields (Abidi & Miquel-Flores, 2018), reduces private credit demand among these corporate borrowers, and shifts lending towards riskier groups like small and medium-sized enterprises (SMEs) (Ertan et al., 2024; Grosse-Rueschkamp et al., 2019).

The CSPP setting provides unique advantages for studying controlled risk-taking.[4] First, by July 2020, national central banks had invested over €219 billion in corporate bonds, with about €5 billion invested monthly, making the program an economically significant intervention in credit markets. Second, the CSPP is a novel example of direct central bank lending to nonfinancial corporations. Third, the timing of the introduction of the CSPP is less affected by economic shocks (such as the COVID-19 crisis), which supports our identification strategy. In turn, our results are less likely to be affected by alternative explanations.

We investigate controlled risk-taking in the syndicated lending market for several reasons. First, syndicated lending is one of the most significant operations in large banks and one of the largest sources of external financing for non-financial firms. Second, syndicated loans allow for additional risk-mitigation mechanisms compared to direct lending due to the multiple-lender structure (Sufi, 2007). Third, syndicated loans and bonds share key

[3]Similar corporate bond purchase settings, such as the introduction of Secondary Market Corporate Credit Facility (SMCCF) by the Federal Reserve were introduced in conjunction with other programs as a response to the Covid lockdowns in April 2020.
[4]Several central banks such as the Federal Reserve, the Swiss National Bank, and the Bank of Japan have implemented similar programs, however, during different periods.

characteristics, such as funding large capital needs, risk distribution, and secondary market trading. Thus, corporate QE policies will likely affect the syndicated lending market.

For our identification strategy, we exploit differences in lending exposure to the CSPP in a difference-in-differences design, similar to studies by Grosse-Rueschkamp et al. (2019) and Berg et al. (2024). Based on syndicated lending data from Dealogic and publicly available data from the ECB on eligible borrowers, we are able to differentiate lenders and lending syndicates in their exposure to CSPP-eligible borrowers when the program was introduced. High CSPP-exposed lenders form the treatment group, while lenders with low exposure form our control group. One strength of our setting is that the CSPP announcement was not anticipated by capital markets, providing a valid source of exogenous variation. We also support our identification strategy by showing that lenders in the treatment and control group show similar pre-trends in lending to eligible borrowers, first-time borrowers and new-relationship borrowers. Additionally, the total number of loans remains constant for both groups before and after the CSPP. Only treated lenders reduce lending to eligible borrowers after the CSPP while the control group's lending stays on a similar level than before the CSPP. This supports previous evidence that eligible borrowers tend to explore new financing options by accessing corporate bond markets (Galema & Lugo, 2021).

Our empirical analysis yields the following findings. First, we document evidence for changes in capital allocation by treated lenders. In line with previous studies on monetary policy interventions and risk-taking (e.g., Arce et al., 2018; Borio & Zhu, 2012; Grosse-Rueschkamp et al., 2019; Ioannidou et al., 2015), we find evidence that treated lenders reduce lending to eligible borrowers compared to the control group. We particularly investigate the role of lead arrangers, given their dominant role in negotiating loan terms and assembling the syndicate. Findings show that treated lead arrangers reallocate lending following the introduction of corporate QE to first-time and new-relationship borrowers. Further, treated lead arrangers that

predominantly lend to new borrowers do so within the leveraged loan segment-i.e., the riskier segment of the market. Thus, these analyses confirm that exposed lenders approach new and riskier borrowers-i.e., a higher risk-taking.

Next, we explore controlled risk-taking after corporate QE within the syndicated lending market. We argue that lenders extend credit to new and riskier borrowers while simultaneously implementing mechanisms to cap their risk exposure at a certain limit, a mechanism, which we call "controlled" risk-taking. We explore controlled risk-taking across four key dimensions: loan contract terms, syndicate structure, debt enforcement practices within the borrower's jurisdiction, and loan pricing.

First, we examine controlled risk-taking through the adjustment of loan contracting terms, typically set by the lead arranger at the syndicate level. Therefore, we categorize a syndicate as treated if at least one lead arranger is highly exposed to the CSPP. Using a difference-in-differences approach, we assess changes in loan contracting among treated syndicates. These changes may include increasing collateral, reducing loan amounts, shortening maturities for earlier renegotiation, and adding cross-default clauses to safeguard against borrower defaults on other obligations. Conversely, borrowers might struggle to meet higher collateral demands or oppose reduced loan sizes and shorter maturities. Our findings indicate controlled risk-taking: syndicates with CSPP exposure tend to enforce stricter collateral requirements and cross-default clauses, while also reducing loan sizes and maturities. These adjustments are economically significant across all variables, suggesting a heightened risk associated with loans post-corporate QE, while proactively responding in modifying loan contract terms.

Second, we investigate controlled risk-taking through the adjustment of the syndicate size and relationship lending between syndicate members. Lead arrangers might increase the number of lenders in a deal to enhance risk sharing or decrease it to assume greater risk.

Additionally, they may prefer adding familiar lenders over new lenders to the syndicate. Our findings reveal that corporate QE correlates with a higher syndicate size. In particular, treated syndicates have more participants, though not increasing the number of lead arrangers. Specifically, in the leveraged loan segment, treated lead arrangers intensify relationships with known participants, contrasting with no significant changes in the investment-grade segment. This suggests that exposed lead arrangers bolster existing relationships with other lenders to expand syndicate size and risk sharing in response to the heightened risks from unconventional monetary policies, opting for risk-averse loan contracting with familiar lenders.

Third, we investigate how exposed syndicates form new relationships with riskier borrowers, conditional on the borrower's legal jurisdiction. A high level of debt enforcement and insolvency procedures can prevent loan defaults ex ante. Moreover, a high debt enforcement regime can facilitate easier loan contracting for lenders after corporate QE. In line with our previous results, we find evidence that new borrower-lender relationships are formed in countries characterized by high legal efficiency. In particular, lending syndicates give out loans to riskier borrowers-i.e., in the leveraged loan market-when there is a high level of debt enforcement available. In contrast, we find no effects in countries with low legal efficiency as well as for investment grade loans regardless of the country's legal efficiency. These results undermine that lenders rather tend to engage in risk-taking if they are protected by high debt enforcement in case of a borrower's default.

Fourth, we examine controlled risk-taking via the adjustment of loan pricing. Exposed syndicates may adjust their loan pricing by raising their loan spreads to account for increased risks. Our findings show no significant increases in loan spreads to compensate for additional risks. More critically, we also observe no reductions in loan spreads among exposed syndicates. Therefore, these results do not support excessive risk-taking by lenders, aligning more closely with the concept of controlled risk-taking.

From the perspective of evaluating monetary policy, our study provides new insights into how lenders manage risk following monetary policy interventions, specifically after corporate QE. We recognize that the efficacy of risk mitigation mechanisms and monetary policy transmission may vary with loan size, from small and medium-sized loans to syndicated lending, and across different countries and jurisdictions. Nonetheless, our findings suggest lenders *can* engage in controlled risk-taking post-corporate QE to manage risk exposure. Furthermore, our results indicate that the impact of corporate QE on lending markets and the broader economy might be more controlled than previously understood.

The paper is structured as follows: Section 2 presents our contribution to related literature. Section 3 presents the institutional background. Section 4 discusses our identification strategy and data. Section 5 analyzes the effect of the CSPP on lenders' capital allocation and risk-taking. Section 6 presents empirical results on controlled risk-taking by lenders. Finally, section 7 concludes.

2 RELATED LITERATURE

Our results contribute to three strands within the literature. First, we contribute to the literature on monetary policy and the risk-taking of lenders (Kashyap & Stein, 1994). Research in this field investigates both conventional and unconventional monetary policy. This body of work addresses why the Modigliani-Miller theorem fails for banks when bonds and bank loans are non-substitutable and explores how credit supply mediates monetary policy's economic impact (e.g., Campello, 2002; Gambacorta & Mistrulli, 2004; Kashyap & Stein, 1995, 2000). Recent research has shifted to explore the risk-taking channel of conventional monetary policy, analyzing how lower interest rates enhance financial institutions' risk-taking and affect risk premia (Adrian & Shin, 2010; Borio & Zhu, 2012).[5] For unconventional monetary policy, the

[5]Further studies have delved into how lower policy rates modify bank behavior (Jiménez et al., 2014; Maddaloni & Peydró, 2011) and impact consumer credit (Agarwal et al., 2018; Agarwal et al., 2022).

significant effects of negative interest rates on banks' risk taking have been closely examined (Heider et al., 2019). We provide evidence that corporate QE relaxes the financial constraints of members in lending syndicates and affects lending behavior, thereby, illustrating controlled risk-taking by exposed syndicates.

Second, we add to the growing literature on the effects of unconventional monetary policy interventions, especially on the effects of corporate QE. Asset purchase programs such as the CSPP have become a common policy tool once interest rates approached the zero bound. Most studies in this field focus on how stealth recapitalization through sovereign bond purchases and the subsequent price appreciation of bank securities impacts bank lending in a U.S. setting (Brunnermeier et al., 2021; Di Maggio et al., 2016; Kandrach & Schlusche, 2021). In contrast, the CSPP works through a different channel: the portfolio rebalancing channel, in which the bond market becomes more lucrative to raise new capital (Grosse-Rueschkamp et al., 2019; Zaghini, 2019). A large body of literature has studied the effects of the CSPP and provides evidence for the portfolio rebalancing channel.[6] Results show that eligible firms and those whose bonds are purchased by the ECB substitute bank debt with bonds. In particular, a set of studies show the transmission of unconventional monetary policies such as the CSPP to the private debt market (e.g., Arce et al., 2021; Berg et al., 2024; Ertan et al., 2024; Grosse-Rueschkamp et al., 2019) yet not providing systematic evidence on the potential risk mitigating (or risk-increasing) effects of exposed lenders.

The main takeaway from these studies is that when eligible firms reduce their demand (Ertan et al., 2024) for loans, private lenders reallocate lending to ineligible, riskier firms (Grosse-Rueschkamp et al., 2019), small and medium enterprises and unproductive sectors such

[6]A set of studies also investigate the effects of CSPP on bond pricing and issuances. For instance, Zaghini (2019) find a reduction in yield spreads within the first year in the primary market while Todorov (2020) find a reduction in bid-ask spreads and increased liquidity for bonds of eligible firms. Then, studies provide evidence for an effect on firms' financing decisions and access to bond markets (e.g., Galema & Lugo, 2021; Grosse-Rueschkamp et al., 2019).

as real estate asset managers (Berg et al., 2024). Arce et al. (2021), who study the substitution effect in a Spanish setting, provided early evidence on tighter credit conditions, reflected through more collateral and shorter maturities. Our study contributes to this discussion by examining lenders' use of risk-mitigating mechanisms through loan contracting within the syndicated lending market, particularly focusing on the effects of the CSPP across the Euro area. We further refine the existing literature by detailing how lending syndicates respond to increased risks in their portfolios, considering the unique risk-mitigating mechanisms they utilize.

Third, our paper contributes to the literature on the determinants and formation of lending syndicates. Prior work examines how the syndicate's structure and debt contracting adapt to shifts in risk factors at both the firm- and industry levels, including the borrower's information environment (Sufi, 2007), patent disclosures (Saidi & Žaldokas, 2021), and financial situation (Godlewski, 2010; Lee & Mullineaux, 2004). While Cahn et al. (2024) investigate how unconventional monetary policy is transmitted based on borrower-lender relationships, the ways in which varying monetary and legal environments influence the structure and contracting of lending syndicates remain less understood.

3 INSTITUTIONAL BACKGROUND

3.1 The Corporate Sector Purchase Program

Since the 2007 financial crisis, the ECB has announced several asset purchase programs aiming to stabilize prices, stimulate the economy, and create jobs in the Eurozone.[7] These programs mainly targeted sovereign bond purchases as well as other interest rates to stimulate the European economy.

[7]See Krishnamurthy et al. (2018) for a review on the different ECB policies targeting government bond purchases and their potential channels.

On March 10, 2016, the ECB announced a novel program aimed directly at the corporate sector (ECB, 2016). Under the CSPP, launched in June 2016, central banks in the Eurozone purchase corporate bonds of non-financial firms in the primary and secondary markets. Effectively, the CSPP injects new credit into capital markets of the European currency area to spur economic growth and develop the European corporate bond market. Corporate bonds are eligible under the CSPP if they satisfy the following six criteria: (1) denominated in euros; (2) have an investment-grade credit rating (as determined by Standard & Poor's, Moody's, Fitch Ratings, or DBMS); (3) have remaining maturity longer than six months, but shorter than 31 years at the time of purchase; (4) satisfy eligible collateral requirements under the Euro system collateral framework for credit operations; (5) issued by a company incorporated in the euro area, but may have a parent company outside of the Eurozone; and (6) issued by a non-bank corporation, whereby both the issuer and its parents are not subject to banking supervision.

Under the supervision of the ECB, the following six national central banks carry out bond purchases based on the geographic location of the borrower: Belgium, Finland, France, Germany, Italy, and Spain. Purchases of corporate bonds take place in the primary and secondary markets. These national central banks can buy up to 70% of the outstanding amount of a unique bond. On the issuer-group level, there is an unspecified cap to ensure "a diversified allocation of purchases across issuers" (ECB, 2016). Further, the ECB refrains from announcing the total volume it intends to purchase each week to allow flexibility in providing additional liquidity to bond markets if needed. Therefore, purchases are supposed to be made market-neutral and not favor a specific country or industry.

Until the end of 2019, the ECB bought roughly €5.5 billion of corporate bonds per month. In total numbers, CSPP holdings of the ECB amounted to around €185 billion in 2019. Holding other factors constant, this monthly injection of liquidity increases the attractiveness of bonds and leads to a decrease in demand for borrowing from lending syndicates by eligible

borrowers (Arce et al., 2021). Given the unexpected announcement as well as the severity of the liquidity injection, the CSPP serves as a plausible natural experiment to examine controlled risk-taking after corporate QE.

