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Collateral eligibility of corporate debt in the Eurosystem

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ABSTRACT

We study the many implications of the Eurosystem collateral framework for corporate bonds. Using data on the evolving collateral eligibility list, we identify the first inclusion dates of bonds and issuers and use these events to find that the increased supply and demand for pledgeable collateral following eligibility (a) increases activity in the corporate securities lending market, (b) lowers eligible bond yields, and (c) affects bond liquidity. Thus, corporate bond lending relaxes the constraint of limited collateral supply and thereby improves market functioning.

1. Introduction

In March 2020, the U.S. Federal Reserve System ("the Fed") introduced its Primary and Secondary Market Corporate Credit Facilities, as part of its response to alleviate the financial consequences of the COVID-19 pandemic. These facilities were designed to encourage more widespread use of corporate bonds as collateral in the monetary policy operations of the Fed and were expected to have an impact on collateral money markets, bond cash markets, and corporations' borrowing strategies by eliminating frictions and improving market liquidity.

While the Fed's facilities are relatively new, similar arrangements have been in place in the euro area for over two decades and provide an ideal historical parallel to investigate the impact of such facilities. We study the impact channels in the context of the euro area, where the European Central Bank (ECB) has been accepting corporate bonds as a significant fraction of eligible collateral since the inception of the euro in 1999. Thus, the ECB has a fairly long history of accepting corporate debt in its open market operations (OMOs) and its associated overnight lending facility. These two monetary instruments are especially important in providing short-term funding to the banking sector.

The cornerstone of funding liquidity provision to banks in the euro area is the Eurosystem Collateral Framework (ESCF), a set of guidelines for adequate collateral. The framework serves a vital policy function in normal times but is especially important during crises. The ECB's collateral framework is comprehensive in both scale and scope, as it permits a large number of counterparties to partake of collateralized lending by pledging a variety of assets. Two distinctive features of the Eurosystem's collateral policy, however, are the ease of pledgeability of *corporate debt* with the central bank and the consequent borrowing in the marginal lending facility by banks that are unable or prefer not to obtain funding from the interbank lending market.[1] An examination of

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[1] Unlike the repo facility at the Fed, financial market participants in the euro area do not attach any stigma to banks accessing the ECB's marginal lending facility. Lee and Sarkar (2018) attribute this difference in perception partly to clear central bank communication and transparent regulation. More specifically, the ECB does not solely portray the marginal lending facility as the lender of last resort. Additionally, under its disclosure policy, the ECB only publishes daily aggregates of marginal lending activities (and not the identities and positions of individual borrowing banks). Moreover, the ECB imposes the same collateral and counterparty requirements for OMOs and the standing facility (SF), allowing for similar terms across borrowers and, therefore, more widespread use of the overnight facility.

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the collateral eligibility of corporate bonds and especially its effects on collateral money markets, bond cash markets, and corporations' borrowing strategies would be instructive in ascertaining the impact of similar facilities at other central banks, including the Fed. Corporate bond pledgeability is an exceptionally versatile and powerful policy tool by which banks in the Eurosystem can obtain funding against eligible assets (EAs) through collateralized lending operations: OMOs achieved through repurchase agreements ("repos") and collateralized borrowing.

Focusing on the period from 2010 until 2016, we investigate 160 unique eligibility events with multiple bonds treated at one time. We study whether the inclusion of an asset on the Eurosystem's list of eligible collateral ("EA list") has an impact on the secondary market for collateral; that is, the securities lending (SL) market. We also investigate the yield and liquidity reaction in the secondary market for corporate bonds (bond cash market). Finally, we analyze the effect of eligibility on the primary market for bond issuance by the underlying firms.

There are several advantages of using the euro area as a laboratory to study the efficacy of collateral policy as a monetary policy tool. First, in this context we can measure the *direct* effect of central bank operations on the SL market, given the virtual absence of an active (private) corporate bond repo market in Europe. Second, by comparing the eligibility premium in secondary bond market yields across bonds that are active on the SL market and those that are not, we can investigate whether the SL market mitigates the demand pressure on EA prices (yields). Third, we can analyze firms' supply response by examining the capital structure decisions of bond-issuing firms, since the ECB's eligibility framework permits us to identify the precise inclusion date of individual corporate bonds on the EA list and the first-ever inclusion date at the issuer firm level. Additionally, non-financial corporate bonds seem to be the most appropriate asset class for studying the concept of eligibility, since EUR-denominated sovereign bonds are automatically included on the EA list at issuance, while bank bonds might suffer from multiple confounding effects, such as cross-holdings across banks, that may diminish the effects of eligibility. Furthermore, there is an active repo market for both sovereign and bank bonds in Europe, which is not the case for corporate bonds.

To the best of our knowledge, this is the first study to examine the many implications resulting from a central bank's collateral policy use as a monetary tool in a general setting. Specifically, we contribute to the literature on collateral and SL in two distinct ways. First, we study how the ECB improves market functioning and induces a spillover effect between the overnight lending facility and the collateral money market (the SL market). Second, we examine the extent to which corporate bond eligibility affects European capital market development in terms of the pricing and liquidity of corporate bonds and the subsequent debt financing decisions of firms. Thus, our paper fills a gap in the literature, which has recently focused primarily on unconventional monetary policies – that is, actual central bank purchases of corporate debt securities – and has given limited attention to the role that conventional monetary policy and within it central bank *collateral eligibility* might play in primary and secondary capital markets.

In this paper, we consider the channels through which the ECB's collateral framework affects eligible bonds and bond-issuing firms, as shown in Fig. 1. The direct effect of collateral eligibility arises due to banks' increased demand for pledgeable assets, either in the SL market, which is a money market and serves as the secondary market