3.2 Syndicated lending and unconventional monetary policy

We investigate our research question in the European syndicated loan market, which has several unique features that make it suitable for our study. First, syndicated lending is one of the most significant operations for commercial credit in banks and one of largest sources of external financing for nonfinancial firms (e.g., Berg et al., 2024; Gorton & Winton, 2003; Sufi, 2007). Primarily, European firms rely on bank-based financing for larger projects (Bats & Houben, 2020).

Second, syndicated lending provides a unique setting for investigating controlled risk-taking and its monetary policy implications as information frictions exist between borrowers and lenders and between lead arranger and participants (Sufi, 2007). A syndicated loan is issued to a borrower by multiple lenders, serving as either lead arrangers or syndicate participants. In the syndication process, the lead arrangers establish the initial connection with the borrower and are responsible for information collecting, screening, and monitoring post loan origination. Lending syndicates differ from direct lending primarily in the larger size of the loan deal, and the risk sharing attributes that the multiple lender structure offers.

Third, because syndicated loans and bonds share key characteristics-such as the funding of large capital needs, risk distribution, and secondary market trading-the syndicated lending market is likely to be significantly affected by corporate QE programs such as the CSPP. Syndicated loan markets also experience stronger movements with banking crises and economic recessions (Godlewski, 2010; Lee & Mullineaux, 2004; Sufi, 2007). Lastly, syndicated lending also allows for relationship lending between lead arrangers and participants. Relationship lending is more prevalent in loan syndicates funding opaque and riskier borrowers

(Sufi, 2007). Studies also show that relationship lending can facilitate more efficient negotiation between syndicate lenders, resulting in faster loan origination (Godlewski, 2010) and more efficient restructuring in cases of financial distress (Lee & Mullineaux, 2004). Thus, relationship lending can be valuable to alleviate increased risks.

Syndicated loans can also be differentiated based on their risk profile into investment grade or leveraged loans. Especially, the leveraged loan segment has grown extensively in recent years, serving as a substitute for non-investment grade bonds (Bruche et al., 2020). While investment grade loans are typically issued to borrowers with a credit rating of BBB- or higher, leveraged loans reflect a higher default risk of the borrower and are typically issued by borrowers with lower credit ratings. Leveraged loans are typically used for operations such as buyouts, acquisitions, or recapitalizations, where higher leverage is involved (Nini & Smith, 2023). The rise in leveraged loans could also be attributed to the quantitative easing of monetary policy and the prevalence of zombie lending (Acharya et al., 2019).

4 DATA, SAMPLE AND IDENTIFICATION

4.1 Data and sample

We use different data sources to investigate controlled risk-taking after corporate QE. First, our main data source for syndicated lending contracts is Dealogic.[8] The database includes information on syndicated lending deals and their individual tranches. We treat each tranche of a deal as one loan. Second, data on eligible bonds stems from the ECB. We further use bond data from Dealogic in order to identify firms in our syndicated lending sample that have CSPP eligible bonds outstanding. We match the loan data to the ECB's eligible bond data in two steps. In the first step, we get a list of bond issuers from Dealogic. Then, we match the ECB's list of eligible bonds to the Dealogic bond data using the ISIN of the bond and create a list of

[8]In comparison to other syndicated lending databases such as DealScan, Dealogic has a broader coverage of syndicated loans especially for the European syndicated loan market.

eligible borrowers. In the second step, using the borrower parent name that is equal in the Dealogic loan and bond datasets, we identify eligible borrowers in the syndicated loan market. To construct relationship lending and relationship intensity measures, we use Dealogic loan data from 2007 until 2018 in order to have a sufficiently large timeframe.

For our final dataset, we exclude loans issued by financial institutions and government entities.[9] We also exclude very small loans, which are below $20 million, and loans issued outside the Euro area.[10] We further exclude loans with missing variables following the regression specifications. To minimize the effect of other confounding factors and events, our sample period is five years from 2014 until 2018 (we have a pre-period of eight quarters and a post-CSPP period of eleven quarters).[11] Our final dataset includes 6,902 loans issued by 642 lenders. A table on the sample selection is presented in Appendix B. We rely on the classification of Dealogic to identify a lead arranger on the loan deal.[12]

[Insert Table 1 about here.]

We present some facts on the Euro area syndicated lending market based on our final sample in Table 1. Between 2014 and 2018, 6,902 syndicated loans are issued to corporate borrowers. During this time 642 lenders are actively lending in the market. Lenders take on different roles (lead arranger or participant) within the syndicates they participate in. We consider a lender as

[9]We exclude loans where the borrower parent according to Dealogic's industry classification belongs to the following industries: finance, closed end funds, insurance, government, holding companies, or real estate/property.
[10]In particular, the effect of the "Brexit" might affect our inferences (Berg et al., 2021). Thus, we have excluded other non-Eurozone countries such as Great Britain. Results remain qualitatively the same, when included.
[11]Our sample period from 2014 until 2018 is also less affected by other potential explanations. First, in the wake of the European sovereign debt crisis between the years 2011 and 2012, the ECB has implemented several other asset purchase programs and policies such as Outright Monetary Transaction (OTM) program, which may affect our inferences (Acharya et al., 2019). Second, commercial banks implemented the expected credit loss model of IFRS 9 in the end of 2018, which affected both lending behavior and profitability of many European banks (Ertan et al., 2024).
[12]In Dealogic, we specifically use information on loan level on the Lead Left Parent, Bookrunner Parent and the MLA Parent (Mandated Lead Arranger Parent). A "lead left" bookrunner is a single bookrunner appointed to run the whole general syndication phase. The lead-left book runner plays the most important role in the transaction and will typically assign parts of the new issue to other underwriting firms for placement while retaining the most significant portion for themselves. Consequently, we first consider the lead left parent, followed by the bookrunner parent and if neither is available the MLA parent.

lead arranger when this is the role in a syndicate for a specific loan deal. A syndicate issuing one loan comprises on average 3.37 lead arrangers and 2.56 participants and has a volume of $695.05 million.[13] Further, loans have an average maturity of 77.73 months (6.6 years) and a median maturity of 60 months (5 years). 71% of loans are investment grade and 44% collateralized. 31% are revolver loans and 7% Term loan B or below. We split lenders into bank lenders (commercial banks) and other types of lenders (e.g., investment firms and hedge funds). Bank lenders dominate slightly with 63%. A lender issues on average loans with an amount of $71 million and a maturity of 72 months (6 years). The share of investment grade loans is high with on average 70% in a lender's portfolio.

[Insert Figure 1 and 2 about here.]

We show distribution of syndicated loans by country in Figure 1. Most loans in our sample stem from France, Germany, Italy, the Netherlands, and Spain. Additionally, we show distribution of loans by industry in Figure 2. Most loans in our sample are issued by borrowers in the utility and energy industry, followed by the construction industry. Remaining loans are distributed evenly.

[Insert Figure 3 about here.]

An alternative explanation of our study could be that the CSPP changed the attractiveness of the syndicated loan market and therefore the frequency of loan issuances, as lenders could move their lending towards SME credit markets or other operations. To alleviate these potential concerns, we plot the number of syndicated loans issued around the corporate QE introduction, as depicted in Figure 3. The time trend indicates no significant drop or rise in

[13]Our descriptive loan statistics are comparable to other studies in the European syndicated loan market. For instance, Heider et al. (2019) reports average syndicated loan amounts of 740 million, an average maturity of 59 months, and an average number of lead arrangers of 3.64.

the number of loans issued. This result stresses that the syndicated loan market is still a viable lending option for both lenders and borrowers.

4.2 Identifying exposed lenders

Our paper exploits disparities in the exposure of lenders towards monetary policy interventions (e.g., Rodnyansky & Darmouni, 2017). In particular, we exploit the varying exposure of syndicated lenders to eligible borrowers under the CSPP. First, we identify borrowers affected by the CSPP by determining which bonds are eligible and their eligibility period. Following Galema and Lugo (2021), we use the ECB's published list of eligible assets to select corporate bonds denominated in euros and issued by non-financial corporations in Eurozone countries. From this sample, we identify corporate borrowers with an eligible bond outstanding on the CSPP announcement date. More details on this selection process are available in Appendix C.

In the second step, we identify lenders affected by the CSPP. Following the methodologies outlined in Berg et al. (2024) and Grosse-Rueschkamp et al. (2019) we categorize lenders into treatment and control groups based on their exposure to CSPP-eligible borrowers. We assume that CSPP-eligible borrowers are more likely to leave the private debt market after the CSPP, as they can obtain cheaper financing in the bond market.[14] Initially, we construct a lender-level exposure measure, ($CSPP\_exposure_{it}$) by calculating the ratio of loans to CSPP-eligible borrowers to the total number of loans per year, where i indexes the lender and t the year:

$$CSPP\_exposure_{it} = Number\ loans\ to\ eligible\ borrowers_{it} \,/\, Total\ number\ loans_{it}$$

Using this exposure measure, we then identify our treatment group-i.e., lenders with high CSPP exposure. We include in our sample lenders that were active in 2014 or 2015 and extended credit to at least one CSPP-eligible borrower. A median split is performed to classify

[14]Todorov (2020) finds evidence that eligible borrowers are likely to issue new corporate bonds to refinance themselves. Firms also tailor their new bond issuances to become eligible for purchase by the ECB Pegoraro and Montagna (2021).

lenders with an above-median percentage of CSPP-eligible borrowers in their portfolio in either of the two years as "Exposed lenders":

$$Exposed\ lender_i = (CSPP\_exposure_{i2014} > p50 \mid CSPP\_exposure_{i2015} > p50)$$

Our control group is comprised of lenders that had a below median percentage of CSPP-eligible borrowers in their portfolio and also lenders that did not lend to CSPP-eligible borrowers in the two years before the CSPP.[15]

We present detailed summary statistics for all lenders and the subsample of lead arrangers separately for the treatment and control groups in Appendix D. On average, treated lenders issue 31% of their loans to eligible firms, compared to just 5% for control group lenders, and generally issue larger loans. Despite similar loan maturities and proportions of collateralized loans between groups, treated lenders have a higher proportion of revolver loans. The presence of Term Loan B or below is similarly low across both groups, at 8%-9%. Treated lenders extend a lower percentage of loans to first-time and new-relationship borrowers. The share of leveraged loans is similar across both groups, indicating comparable risk profiles in their portfolios. To illustrate our identification strategy, we tabulate the largest banks and non-banks and their exposure to the CSPP. Results are reported in Appendix E of the paper. In particular, the largest exposed lenders in the syndicated loan market are BNP Paribas, HSBC, and Uni Credit with an exposure of more than 30%.

[Insert Figure 4 about here.]

In support of our parallel trend assumption, we plot the average number of loans issued by lenders in the treatment and control group in Figure 4. While lenders in the treatment group issue on average more loans per quarter than lenders in the control group, we do not observe

[15]To ensure a comprehensive analysis, our control group includes lenders that did not lend to CSPP-eligible borrowers, provided they are involved in syndicated loan deals exceeding $20 million within the Euro Area. This approach excludes specialized and small lenders, thereby mitigating potential biases and ensuring the inclusion of a representative sample of the market.

any differences in the trends of the pre-period. Thus, we are confident that the results in the following empirical analyses are not driven by sudden reductions or increases in the number of loans issued by one of those groups.

5 CORPORATE QE AND LENDER RISK TAKING

In this section, we examine the transmission of corporate QE within the European syndicated lending market. In line with previous evidence on the different channels of monetary policy, we expect that CSPP-exposed lenders and specifically CSPP-exposed lead arrangers to reduce loan issuances to eligible borrowers. Further, we expect exposed lenders to redirect capital and increase loan issuances to new and potentially riskier borrowers.

5.1 Corporate QE's impact on lender loan share

We begin by investigating changes in the share of loans given out by CSPP-exposed lenders. Our panel dataset on lender-quarter level comprises 3,027 observations between 2014 and 2018. We estimate the following regression model within a difference-in-differences design:

$$Y_{it} = \beta_1(Exposed\ Lender_i \times Post_t) + \beta_2 X_{it} + \gamma_i + \gamma_t + \varepsilon_{it} \quad (1)$$

Where Y_{it} measures the share of loans given out by lender i in quarter t to a specific borrower group compared to the total number of loans issued. Specifically, we investigate the loan share to three borrower groups: the share of loans to eligible borrowers (*Eligible borrower loan share*), borrowers accessing the syndicate lending market for the first time (*First-time borrower loan share*) and to new-relationship borrowers (*New-relationship borrower loan share*). We define borrowers as eligible if at least one of their bonds is on the ECBs list for eligible assets in the two years prior to the CSPP. First-time borrowers are borrowers that have not accessed the syndicated lending market since before the financial crisis in 2007. New-relationship borrowers are defined as borrowers not having borrowed from the lender in the previous five years. New-relationship borrowers may include first-time borrowers but also borrowers that switch lenders. As previous research shows that lending syndicates increase

lending to riskier borrowers, we also investigate the share of newly issued leveraged loans (*Leveraged loan share*).

Our binary variable *Exposed lender*$_i$ identifies the treatment group, comprised of lenders with high CSPP exposure, which we contrast with lenders that have low CSPP exposure, our control group. *Post*$_t$ is an indicator variable that takes the value of one if the loan was priced after Q4 2015 and zero otherwise. Our coefficient of interest, β_1, the coefficient on the interaction term *Exposed lender*$_i$ x *Post*$_t$, measures whether for lenders with high CSPP exposure the probability for new relationships changes after the CSPP, relative to lenders with low exposure. We include a set of different control variables (X_{it}) for loan size, maturity, collateralized loans, revolver loans, term loans B or below, and gross domestic product of the borrower country (*GDP*) to alleviate other explanations. Controls are aggregated at the lender-quarter level. All variables are described in detail in Appendix A. We use lender (γ_i) and quarter (γ_t) fixed effects and cluster the analysis at the level of treatment-i.e., on lender-level (Bertrand et al., 2004). Our identifying assumption is that after including the above-mentioned controls and different fixed effect structures, treatment (high CSPP exposure) is as good as randomly assigned-i.e., that treatment and control lenders do not differ in their changes of loan shares based on unobservables.

[Insert Table 2 about here.]

Results for the impact of the CSPP on the share of eligible borrowers, first-time borrowers and new-relationship borrowers are presented in Table 2 Panel A. The CSPP is associated with a significant decrease of the loan share to eligible borrowers by 8.5-10.3 percentage points more for treated lenders as compared to the control group. For the subsample of lead arrangers, we observe a decrease of 5 percentage points. It is worth highlighting that this decrease is similar to that found by Berg et al. (2024) on a sample of German banks. The decrease is sizeable as it presents 27-33% reduction compared to the sample mean.

Given that the CSPP is associated with a decrease in loan demand from eligible borrowers, we examine if lenders reallocate credit to different borrower groups. Our findings indicate that the CSPP prompts treated lenders to redirect capital toward first-time borrowers in the European syndicated lending market, with a significant increase of 4.4 to 5.7 percentage points, depending on the specification. Treated lead arrangers increase lending by around 4.5 percentage points.[16] Furthermore, we investigate the share of loans issued to borrowers without a previous relationship with the lender. Results show an increase in loan share between 7.2 to 8.4 percentage points for all lenders in the treatment group and 6.7 percentage points for lead arrangers. All results are significant at the 1%-10% level. Consequently, we observe that treated lenders allocate a large part of their loss in the eligible borrower share to new borrowers, which includes first-time borrowers. Our coefficients are stable across different specifications with and without controls, which supports the reliability of our results.[17]

[Insert Figure 5 about here.]

Next, we explore the robustness of our loan share results. For this, we plot parallel trends graphs across our different specifications. Figure 5 illustrates the development in borrower shares over five quarters around the CSPP for the treatment and control group. Before the CSPP, our two types of lenders did not differ in lending to CSPP-eligible borrowers compared to non-eligible borrowers. After CSPP initiation, we observe that the share of eligible borrowers decreases over time for the treatment group, while we do not observe a change for the control group. We further illustrate the loan share to first-time borrowers and new-relationship borrowers. The figure presents parallel trends before the CSPP. After the CSPP, we observe more substantial increases for the treatment group than the control group. However, the control group also experiences some changes in borrower composition possibly due to spillover effects.

[16]In line with these results, Appendix F provides evidence for an increase in the likelihood of first-time borrower loan issuances by treated lenders after the CSPP.
[17]This holds also for all the following empirical analyses.

Borrowers previously obtaining loans from the control group might switch to lenders in the treatment group as capital becomes available. Consequently, lenders in the control group could also be affected by a change in demand even though not as strong as the treatment group.

[Insert Figure 6 and 7 about here.]

We plot coefficients in Figure 6 for eligible borrower share. We observe average quarterly effects, that are especially pronounced in the year after the CSPP. In Table 2 Panel B we investigate the share of leveraged loans issued by lead arrangers and see whether we can observe changes after the CSPP with respect to the riskiness of loans. We find positive but insignificant coefficients in the baseline specification. Figure 7 presents similar trends for treated and control groups and shows a slight increase in the leveraged loan share after the CSPP in both groups. Furthermore, we find that CSPP exposure is associated with a substantial increase in the share of new relationships among treated lead arrangers, leading to a 9.8 percentage point rise in the leveraged loan segment.

5.2 Corporate QE's impact on new relationships

Next, we analyze the probability for new relationships between lead arrangers and borrowers after corporate QE. While the prior lender-quarter level analysis provided an overview of syndicated lenders' responses to the CSPP, this analysis dives deeper, examining lead arranger-borrower-loan interactions to assess how the propensity for establishing new relationships changes. We use a panel dataset consisting of 41,578 unique borrower-lead arranger-loan observations between 2014 and 2018. This approach allows us to capture more granular shifts in relationship dynamics directly at the level of individual loans. Specifically, we estimate the following linear regression model:

$$New\ relationship_{ijt} = \beta_1(Exposed\ lender_i \times Post_t) + \beta_2 X_{it} + \gamma_i + \gamma_t + \gamma_{ck} + \gamma_p + \varepsilon_{it} \quad (2)$$

The dependent variable, *New relationship*$_{ijt}$, represents our measure for new relationships between lender *i* and borrower *j* at time *t*. We follow previous literature (Bharath et al., 2011; Bushman et al., 2017) and measure a new relationship as an indicator that takes the value of one if there was no loan issued by the lead arranger to the borrower in the previous five years preceding, and zero otherwise.[18] *Exposed lender*$_i$ and *Post*$_t$ are defined as before. Our coefficient of interest, β_1, the coefficient on the interaction term *Exposed lender*$_i$ *x Post*$_t$, measures whether for lenders with high CSPP exposure the probability for new relationships changes after the CSPP, relative to lenders with low exposure.

Again, we include a set of different control variables (X_{it}) for loan size, maturity, collateralized loans, revolver loans, term loans B or below, and gross domestic product of the borrower country (*GDP*) to alleviate other explanations. We further include a set of fixed effects. Depending on the specification we include lender (γ_i), quarter (γ_t), country-industry (γ_{ck}), and loan purpose (γ_p) fixed effects. We employ lender fixed effects, which allows us to investigate how lenders change borrower relationships after the introduction of the CSPP. Interacted country and industry effects control for potential industry effects within countries (e.g. the effect of strong automobile industry in Germany). Lastly, quarter fixed effects aim to eliminate time specific trends in lending behavior. We cluster standard errors at the lender level, i.e., the level of treatment (Bertrand et al., 2004). Our identifying assumption is that after including the above-mentioned controls and different fixed-effect structures, treatment (high CSPP-exposure) is as good as randomly assigned-i.e., that treatment and control lenders do not differ in their formation of new relationships with new borrowers based on unobservables.

[Insert Table 3 and Figure 8 about here.]

Results in Table 3 show that treated lead arrangers are more likely to form new relationships with borrowers (i.e., with no prior relationship in the past 5 years) by 4.1-7.7

[18]The loans in our sample have a median maturity of 5 years, see Table 1 of the paper.

percentage points compared to the control group. Splitting the sample by the loan grade into leveraged and investment grade loans shows that this increase is driven by an increase of 8.5 percentage points in the probability for new relationships in the leveraged loan segment. To further alleviate concerns about the pre-trends in the formation of new relationships between treatment and control groups, in Figure 8 we plot coefficients over five quarters before and after the CSPP for the baseline regression in Table 3 Column (1).[19]

Taken together, we find that treated lenders experience a reduction in the demand for loans by eligible borrowers and allocate financing to new borrowers that tend to be riskier. In particular, exposed lead arrangers form new relationships with these risky borrowers. These results are in line with the existence of the portfolio rebalancing channel of monetary policy within the European syndicated lending market (Grosse-Rueschkamp et al., 2019).

6 CORPORATE QE AND CONTROLLED LENDER RISK-TAKING

We proceed to explore the concept of controlled risk-taking by lenders, examining particular risk mitigation strategies they may employ. Controlled risk-taking involves lenders seeking higher returns through extending credit to new, potentially riskier borrowers, while also employing strategies to manage their risk exposure effectively. In this section, we investigate the following four dimensions of risk mitigation: First, lenders can adjust different non-price terms on the loan contract level. Second, they can adjust syndicate composition and lending relationships between the lending parties. Third, they can take the level of debt enforcement in the jurisdiction of the borrower into account. Fourth, we investigate potential changes in the pricing terms of loan contracts using loan spreads.

[19]To alleviate potential concerns about possible changes in loan demand, we follow Khwaja and Mian (2008) and estimate our different regression designs including borrower fixed effects. We present these results in Appendix G. This approach ensures that comparisons are made across banks' lending to the same firm, controlling for firm-specific demand shocks, which are absorbed by the borrower fixed effects.

6.1 Non-price loan contracting terms

First, we explore controlled risk-taking on the loan contract level. Previous literature has documented that exposed lenders do not adjust for additional risks after conventional monetary policy interventions (Ioannidou et al., 2015; Jiménez et al., 2014). Limited research on unconventional monetary policy, however, provides some indication for the adjustment of loan terms in the Spanish setting (Arce et al., 2021).

On the mechanical level, we explore the effects of the CSPP on loan contract design, specifically focusing on non-pricing terms. We investigate collateral requirements, loan size, maturity and the use of cross-default clauses. These loan contracting terms are common tools in syndicated lending to alleviate risks between borrower and lenders. Collateral, for example, is employed as a signaling mechanism for borrower's quality and as a protection mechanism for lenders in the occurrence of a default event (Benmelech et al., 2022; Rajan & Winton, 1995; Stiglitz & Weiss, 1981). Further, lenders might prefer loans of shorter maturity to control for agency problems arising from lending to new and non-relationship borrowers (Dennis et al., 2000; Gottesman & Roberts, 2004). Similarly, lenders might reduce loan amounts to lower the overall risk in case of solvency issues.

The introduction of the CSPP decreased the demand for loans from eligible borrowers. Due to the ECB's selection criteria, these include borrowers characterized by lower default risks, as either the securities issued, or the borrower itself must have an investment grade rating. Consequently, borrowers that are opaquer without an investment grade rating are left to borrow from the private debt market. Based on this motion, lenders should hedge against the incremental risk by requiring more securitization when financing riskier borrowers. However, riskier borrowers often have limited access to collateral and may lack a sufficient collateral pool to meet lenders' requirements.

To determine exposure at the loan level, we assess whether a syndicate is affected by the CSPP. For this, we define *Exposed syndicate*$_{kt}$ as an indicator variable that takes the value of one if at least one of the lead arrangers is exposed to the CSPP, zero otherwise.

$$Exposed\ syndicate_j = (\sum_l Exposed\ lead_{jl} \geq 1)$$

The independent variable, *Exposed syndicate*$_j$, measures syndicate *j*'s exposure to the CSPP. We investigate a difference-in-differences design, where our treatment group includes syndicates with high CSPP exposure, compared to those with low exposure. *Exposed syndicate*$_j$ is an indicator variable set equal to one if a lead arranger *l* in syndicate *j* is exposed, and zero otherwise. We choose to rely on the lead arranger's exposure as they have a leading role in the syndicate and influence the composition by approaching lenders to participate in the loan.[20] Given this, we estimate the following linear regression model:

$$Y_{jt} = \beta_1 Exposed\ syndicate_j + \beta_2 Post_t + \beta_3 (Exposed\ syndicate_{jt} \times Post_t) + \beta_4 X_{it} + \gamma_t + \gamma_{ck} + \gamma_p + \varepsilon_{it}. \quad (3)$$

The dependent variable Y_{jt} represents the different loan contracting mechanisms for each loan managed by syndicate *j* at time *t* with each syndicate being unique to a specific loan. We investigate the following loan contracting mechanisms: *Collateral* is an indicator variable that takes the value of one if the loan is collateralized, zero otherwise. *Loan size* is measured as the natural logarithm of the loan nominal amount. *Maturity* is measured as the number of months until the loan matures. C*ross-default clause* is an indicator that captures if the loan includes a clause that puts the borrower in default if the borrower defaults on another loan obligation.

Our coefficient of interest β_3 captures changes in loan contract design for exposed syndicates after the CSPP, compared to the control group. Again, *Post*$_t$ is an indicator variable

[20]We additionally have investigated the syndicate exposure by total exposure of both lead arrangers and participants combined. Untabulated results are similar in coefficient directions, but smaller in economic size.

that takes the value of one if the loan was priced after Q4 2015 and zero otherwise. Depending on the specification we further include control variables for loan size, maturity, revolver loan, and GDP (all variables are described in detail in Appendix A). We use robust standard errors clustered at the borrower level. Additionally, we include quarter (γ_t), country-industry (γ_{ck}), and loan purpose (γ_p) fixed effects. Our identifying assumption is that after including the above-mentioned controls and different fixed effect structures, treatment (i.e., syndicates with a large fraction of CSPP eligible borrowers in their portfolio) is as good as randomly assigned-i.e., that treatment and control syndicates do not differ in their loan contracting mechanisms based on unobservables.

[Insert Table 4 about here.]

Table 4 reports the results for the effect of the CSPP on the probability of collateralizing the loan (column (1)), changes in the size of the loan (column (2)), changes in maturity (column (3)) and on the probability of cross-default clauses (column (4)). In particular, we find that for loans issued by treated syndicates the probability of collateralizing the loan increases relative to the control group by 11.8% (compared to the sample mean of 44%), reflecting the increased risk associated with lending to newer borrowers that are potentially smaller and riskier. Furthermore, treated syndicates are associated with a reduction in the loan size by 18.5% and a reduction in loan maturity by approximately 6.2 months, which translates to a 7.97% decrease relative to the mean maturity of 77.7 months. Lastly, the CSPP is associated with an increase in the probability for the use of cross-default clauses by 4.7 percentage points. These default clauses help exposed lenders to shield themselves from any defaults in case of multiple loans to different lenders. All results are significant between the 1% and 5% level. Our results underline that CSPP-exposed lenders respond to additional risks by adjusting the loan contracting terms. While exposed syndicates lend to new and riskier borrowers after corporate QE, they *can* adjust their loan contracting terms to those riskier borrowers.

6.2 Syndicate composition and relationship intensity

Next, we explore controlled risk-taking on the syndicate structure level. First, we analyze changes in the syndicate composition. In the syndicated lending market, the composition of lending syndicates and the intensity of relationships between lead arrangers and participants play a crucial role in managing borrower risks. Strong, long-term relationships foster trust and reduce information asymmetry, enabling lenders to better assess and mitigate borrower risk. Sufi (2007) highlights how frequent and deep interactions among syndicate members enhance the structure and effectiveness of financing arrangements, particularly in environments with high information asymmetry. Similarly, Ivashina (2009) finds that prior relationships within syndicates lead to lower loan spreads, reflecting increased confidence and reduced risk perception among lenders. Furthermore, relationship banking, characterized by sustained interactions and mutual knowledge, strengthens lender-borrower ties, which can enhance credit availability and improve loan terms (Boot, 2000; Degryse & van Cayseele, 2000). Thus, it is likely that exposed syndicates change the syndicate composition after corporate QE.

We rely on equation (3) from the previous section and employ three measures to capture syndicate composition: *Number of lenders*, *Number of lead arrangers* and *Number of participants*. We conduct our analysis at the loan level, where each syndicate has a unique composition of lenders. The independent variable, *Exposed syndicate*$_j$, captures syndicate *j*'s exposure to the CSPP. Our treatment group includes syndicates with high CSPP exposure, which we compare to syndicates with low exposure.

[Insert Table 5 about here.]

Results presented in Table 5 show that all else being equal, treated syndicates significantly increase in size, with an average addition of 0.53 lenders (significant at the 5%

level). Economically speaking, this means that the number of lenders in exposed syndicates grows by approximately 8.9% more relative to the average syndicate size in the sample.

Next, we split lenders into lead arrangers and participants to investigate whether positive change in syndicate size is explained by one or both groups. Our findings indicate no significant change in the number of lead arrangers for treated syndicates. However, the results show a significantly positive increase in the number of participants, corresponding to a 17.6% increase relative to the sample mean (significant at the 5% level). This suggests that exposed syndicates modestly expand their participant base, likely as part of a strategy to distribute risk more widely or to secure more support within the syndicate structure. Especially, lead arrangers still benefit from originating the loan (origination fees etc.) by increasing the number of participants.

Building on the previous findings, we investigate the association of CSPP exposure with changes in relationship intensity between lead arrangers and participants. On one hand, the observed increases in syndicate size could be associated with forming new relationships, as some established participants may avoid syndicates with higher risk structures. On the other hand, lead arrangers might prefer to engage with existing participants, leveraging their familiarity with these participants' risk-return profiles from prior lending interactions. We assess the relationship intensity between lead arrangers and participants using a continuous measure of relationship intensity (Bharath et al., 2011). We rely on a measure of relationship intensity instead of an indicator variable because untabulated descriptives show that 97% of our lenders in our sample had previous relationships with other lenders in the previous five years resulting in low variation across lenders. This descriptive evidence stresses that syndicate lending markets are very intertwined. Thus, a measure of intensity is better suited to capture changes in both depth and strength of lending relationships between different lending parties within a syndicate.

Following previous literature (e.g., Sufi, 2007), we structure our dataset at the lead arranger-participant level with 75,065 unique lead arranger-participant-loan observations. $Exposed\ lender_j$ is an indicator variable that takes the value of one if the lead arranger is exposed to the CSPP and zero otherwise. Again, $Post_t$ is an indicator variable that takes the value of one if the loan was priced after Q4 2015 and zero otherwise. We further include control variables for maturity, revolver loan, Term loan B or below, and GDP (all variables are described in detail in Appendix A). We cluster standard errors at the lender level-i.e., the level of treatment (Bertrand et al., 2004).

We further include loan purpose (*Loan purpose FE),* lender (*Lender FE*), country-industry (*Country×Industry FE*), and quarter (*Quarter FE*) fixed effects in our specification. In particular, we employ lender fixed effects, which allows us to investigate how a lead arranger's relationship intensity changes after the introduction of the CSPP. Interacted country and industry effects control for potential industry effects within countries (e.g., the effect of strong automobile industry in Germany). Lastly, quarter fixed effects aim to eliminate time specific trends in lending behavior.

[Insert Table 6 about here.]

Results are presented in Table 6 and are consistent with the argument that lead arrangers work with existing participants. In particular, we do not observe any changes in the relationship intensity for the treatment group in our baseline regression (Column (1)). However, treated lead arrangers lending in the leveraged loan segment show a significant increase in their relationship intensity compared to the control group (Column (2)). The coefficient of 0.012 reflects an increase in relationship intensity of approximately 10% relative to the sample mean of 0.12 and 0.18 standard deviations, significant on the 5% level. In the investment-grade loan market, we observe no significant effects (Column (3)). These results suggest a moderate, economically meaningful strengthening in relationship intensity, indicating that exposed lead arrangers

slightly deepen their lending connections, likely as an adaptive measure in response to riskier borrowers in their portfolio post CSPP introduction.

6.3 Legal efficiency

Third, we investigate controlled risk-taking at the jurisdiction level and investigate how lending syndicates form new relationships with riskier borrowers, conditional on the borrower's legal jurisdiction. A high level of debt enforcement and insolvency procedures can prevent loan defaults ex ante. Moreover, a high debt enforcement regime can facilitate easier loan contracting for lenders after monetary interventions such as the CSPP. For this, we investigate how the probability of a new borrower lead arranger relationship is conditional on the jurisdiction of the borrower. The sample and is analogous to the one used in section 5.2 (Table 3) and we use the regression design presented in equation (2).

We construct a binary score to measure countries' legal efficiency related to debt enforcement following Bischof et al. (2022). More information on the score is provided in Appendix H of the paper. The *Legal efficiency* indicator shows a large heterogeneity among European countries. While countries such as Germany and France have higher legal efficiency with regard to debt enforcement, countries such as Cyprus and Greece have a low legal efficiency.

[Insert Table 7 about here.]

Results are reported in Table 7. In particular, we find that new relationships between borrowers and lenders are concentrated among high legal efficiency countries (0.059; significant on the 5% level), while we find insignificant results for low legal efficiency countries, as reported in Panel A. Thus, a high debt enforcement regime is crucial for forming a new relationship after corporate QE. Next, we split our analysis into investment grade and leveraged loans, as reported in Panel B. In particular, syndicates give out loans to riskier borrowers when there is a high level of debt enforcement (Panel B, Column (3)). In contrast,

we find insignificant effects in countries with low legal efficiency as well as for investment grade loans in high legal efficiency countries. These results undermine that risk-taking might only be apparent in countries where lenders are protected by a high debt enforcement regime.

6.4 Loan pricing terms

Finally, we investigate controlled risk-taking via adjusting pricing terms in loan contracts. The effect of a corporate QE program such as the CSPP on loan spreads remains ambiguous. On the one hand, easing monetary policy could result in lenders engaging in riskier borrowers with an even lower loan spread (Ioannidou et al., 2015; Jiménez et al., 2014). In particular, Ertan et al. (2024) found evidence for lower spreads in the SME segment after the initiation of the CSPP. On the other hand, lenders can adjust the overall spread upwards through a higher risk premium. We investigate this mechanism on a subsample of syndicated loans that have information on the loan pricing.[21] In total, our subsample has a representative sample of 1,219 syndicated loans.

[Insert Table 8 about here.]

The results presented in Table 8 align with our prior findings, showing no significant decrease in loan spreads following the initiation of the CSPP. Furthermore, the interaction effect of *Exposed syndicate x Post*, as depicted in Columns (1) and (2), does not indicate a significant increase in loan spreads. These findings suggest that lenders classified as exposed do not adjust the pricing terms for borrowers within syndicated loan contracts. More crucially, our data does not show that these lenders offer lower interest rates to riskier borrowers, indicating a lack of excessive risk-taking in the syndicated loan market.

7 CONCLUSION

In this paper, we conduct a nuanced analysis of lenders' risk-taking behaviors following the introduction of a corporate QE program by the ECB, focusing on potential risk-mitigation

[21]Dealogic does not require lenders to report the spreads of loan contracts. Thus, our analysis is limited to a constrained sample of syndicated loan contracts.

mechanisms, which we define as "controlled" risk-taking. This term describes a scenario where lenders increase their risk-taking, for example by lending to new and potentially riskier borrowers, while simultaneously implementing mechanisms to limit their exposure to risk. Specifically, lenders manage their risk exposure by utilizing various loan contract mechanisms designed to cap potential losses.

First, we provide evidence in line with the portfolio rebalancing channel for the European syndicated lending market. In our sample, treated lenders experience a reduction in loan issuances to higher-quality borrowers and reallocate capital to new-relationship borrowers and first-time borrowers. Second, we provide evidence for controlled risk-taking along three dimensions. We find that treated syndicates adjust loan contracting design. Loans issued by treated syndicates are more often collateralized, have lower maturity and size, and more often contain cross-default clauses. Additionally, treated syndicates increase the number of participants and the intensity of their relationships with participants. Third, we provide evidence for the relevance of countries' legal efficiency regimes. Finally, we find no significant decreases in loan spreads for exposed lenders. Our results indicate that lending syndicates adopt risk-mitigating mechanisms rather than taking excessive risks when redirecting capital to new borrower groups.

Our study offers fresh insights into lenders' risk management mechanisms following corporate QE. We note that the effectiveness of risk mitigation and monetary policy transmission could differ by loan size and vary across countries and jurisdictions. However, our findings reveal that lenders can undertake controlled risk-taking after corporate QE to manage their risk exposure. Additionally, our results suggest that controlled risk-taking should be considered when evaluating the effects of corporate QE policies.

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FIGURES

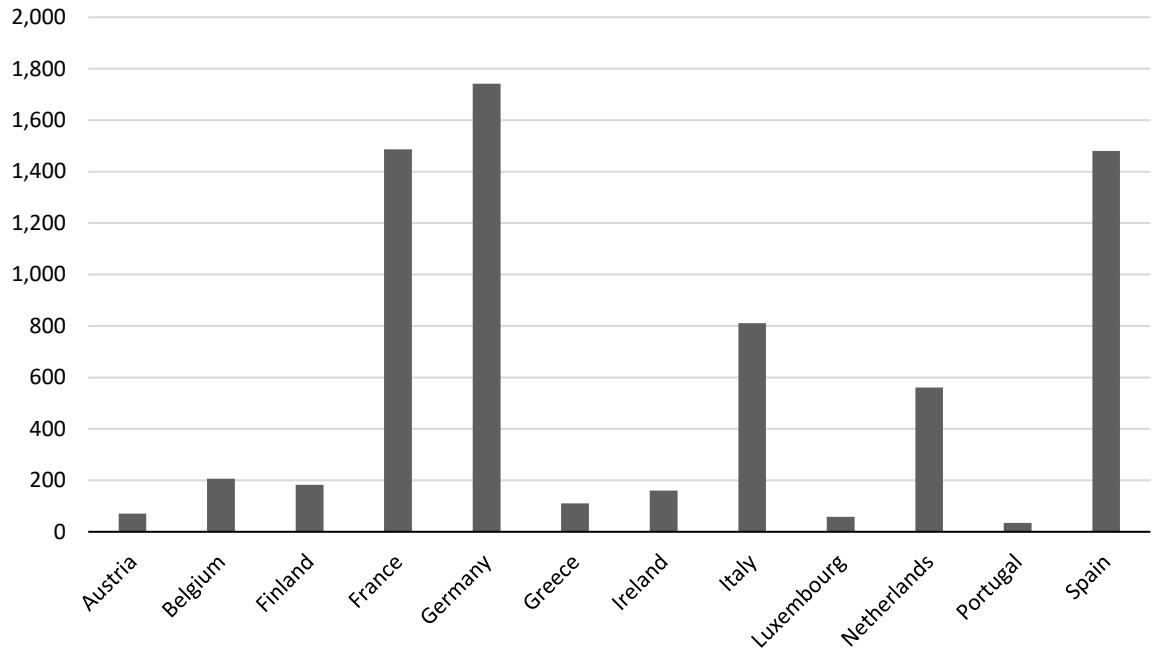

Figure 1: Loans by deal country.

Notes: This figure shows the number of loans per country for our sample of loans in the Euro area countries between 2014 and 2018.

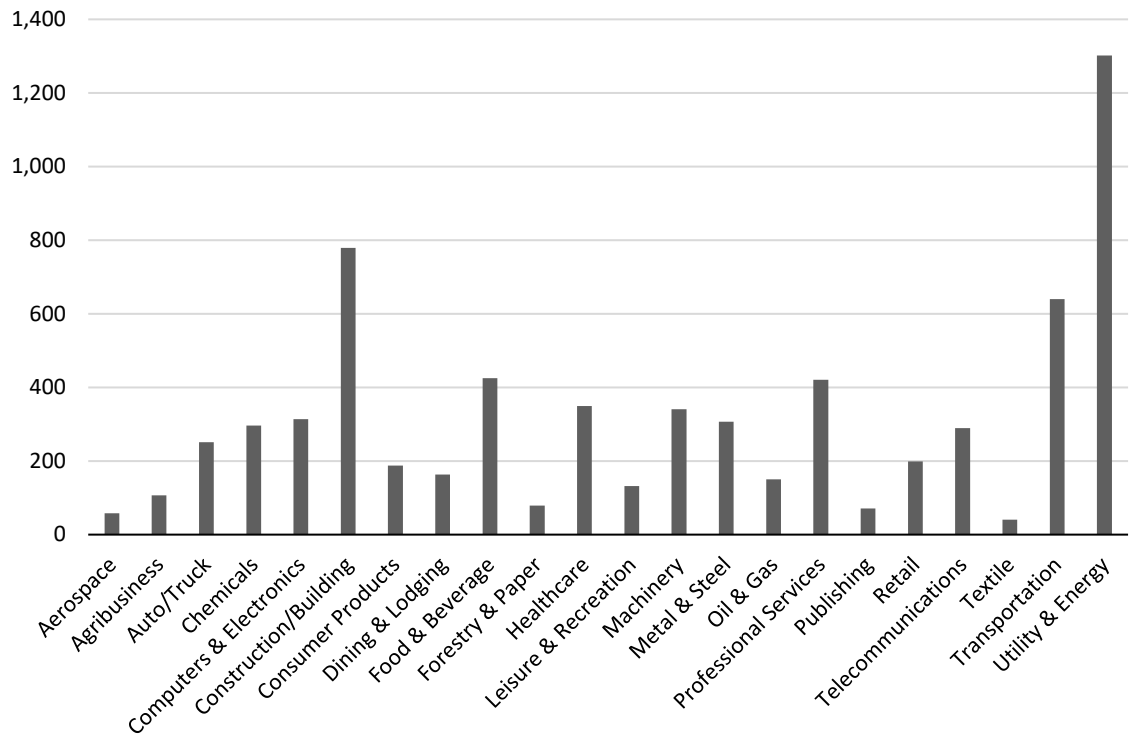

Figure 2: Loans by borrower industry.

Notes: This figure shows the number of loans per borrower industry for our main sample of loans in the Euro area countries between 2014 and 2018.

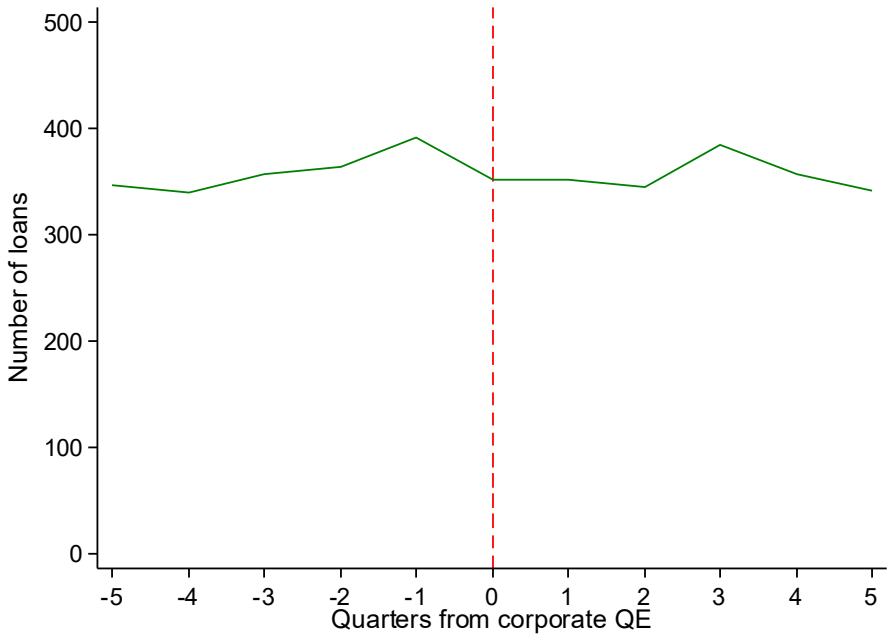

Figure 3: Number of loans issued around corporate QE.

Notes: This figure shows the number of total loans issued by syndicates with high-Exposure to the CSPP (Treated) and syndicates with low exposure to the CSPP (Control) around the corporate QE intervention.

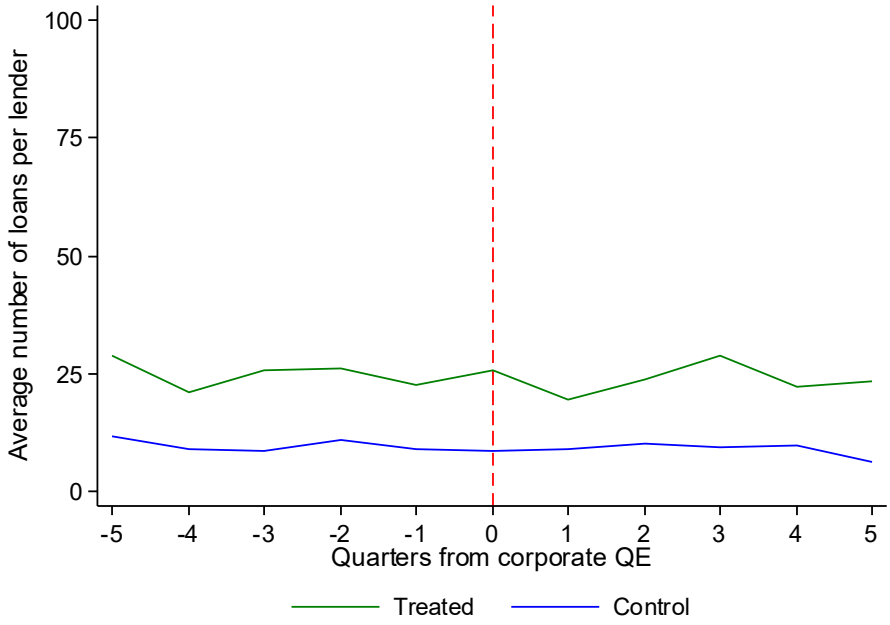

Figure 4: Average number of loans per lender issued around corporate QE.

Notes: This figure shows the average number of total loans issued by lenders with high exposure to the CSPP (Treated) and lenders with low exposure to the CSPP (Control) around the corporate QE intervention.

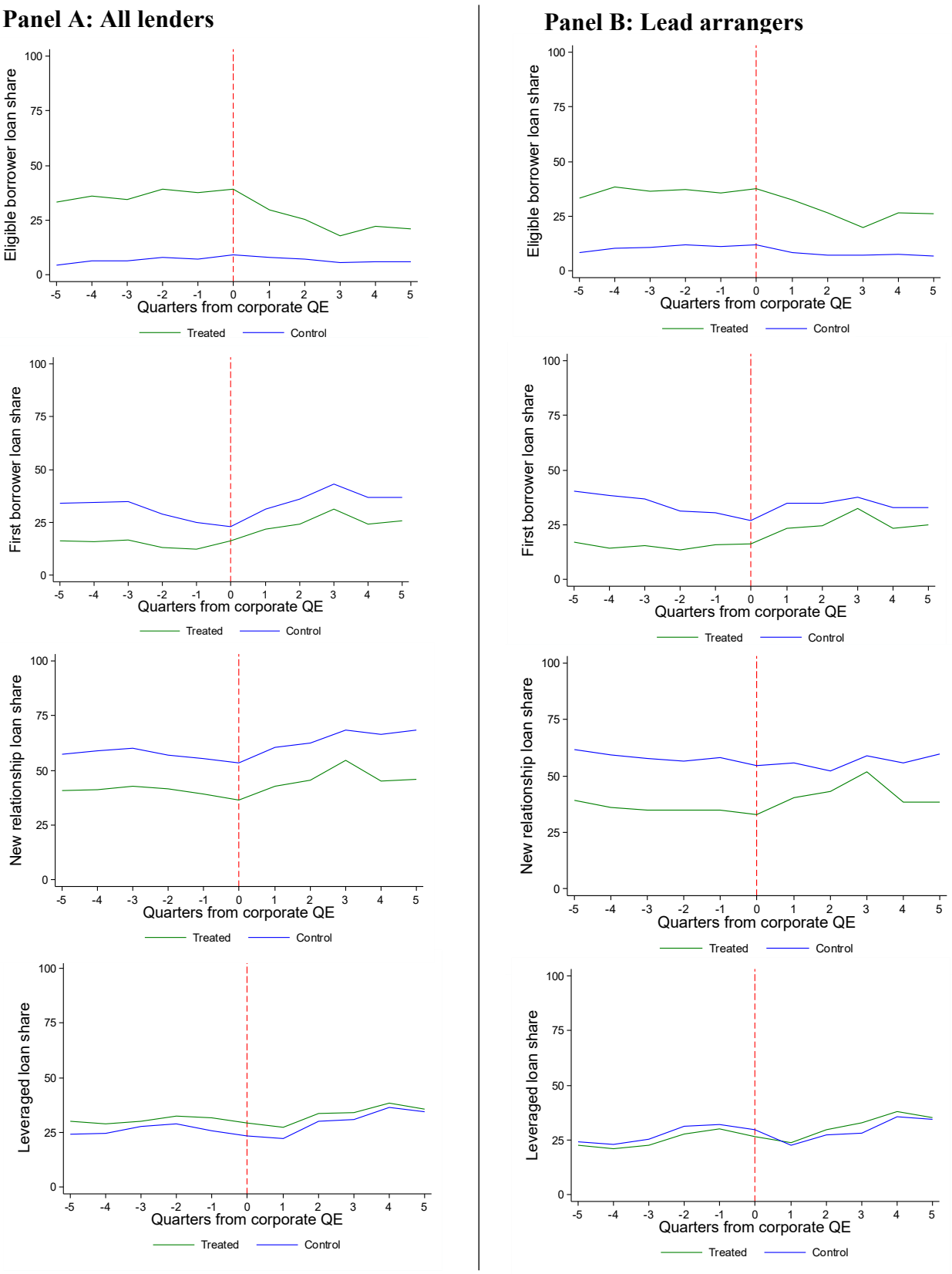

Figure 5: Parallel trends plots for lender loan share.

Notes: These figures plot the average lenders' share of loans to eligible borrowers, first-time borrowers, new-relationship borrowers and issuances of leveraged loans around the corporate QE announcement in Q4 2015. Panel A presents developments for all lenders, while Panel B presents results for the lead arranger subsample.

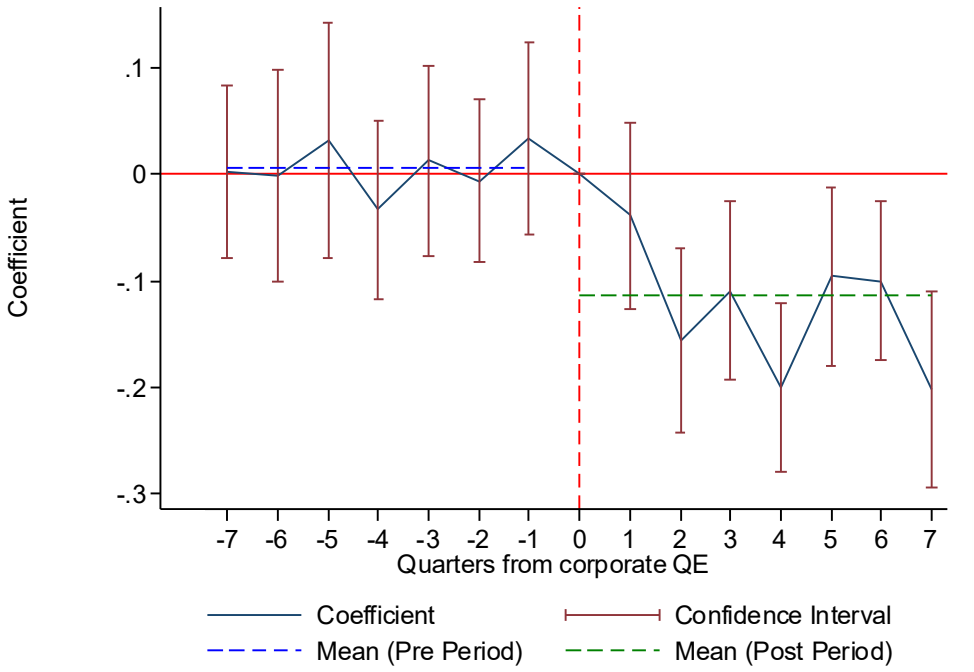

Figure 6: Coefficient plot for effect of corporate QE on share of eligible borrowers.

Notes: This figure plots the coefficients of the interaction term *Exposed lender*$_i$ *x Post*$_t$ for the baseline regression model estimated in Table 2 Panel A column (1) using equation (1). Direct vertical lines present confidence intervals at 90%.

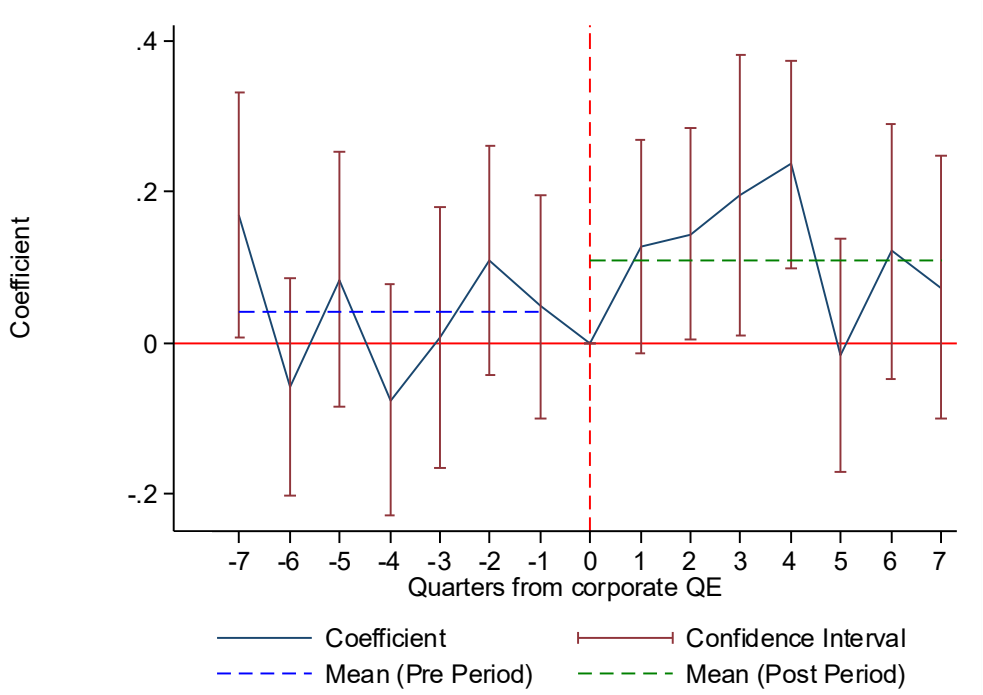

Figure 7: Coefficient plot for effect of corporate QE on share of new-relationship borrowers.

Notes: This figure plots the coefficients of the interaction term *Exposed lender*$_i$ *x Post*$_t$ for the baseline regression model estimated in Table 2 Panel A column (7) using equation (1). Direct vertical lines present confidence intervals at 90%.

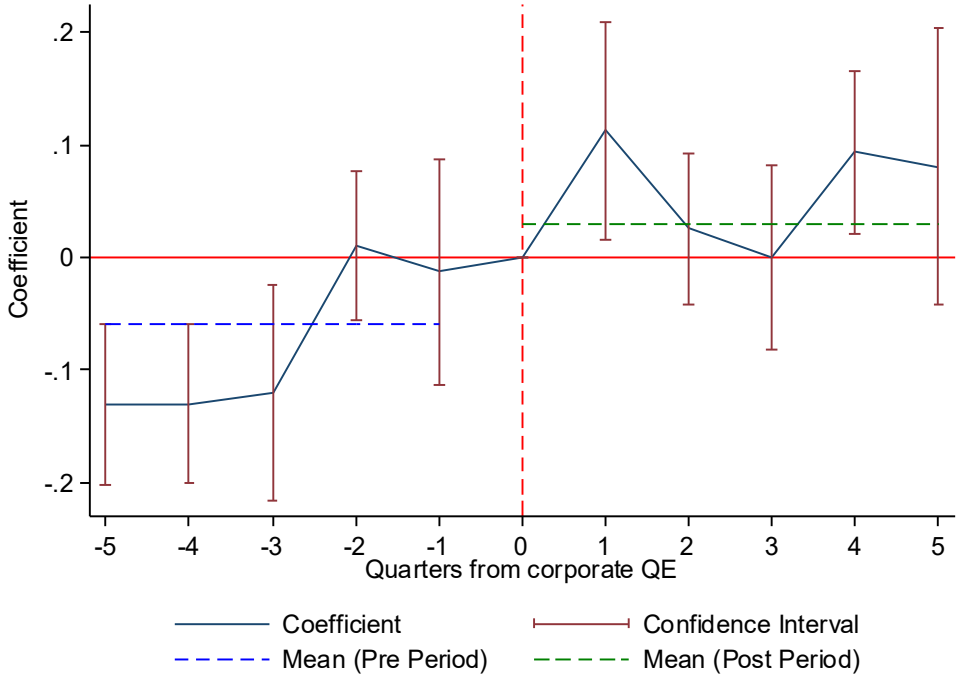

Figure 8: Coefficient plot for effect of corporate QE on new relationships between lead arrangers and borrowers.

Notes: This figure plots the coefficients of the interaction term *Exposed lender*$_i$ *x Post*$_t$ for the baseline regression model estimated in Table 3 using equation (2). Direct vertical lines present confidence intervals at 90%.

Tables

Table 1: The European syndicated lending market

Panel A: Loan-level

	N	Mean	SD	p25	Median	p75
Number lenders	6,902	5.95	4.89	3.00	5.00	8.00
Number lead arrangers	6,902	3.37	3.25	1.00	2.00	4.00
Number participants	6,902	2.56	3.52	0.00	1.00	4.00
Loan size ($ million)	6,902	695.05	2,543.46	68.22	179.64	548.47
Maturity (Months)	6,902	77.73	53.64	54.27	60.02	84.00
Investment grade (0/1)	6,902	0.71	0.45	0.00	1.00	1.00
Collateral (0/1)	6,902	0.44	0.50	0.00	0.00	1.00
Revolver (0/1)	6,902	0.31	0.46	0.00	0.00	1.00
Term loan B or below (0/1)	6,902	0.07	0.25	0.00	0.00	0.00

Panel B: Lender-level

	N	Mean	SD	p25	Median	p75
Bank lender (0/1)	642	0.63	0.48	0.00	1.00	1.00
Average loan amount ($ million)	642	71.24	89.03	20.27	40.73	86.12
Average maturity (Months)	642	72.26	41.67	51.09	59.99	77.33
Investment grade loan share	642	0.70	0.39	0.44	1.00	1.00
Collateralized loan share	642	0.34	0.40	0.00	0.16	0.71
Revolver loan share	642	0.33	0.31	0.00	0.30	0.50
Term loan B or below loan share	642	0.07	0.21	0.00	0.00	0.00
Leveraged loan share	642	0.30	0.39	0.00	0.00	0.56

Notes: This table presents descriptive statistics on the European syndicated lending market. The sample period is from 2014 to 2018. Panel A presents descriptives on syndicated loans issued during the sample period. Panel B presents lender-level descriptives for lenders in the syndicated lending market. For a detailed variable description, we refer to Appendix A.

Table 2: Loan share after corporate QE

Panel A: Lenders' loan share to eligible borrowers, first-time borrowers, and new-relationship borrowers after corporate QE

	Eligible borrower loan share			***First-time borrower loan share***			***New-relationship borrower loan share***		
	All lenders		*Lead arrangers*	*All lenders*		*Lead arrangers*	*All lenders*		*Lead arrangers*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Exposed lender x Post	-0.103***	-0.085***	-0.050**	0.057**	0.044**	0.045*	0.084***	0.072**	0.067**
	(0.018)	(0.015)	(0.019)	(0.022)	(0.021)	(0.027)	(0.029)	(0.028)	(0.031)
Average loan size		0.068***	0.102***		-0.075***	-0.065***		-0.070***	-0.099***
		(0.007)	(0.010)		(0.009)	(0.011)		(0.008)	(0.012)
Investment grade share		0.030	0.068**		0.060**	0.010		0.011	0.075*
		(0.023)	(0.029)		(0.029)	(0.050)		(0.032)	(0.043)
Collateral share		0.006	-0.041		0.044	0.010		0.077**	0.103**
		(0.020)	(0.027)		(0.029)	(0.041)		(0.036)	(0.041)
Revolver share		0.233***	0.282***		-0.145***	-0.218***		-0.180***	-0.181***
		(0.031)	(0.039)		(0.033)	(0.036)		(0.037)	(0.045)
Term loan B share		-0.117**	-0.087		0.081	-0.012		-0.015	-0.132
		(0.053)	(0.055)		(0.064)	(0.094)		(0.076)	(0.137)
Average maturity		0.000	-0.000		0.001***	0.001***		0.001***	0.001***
		(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.000)
Lender FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,027	3,027	1,735	3,027	3,027	1,735	3,027	3,027	1,735
R-squared	0.527	0.614	0.596	0.474	0.520	0.507	0.474	0.520	0.512

[Table 2 continued.]

Panel B: Lead arrangers' leveraged loan share

	Leveraged loan share			
	Baseline	*Controls*	*Below median new-relationship borrower loan share*	*Above median new-relationship borrower loan share*
	(1)	(2)	(3)	(4)
Exposed lender x Post	0.026	0.016	0.004	0.098*
	(0.023)	(0.021)	(0.021)	(0.052)
Average loan size		-0.017	-0.015	-0.018
		(0.010)	(0.013)	(0.018)
Collateral share		0.344***	0.465***	0.263***
		(0.048)	(0.060)	(0.055)
Revolver share		0.026	0.097**	-0.033
		(0.044)	(0.042)	(0.072)
Term loan B share		0.535***	0.455***	0.595***
		(0.077)	(0.085)	(0.170)
Average maturity		-0.002***	-0.002***	-0.002***
		(0.000)	(0.001)	(0.000)
Lender FE	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes
Observations	1,735	1,735	993	742
R-squared	0.547	0.636	0.729	0.683

Notes: This table displays results from a difference-in-differences analysis using linear regression models, estimating the impact of an *Exposed lender x Post* interaction term on lenders' loan shares with lender and time fixed effects. *Exposed lender* is an indicator that takes the value of one if the lender is exposed to the CSPP, and zero otherwise. *Post* is an indicator that takes value of one if the loan was priced in Q4 2015 or later, and zero otherwise. *Eligible borrower loan share* captures the share of quarterly newly issued loans to eligible borrowers to all newly issued loans. *New borrower loan share* captures the share of quarterly newly issued loans to first-time borrowers to all newly issued loans. *New-relationship borrower loan share* captures the share of quarterly newly issued loans to borrowers without a previous lending relationship to all newly issued loans and *Leveraged Loan Share* captures the share of quarterly newly issued loans in the leveraged market, compared to all issued loans. The analysis is based on data from 2014 to 2018. A detailed variable description can be found in Appendix A. Results are based on values of variables which are winsorized at 1st and 99th percentile. We use robust standard errors clustered at the lender-level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 3: Likelihood of new relationships between borrower and lead arranger after corporate QE

	New relationship			
	Baseline	*Loan-level and economic controls*	*Loan grade*	
			Leveraged	*Investment*
	(1)	(2)	(3)	(4)
Exposed lender x Post	0.077***	0.041**	0.085**	0.018
	(0.020)	(0.016)	(0.036)	(0.020)
Loan size		-0.073***	-0.076***	-0.068***
		(0.005)	(0.013)	(0.004)
Maturity		0.001***	0.001***	0.001***
		(0.000)	(0.000)	(0.000)
Collateral		0.028**	-0.006	0.061***
		(0.011)	(0.017)	(0.017)
Revolver		-0.066***	-0.051***	-0.073***
		(0.008)	(0.010)	(0.010)
Term loan B		-0.061**	-0.064***	0.143***
		(0.024)	(0.020)	(0.035)
GDP		-0.010	0.085***	-0.017
		(0.011)	(0.029)	(0.010)
Lender FE	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes
Country *x* Industry FE	No	Yes	Yes	Yes
Loan purpose FE	No	Yes	Yes	Yes
Test for differences in *Exposed lender x Post* (p-values)			0.055	
Observations	23,523	23,523	6,998	16,525
R-squared	0.101	0.326	0.398	0.354

Notes: This table displays the results from a difference-in-differences analysis using linear regression models, estimating the impact of an *Exposed lender x Post* interaction term on a *New relationship* indicator including fixed effects for the lender, time, country-industry and loan purpose. *Exposed lender* is an indicator that takes the value of one if the lender is exposed to the CSPP and zero otherwise. *Post* is an indicator that takes value of one if loan was priced in Q4 2015 or later and zero otherwise. *New relationship* is an indicator that takes the value of one, if in the previous five years at least one loan was issued to the borrower by the lead arranger and zero otherwise. Column (1) provides baseline results. In column (2) we add loan specific controls, control for economic conditions, country and industry specifics and loan purpose. In column (3) and (4) we investigate the effect of the loan grade. *Loan grade* is an indicator that takes the value of one if the loan is investment grade and zero if it is a leveraged loan. The analysis is based on data from 2014 to 2018. A detailed variable description can be found in Appendix A. Results are based on values of variables which are winsorized at 1st and 99th percentile. We use robust standard errors clustered at the lender-level. ∗∗∗, ∗∗, and ∗ indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 4: Effect of corporate QE on loan contracting terms

	Collateral	*Loan size*	*Maturity*	*Cross-default clause*
	(1)	(2)	(3)	(4)
Exposed syndicate x Post	0.052**	-0.185**	-6.197**	0.047***
	(0.024)	(0.076)	(2.960)	(0.006)
Exposed syndicate	-0.046**	0.613***	3.695	-0.010
	(0.023)	(0.073)	(2.687)	(0.008)
Loan size	0.020***		0.210	0.003
	(0.007)		(0.708)	(0.004)
Investment grade loan	-0.511***	-0.081	22.827***	-0.029**
	(0.023)	(0.055)	(2.211)	(0.014)
Collateral		0.147***	29.737***	-0.015
		(0.054)	(2.478)	(0.012)
Maturity	0.002***	0.000		-0.000**
	(0.000)	(0.000)		(0.000)
Revolver	-0.054***	0.070**	-15.734***	0.001
	(0.010)	(0.029)	(1.189)	(0.005)
Term loan B	0.082***	0.470***	0.043	-0.019**
	(0.020)	(0.078)	(1.560)	(0.008)
Syndicate size	-0.009***	0.168***	-0.744***	0.002**
	(0.002)	(0.006)	(0.166)	(0.001)
GDP	-0.005	-0.083	1.678	-0.011*
	(0.016)	(0.058)	(1.722)	(0.006)
Country *x* Industry FE	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes
Loan purpose FE	Yes	Yes	Yes	Yes
Observations	6,902	6,902	6,902	6,902
R-squared	0.400	0.592	0.322	0.202

Notes: This table displays the results from a difference-in-differences analysis using linear regression models, estimating the impact of an *Exposed syndicate x Post* interaction term on a set of loan contracting variables including country-industry, and time fixed effects. In particular, we estimate changes in loan collateral, loan size maturity and cross-default clauses as a function of the syndicate's exposure to the CSPP. *Exposed syndicate* is an indicator that takes value of one if at least one lead arranger in the syndicate is exposed to the CSPP and zero otherwise. *Post* is an indicator that takes value of one if loan was priced after Q4 2015 and zero otherwise. Depending on the specification, we include control variables for loan size, investment grade loan, collateral, maturity, revolver, term loan B, syndicate size and GDP. The sample period is from 2014 to 2018. Results are based on values of variables which are winsorized at 1st and 99th percentile. We use robust standard errors clustered at the borrower-level. ∗∗∗, ∗∗, and ∗ indicate significance at the 1%, 5%, and 10% levels, respectively. For a detailed variable description, we refer to Appendix A.

Table 5: Effect of corporate QE on syndicate composition

	Number of lenders	*Number of lead arrangers*	*Number of participants*
	(1)	(2)	(3)
Exposed syndicate x Post	0.529**	0.075	0.451**
	(0.227)	(0.157)	(0.211)
Exposed syndicate	0.555***	1.461***	-0.894***
	(0.216)	(0.163)	(0.191)
Loan size	2.170***	1.162***	0.954***
	(0.080)	(0.068)	(0.070)
Investment grade loan	-0.153	0.277*	-0.471**
	(0.197)	(0.142)	(0.209)
Collateral	-0.810***	0.089	-0.907***
	(0.170)	(0.145)	(0.181)
Maturity	-0.004***	-0.001	-0.003***
	(0.001)	(0.001)	(0.001)
Revolver	0.740***	0.727***	0.044
	(0.129)	(0.097)	(0.108)
Term loan B	-1.360***	-0.756***	-0.625**
	(0.338)	(0.182)	(0.281)
GDP	0.044	0.177	-0.102
	(0.173)	(0.131)	(0.141)
Country *x* Industry FE	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes
Loan purpose FE	Yes	Yes	Yes
Observations	6,902	6,902	6,902
R-squared	0.562	0.443	0.307

Notes: This table displays results from a difference-in-differences analysis using linear regression models estimating the impact of an *Exposed syndicate x Post* interaction term on syndicate composition variables (*number of lenders, number of lead arrangers* and *number of participants*) with time, country-industry and loan purpose fixed effects. *Exposed syndicate* is an indicator that takes value of one if at least one lead arranger in the syndicate is exposed to the CSPP and zero otherwise. *Post* is an indicator that takes value of one if loan was priced after Q4 2015 and zero otherwise. We include control variables for loan size, investment grade loan, collateral, maturity, revolver, term loan B and GDP across all specifications. The sample period is from 2014 to 2018. Results are based on values of variables which are winsorized at 1st and 99th percentile. We use robust standard errors clustered at the borrower-level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. For a detailed variable description, we refer to Appendix A.

Table 6: Relationship intensity between lead arranger and participants

	Relationship intensity			
	Baseline	*Loan-level and economic controls*	*Loan grade*	
			Leveraged	*Investment*
	(1)	(2)	(3)	(4)
Exposed lender x Post	0.004	0.002	0.012**	0.000
	(0.003)	(0.003)	(0.005)	(0.004)
Amount		-0.011***	-0.017***	-0.009***
		(0.002)	(0.002)	(0.002)
Maturity		0.000	0.000**	-0.000
		(0.000)	(0.000)	(0.000)
Collateral		-0.005***	-0.001	-0.002
		(0.002)	(0.003)	(0.005)
Revolver		-0.000	0.000	-0.000
		(0.001)	(0.001)	(0.001)
Term loan B		0.002	0.005**	0.003
		(0.002)	(0.002)	(0.003)
GDP		0.006***	-0.006*	0.008***
		(0.002)	(0.003)	(0.002)
Lender FE	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes
Country *x* Industry FE	Yes	Yes	Yes	Yes
Loan purpose FE	No	Yes	Yes	Yes
Test for differences in *Exposed lender x Post* (p-values reported)			0.008	
Observations	75,065	75,065	21,297	53,768
R-squared	0.138	0.156	0.226	0.157

Notes: This table displays results from a difference-in-differences analysis using linear regression models, estimating the impact of an *Exposed lender x Post* interaction term on the relationship intensity between lead arrangers and participants (*Relationship intensity*) with lender, time and country-industry fixed effects. *Exposed lender* is an indicator that takes the value of one if both lenders are exposed to the CSPP and zero otherwise. *Post* is an indicator that takes value of one if loan was priced in Q4 2015 or later and zero otherwise. *Relationship intensity* is measured by dividing the number of loans where the lead arranger and participant were issuers on by the total number of loans the lead arranger issued in the past five years. Column (1) provides baseline results. In column (2) we add loan specific controls, control for economic conditions, country and industry specifics and loan purpose. In column (3) and (4) we investigate the effect of the loan grade. *Loan grade* is an indicator that takes the value of one if the loan is investment grade and zero if it is a leveraged loan. The analysis is based on data from 2014 to 2018. A detailed variable description can be found in Appendix A. Results are based on values of variables which are winsorized at 1st and 99th percentile. We use robust standard errors clustered at the lender-level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 7: New relationships between borrower and lead arranger conditional on legal efficiency

Panel A: High vs. low legal efficiency

	New relationship	
	High	*Low*
	(1)	(2)
Exposed lender x Post	0.059**	0.010
	(0.024)	(0.023)
Controls	Yes	Yes
Lender FE	Yes	Yes
Quarter FE	Yes	Yes
Country *x* Industry FE	Yes	Yes
Loan purpose FE	Yes	Yes
Observations	11,359	11,266
R-squared	0.362	0.331

Panel B: High vs. low legal efficiency conditional on loan grade

	New relationship			
	Investment		*Leveraged*	
	High	*Low*	*High*	*Low*
	(1)	(2)	(3)	(4)
Exposed lender x Post	0.025	-0.007	0.105**	0.062
	(0.026)	(0.026)	(0.047)	(0.044)
Controls	Yes	Yes	Yes	Yes
Lender FE	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes
Country *x* Industry FE	Yes	Yes	Yes	Yes
Loan purpose FE	Yes	Yes	Yes	Yes
Observations	8,150	7,726	3,209	3,504
R-squared	0.410	0.358	0.395	0.444

Notes: This table displays the results from a difference-in-differences analysis using linear regression models, estimating the impact of an *Exposed lender x Post* interaction term on a *New relationship* indicator including fixed effects for the lender, time, country-industry and loan purpose. Panel A reports results from a sample split among high and low legal efficiency countries. Panel B reports results from a sample split among high and low legal efficiency countries and loan grade. *Exposed lender* is an indicator that takes the value of one if the lender is exposed to the CSPP and zero otherwise. *Post* is an indicator that takes value of one if loan was priced in Q4 2015 or later, zero otherwise. *New relationship* is an indicator that takes the value of one, if in the previous five years at least one loan was issued to the borrower by the lead arranger and zero otherwise. The analysis is based on data from 2014 to 2018. A detailed variable description can be found in Appendix A. Results are based on values of variables which are winsorized at 1st and 99th percentile. We use robust standard errors clustered at the lender-level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 8: Effect of corporate QE on loan pricing

	Spread	
	(1)	(2)
Exposed syndicate x Post	-23.978	-24.257
	(28.276)	(25.180)
Exposed syndicate	36.987	29.828
	(24.521)	(21.877)
Loan size		-4.048
		(4.022)
Investment grade loan		-151.294***
		(13.555)
Collateral		31.511***
		(12.037)
Maturity		-0.023
		(0.075)
Revolver		-0.457
		(5.762)
Term loan B		9.940
		(7.758)
GDP		3.306
		(22.465)
Country *x* Industry FE	Yes	Yes
Quarter FE	Yes	Yes
Loan purpose FE	Yes	Yes
Observations	1,219	1,219
R-squared	0.488	0.689

Notes: This table displays results from a difference-in-differences analysis using linear regression models estimating the impact of an *Exposed syndicate x Post* interaction term on the loan pricing (*Spread*) with time, country-industry and loan purpose fixed effects. *Exposed syndicate* is an indicator that takes value of one if at least one lead arranger in the syndicate is exposed to the CSPP and zero otherwise. *Post* is an indicator that takes value of one if loan was priced after Q4 2015 and zero otherwise. We include control variables for loan size, investment grade loan, collateral, maturity, revolver, term loan B and GDP in the second specification. The sample period is from 2014 to 2018. Results are based on values of variables which are winsorized at 1st and 99th percentile. We use robust standard errors clustered at the borrower level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. For a detailed variable description, we refer to Appendix A.

APPENDIX

A Definition of variables

Table A: Variable description

Variable	Definition	Source
Main dependent variables		
Eligible borrower loan share	This variable is calculated as loans issued to CSPP-eligible borrowers issued by lender *i* in quarter *t* divided by the total number of loans issued by lender *i* in quarter *t* within the Euro Area market. $$\frac{Number\ loans\ to\ eligible\ borrowers_{it}}{Number\ total\ loans_{it}}$$	Dealogic
First-time borrower loan share	Loans issued to first-time borrowers issued by lender *i* in quarter *t* divided by total issued loans issued by lender *i* in quarter *t* within the Euro Area market. First-time borrowers are borrowers that have not obtained a loan since 2007. $$\frac{Number\ loans\ to\ first-time\ borrowers_{it}}{Number\ total\ loans_{it}}$$	Dealogic
New-relationship borrower loan share	This variable is calculated as the number of loans issued to new-relationship borrowers issued by lender *i,* in quarter *t* divided by the number of total loans issued by lender *i* in quarter *t* within the Euro Area market. New-relationship borrowers are borrowers that did not obtain a loan from the lender in the previous five years. $$\frac{Number\ loans\ to\ new\ relationship\ borrowers_{it}}{Number\ total\ loans_{it}}$$	Dealogic
Leveraged loan share	This variable is calculated as the number of leveraged loans issued by lender *i* in quarter *t* divided by total number of loans issued by lender *i* in quarter *t* within the Euro Area market. $$\frac{Number\ leveraged\ loans_{it}}{Number\ total\ loans_{it}}$$	Dealogic
New relationship	This variable is an indicator that takes the value of one, if in the previous five years a loan was issued to the borrower by the lender and zero otherwise.	Dealogic
Relationship intensity	This variable captures the intensity of the lending relationship between a lead arranger and a participant. It is measured as the number of loans issued by the lead arranger *l* to a specific participant *p* divided by all loans issued by lead arranger *l* in the previous five years. $$\frac{Number\ leveraged\ loans_{it}}{Number\ total\ loans_{it}}$$	Dealogic
Number of lenders	Number of lenders involved in the loan tranche.	Dealogic
Number of participants	Number of participants involved in the loan tranche.	Dealogic

[*Table A continued.*]

Number of lead arrangers	Number of lead arrangers involved in the loan tranche.	Dealogic
Cross-default clause	This variable is an indicator that takes the value of one when the loan includes a clause indicating that the loan will be in default if the borrower defaults on another specified facility and zero otherwise.	Dealogic
First Loan	This variable is an indicator that takes the value of one if the loan is the first loan of the borrower in the syndicated lending market since 2007.	Dealogic
Spread	This variable measures how much a borrower pays out to the lender for the loan at the tranche level.	Dealogic
Main independent variables		
Exposed lender	This variable is an indicator that takes value of one if the lender is exposed to the CSPP and zero otherwise. CSPP exposure is defined according to Berg et. al (2024). A lender is exposed if in 2014 or 2015 an above median number of loans was issued to CSPP-eligible borrowers.	ECB
Exposed syndicate	This variable is an indicator that takes value of one if at least one lead arranger in the syndicate is exposed to the CSPP and zero otherwise.	ECB
Post	This variable is an indicator that takes value of one if loan was priced after Q4 2015 and zero otherwise.	
Other variables		
Collateral	This variable is an indicator that takes value of one if loan is collateralized and zero otherwise.	Dealogic
Loan grade	This variable is an indicator that takes the value of one if loan is investment grade and zero if it is a leveraged loan.	Dealogic
Lender type	This variable defines the tpe of the lender. Bank lenders are defined as commercial banks classified by 4-digit SIC codes 6011, 6019, 6021, 6022, 6029, 6035, 6036, 6061, 6062, 6081, 6082, 6091, 6099, 6712, 6719. All other lenders are classified as non-bank lenders.	Hand-collection
GDP	Variable for the Gross Domestic Product of a country.	World Bank
Loan size	Natural logarithm of the issuance amount of the loan.	Dealogic
Maturity	Maturity of the loan in months.	Dealogic
Revolver	This variable is an indicator that takes value of one if loan is revolver loan.	Dealogic

[*Table A continued.*]

Term loan B	This variable is an indicator that takes the value of one if the loan is categorized as term loan B or below and zero for term loan A.	Dealogic
Loan purpose	The primary purpose of the use of proceeds of the loan is defined by Dealogic. The variable is grouped following Schwert (2018) into: Acquisitions, General Corporate Purposes, Repay Debt, Working Capital, Refinancing, and Other.	Dealogic

Notes: This table defines the variables used in the empirical tests.

B Sample selection

Table B: Sample selection

	Loans
Full sample of syndicated lending deals in Dealogic	446,686
- Eliminate loans outside Europe	-343,517
- Eliminate loans issued before 2007 and after 2023	-38,309
- Eliminate loans by issuers from finance and government entities	-21,484
- Eliminate loans with multiple borrower parents	-1,432
- Eliminate loans with a nominal amount below $20 million	-3,072
- Eliminate loans with missing variables	-7,339
Dealogic loan sample	31,533
- Eliminate loans before 2014 and after 2018	-20,799
- Eliminate loans issued outside Euro area	28,182
- Eliminate country-industry pairs with few loans	-21,280
Final sample	6,902

Notes: This table shows the sample selection process for the sample used in the empirical analysis. Our final sample includes 6,902 syndicated loans by 642 unique lenders. Depending on the empirical analysis, we expand this sample into different panel datasets at the quarter level. The panel dataset on lender level amounts to 3,027 lender-quarter observations. The panel dataset on lead arranger-borrower level amounts to 23,523 observations. The panel dataset on lead arranger-participant level amounts to 75,065 observations.

C ECB data preparation

In order to identify borrowers affected by the CSPP, we download and prepare information on all eligible assets for Euro system operations between April 2010 and December 2021[26]. For those eligible assets we obtain the following data points: *ISIN*, *type*, *reference market*, *denomination*, *issuance date, maturity date, issuer name, issuer residence, issuer group* and *coupon definition*. The information is published every weekday. We construct a dataset that contains each eligible asset and the time period it is eligible for. From the list of eligible assets, we select corporate bonds that are eligible for purchase by the ECB under the CSPP. We follow the approach by Galema and Lugo (2021).[27] In particular, we keep bonds and medium-term notes (identified by type AT01 and AT02) that are denominated in euro. We keep bonds issued by corporations (issuer group is IG3 or IG9). Lastly, we keep only corporate bonds issued by corporations incorporated in the EU-19 countries. We end up with a list of 6,165 unique bonds between 2010 and 2022 that are eligible. Based on their *ISIN,* we merge the bonds with Dealogic. For 96% of eligible bonds, we are able to match the issuer in Dealogic.

We use this information to create an *Eligible* indicator variable that takes the value of one if the borrower had a bond outstanding at the CSPP announcement date (03.10.2016), zero otherwise. We merge the ECB data with Dealogic using the *ISIN* identifier. This provides us with the name of the borrower's parent (*BorrowerParent)* of a bond in Dealogic. Based on this name, we match the bond and loan datasets within Dealogic.

[26]Information on eligible assets available at https://www.ecb.europa.eu/paym/coll/assets/html/index.en.html.
[27]This approach differs from Grosse-Rueschkamp et al. (2019) because it considers all the dimensions of the ECB.

D Sample descriptives

Table D1: Sample descriptives for lenders by treatment and control group

Panel A: Lenders

	Treatment				Control			
	N	Mean	SD	Median	N	Mean	SD	Median
Bank lender (0/1)	77	0.68	0.47	1.00	565	0.63	0.48	1.00
Average loan amount ($ million)	77	160.23	145.80	118.48	565	59.11	70.11	37.49
Average maturity (Months)	77	64.03	21.02	59.99	565	73.38	43.63	59.99
Investment grade loan share	77	0.66	0.28	0.69	565	0.70	0.41	1.00
Collateralized loan share	77	0.36	0.26	0.34	565	0.34	0.42	0.00
Revolver loan share	77	0.47	0.24	0.45	565	0.31	0.32	0.25
Term loan B or below loan share	77	0.09	0.20	0.02	565	0.07	0.22	0.00
Eligible borrower loan share	77	0.31	0.27	0.25	565	0.05	0.18	0.00
First-time borrower loan share	77	0.20	0.19	0.17	565	0.36	0.40	0.20
New-relationship borrower loan share	77	0.51	0.24	0.43	565	0.77	0.32	1.00
Leveraged loan share	77	0.34	0.28	0.31	565	0.30	0.41	0.00

Panel B: Lead arrangers

	Treatment				Control			
	N	Mean	SD	Median	N	Mean	SD	Median
Bank lender (0/1)	59	0.71	0.46	1.00	216	0.55	0.50	1.00
Average loan amount ($ million)	59	179.42	222.06	117.25	216	76.36	91.89	50.31
Average maturity (Months)	59	72.72	32.49	65.25	216	92.67	56.45	71.28
Investment grade loan share	59	0.73	0.27	0.75	216	0.63	0.43	0.85
Collateralized loan share	59	0.46	0.32	0.38	216	0.60	0.42	0.69
Revolver loan share	59	0.38	0.26	0.41	216	0.21	0.29	0.05
Term loan B or below loan share	59	0.06	0.15	0.01	216	0.03	0.12	0.00
Eligible borrower loan share	59	0.28	0.25	0.22	216	0.06	0.18	0.00
First-time borrower loan share	59	0.24	0.23	0.22	216	0.37	0.40	0.25
New-relationship borrower loan share	59	0.50	0.26	0.40	216	0.77	0.32	1.00
Leveraged loan share	59	0.27	0.27	0.25	216	0.37	0.43	0.15

Notes: This table presents summary statistics differentiated by treatment and control groups. In Panel A we include all lenders in our sample. Panel B includes lenders that serve as lead arrangers. We differentiate treatment and control group by lenders' exposure to CSPP-eligible borrowers in the two years before the corporate QE program. The sample period is from 2014 to 2018. We winsorize continuous variable on the 1st and 99th percentile. For a detailed variable description, we refer to Appendix A.

Table D2: Sample descriptives

Panel A: Lender-quarter level

	N	Mean	SD	p25	Median	p75
Exposed lender (0/1)	3,027	0.60	0.49	0.00	1.00	1.00
Bank lender (0/1)	3,027	0.73	0.45	0.00	1.00	1.00
Eligible borrower loan share	3,027	0.14	0.26	0.00	0.00	0.18
First-time borrower loan share	3,027	0.27	0.37	0.00	0.03	0.43
New-relationship borrower loan share	3,027	0.55	0.40	0.18	0.50	1.00
Leveraged loan share	3,027	0.29	0.36	0.00	0.13	0.48
Investment grade loan share	3,027	0.71	0.36	0.52	0.87	1.00
Average loan size (Ln)	3,027	6.02	1.30	5.14	5.99	6.93
Average maturity (Months)	3,027	69.73	39.11	52.65	59.99	73.68
Collateralized loan share	3,027	0.34	0.37	0.00	0.24	0.57
Revolver loan share	3,027	0.40	0.31	0.18	0.39	0.54
Term loan B or below loan share	3,027	0.06	0.17	0.00	0.00	0.02

Panel B: Lender-borrower-loan level

	N	Mean	SD	p25	Median	p75
New relationship (Lead arranger - borrower)	41,578	0.57	0.50	0.00	1.00	1.00
Exposed lender	41,578	0.55	0.50	0.00	1.00	1.00
Loan size (Ln)	41,578	19.95	1.55	18.76	19.95	21.04
Maturity (Months)	41,578	67.72	41.26	54.27	59.99	72.01
Collateral (0/1)	41,578	0.36	0.48	0.00	0.00	1.00
Revolver (0/1)	41,578	0.41	0.49	0.00	0.00	1.00
Term loan B or below (0/1)	41,578	0.06	0.24	0.00	0.00	0.00
IG loan (0/1)	41,578	0.70	0.46	0.00	1.00	1.00
GDP	41,578	0.46	0.42	0.20	0.50	0.70

Panel C: Lender-lender-loan level

	N	Mean	SD	p25	Median	p75
Relationship intensity (Lead arranger - participant)	75,065	0.12	0.08	0.05	0.10	0.16
Exposed lender	75,065	0.70	0.46	0.00	1.00	1.00
Loan size (Ln)	75,065	20.90	1.45	19.94	21.14	21.98
Maturity (Months)	75,065	58.72	26.35	49.77	59.99	60.02
Collateral (0/1)	75,065	0.26	0.44	0.00	0.00	1.00
Revolver (0/1)	75,065	0.54	0.50	0.00	1.00	1.00
Term loan B or below (0/1)	75,065	0.05	0.21	0.00	0.00	0.00
IG loan (0/1)	75,065	0.72	0.45	0.00	1.00	1.00
GDP	75,065	0.47	0.42	0.20	0.50	0.80

Notes: This table presents descriptive statistics for the variables used in the empirical tests. The sample period is from 2014 to 2018. Panel A presents descriptive statistics for the variables used in the lender- quarter level analysis. Panel B presents descriptive statistics for the variables used in the analysis on lender-borrower-loan level. Panel C presents descriptive statistics for the variables used in the analyses on lender-lender-loan level. We winsorize continuous variables on the 1st and 99th percentile. For a detailed variable description, we refer to Appendix A.

E Largest lenders in the European market

Table E: Largest lenders in the European market

Panel A: Bank lenders

Lender Name	Lending Volume ($ million)	To Eligibles ($ million)	To Eligibles (%)
BNP Paribas	286,834	90,402	0.32
HSBC	203,408	64,386	0.32
UniCredit	195,861	64,726	0.33
JPMorgan	190,930	68,041	0.36
Credit Agricole CIB	178,011	52,323	0.29
Deutsche Bank	174,806	47,458	0.27
ING	172,896	61,769	0.36
Commerzbank Group	172,274	56,960	0.33
Santander	161,352	63,865	0.40
Barclays	120,363	60,546	0.50

Panel B: Non-bank lenders

Lender Name	Lending Volume ($ million)	To Eligibles ($ million)	To Eligibles (%)
SG Corporate & Investment Banking	204,121	74,045	0.36
BofA Securities	136,166	64,084	0.47
Goldman Sachs	75,824	28,445	0.38
Mediobanca	62,211	17,746	0.29
LBBW	61,940	10,506	0.17
CM-CIC Capital	58,717	16,504	0.28
Morgan Stanley	56,706	22,515	0.40
RBC Capital Markets	41,638	14,851	0.36
Nomura	40,338	779	0.02
European Investment Bank - EIB	34,242	81	0.00

Notes: This table presents the largest lenders in the European syndicated lending market split into bank lenders (Panel A) and non-bank lenders (Panel B). Lending volume is aggregated over the sample period from 2014 to 2018. Per loan we split the nominal amount evenly across all lenders and sum up the shares over the four years.

F First-time loan issuance after corporate QE

[Insert Figure F about here.]

We investigate the lending of exposed syndicates to new borrowers after the announcement of the corporate QE in 2015 Q4. First, we plot the number of new loans to first-time borrowers in Figure F1. We observe that the number of loan issuances to first-time borrowers increases after the announcement of the corporate QE in the treatment group while the number in the control group decreases. This indicates that exposed syndicates issue more loans to first-time borrowers after the announcement of the corporate QE.

[Insert Table F about here.]

We substantiate our plot with regression results in Table F1. We investigate the likelihood for loan issuance to first-time borrowers for exposed syndicates post CSPP. Our regression results show an increase in the likelihood of loan issuance after the corporate QE to borrowers who have not been active in the loan market since 2007. These results provide evidence of the changes in borrower composition post corporate QE.

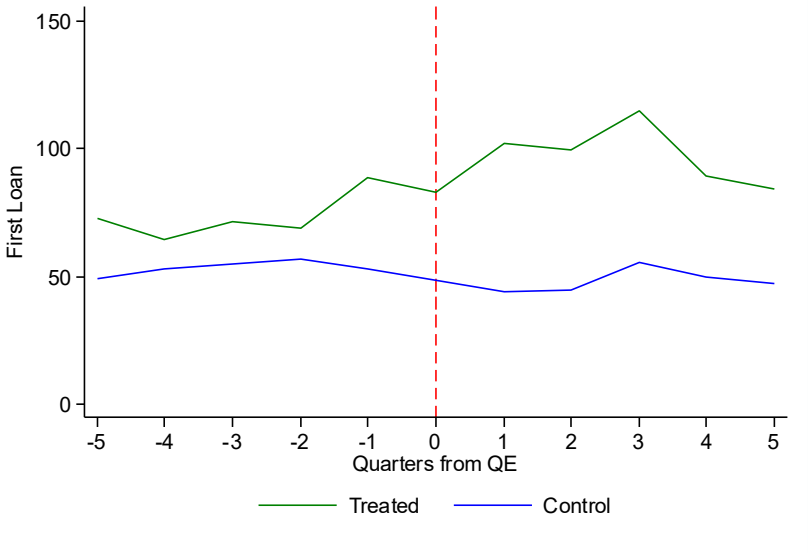

Figure F: First-time borrower loan issuance post CSPP

Notes: This figure shows the number of loans issued to first-time borrowers for the treatment and control group. Treatment and control groups are defined at the syndicate level. Loans by first-time borrowers are defined as loans issued by borrowers that did not borrow in the syndicated lending market since 2007. We depict the quarters relative to the announcement of the corporate QE intervention (CSPP) in 2015 Q4 as quarter 0.

Table F: Likelihood for first-time borrower loan issuance after CSPP

	First-time borrower loan	
	(1)	(2)
Exposed syndicate x Post	0.084***	0.043*
	(0.026)	(0.023)
Exposed syndicate	-0.268***	-0.067***
	(0.022)	(0.021)
Controls	No	Yes
Quarter FE	Yes	Yes
Country*Industry FE	Yes	Yes
Observations	6,902	6,902
Adj. R-squared	0.148	0.366

Notes: This table presents results from a difference-in-differences design, using linear regression models, estimating the impact of an *Exposed syndicate x Post* interaction term on a *First-time borrower loan* indicator. Baseline results are presented in column (1). In column (2) we add control variables and loan purpose fixed effects. *First-time borrower loan* is an indicator that takes the value of one if the loan is the first loan of the borrower in the syndicated lending market since 2007 and zero otherwise. *Exposed syndicate* is an indicator that takes value of one if at least one lead arranger in the syndicate is exposed to the CSPP and zero otherwise. *Post* is an indicator that takes value of one if loan was priced after Q4 2015 and zero otherwise. The sample period is from 2014 to 2018. Results are based on values of variables which are winsorized at 1st and 99th percentile. We use robust standard errors. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. For a detailed variable description, we refer to Appendix A.

G Robustness test Table 4

Following Khwaja and Mian (2008) we estimate our regression using borrower fixed effects. The comparison is then across lenders lending to the same borrower. Borrower-specific demand shocks are absorbed by the firm fixed effects. Our results are presented in Table G. Results remain largely similar. An increase in the probability of new relationships is observed both in the leveraged and investment grade loan market.

Table G: Robustness test for Table 4: Including borrower fixed effects

	New relationship			
	Baseline	Loan-level and economic controls	Loan Grade	
			Leveraged	Investment
	(1)	(2)	(3)	(4)
Exposed lender x Post	0.068***	0.054***	0.065*	0.044**
	(0.019)	(0.018)	(0.035)	(0.019)
Controls	No	Yes	Yes	Yes
Lender FE	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes
Country*Industry FE	No	Yes	Yes	Yes
Loan purpose FE	No	Yes	Yes	Yes
Borrower FE	Yes	Yes	Yes	Yes
Test for differences in *Exposed lender x Post* (p-values)			0.352	
Observations	23.523	23.523	6.998	16.525
Adj. R-squared	0.602	0.624	0.633	0.656

Notes: This table displays results from a difference-in-differences analysis using linear regression models, estimating the impact of an *Exposed lender x Post* interaction term on a *New relationship* indicator with lender and time fixed effects. *Exposed lender* is an indicator that takes the value of one if the lender is exposed to the CSPP, zero otherwise. *Post* is an indicator that takes value of one if loan was priced in Q4 2015 or later and zero otherwise. *New relationship* is an indicator that takes the value of one, if in the previous five years at least one loan was issued to the borrower by the lead arranger and zero otherwise. Column (1) provides baseline results. In column (2) we add loan specific controls, control for economic conditions, country and industry specifics and loan purpose. In column (3) and (4) we investigate the effect of the loan grade. *Loan grade* is an indicator that takes the value of one if the loan is investment grade and zero if it is a leveraged loan. The analysis is based on data from 2014 to 2018. A detailed variable description can be found in Appendix A. Results are based on values of variables which are winsorized at 1st and 99th percentile. We use robust standard errors clustered at the level of treatment, i.e., at the lender-level. ∗∗∗, ∗∗, and ∗ indicate significance at the 1%, 5%, and 10% levels, respectively.

H Legal efficiency score

We follow Bischof et al. (2022) and measure legal efficiency using data from the World Bank Doing Business report. First, we use individual binary and time-invariant variables that take the value of one for countries that have below median *Insolvency Durations, Insolvency Costs, Contract Enforcement Durations, Contract Enforcement Costs,* and *Loss Given Default*. Second, we build a composite variable *Legal efficiency* that takes the value of one if the sum of all individual scores is above the median, zero otherwise. Thus, our final variable *Legal Efficiency* takes the value of one if the loan is issued in a country characterized with high legal efficiency, zero otherwise.

Table H: Legal efficiency by country

Country	*Legal Efficiency*
Austria	0
Belgium	1
Cyprus	0
Estonia	0
Finland	1
France	1
Germany	1
Greece	0
Ireland	0
Italy	0
Luxembourg	1
Malta	0
Netherlands	0
Portugal	0
Slovenia	1
Spain	0

Notes: This table presents the legal efficiency variable for each Euro area country in our empirical analysis (see Table 7). *Legal Efficiency* is an indicator that takes the value of one if the loan is issued in a country with high legal efficiency and zero otherwise.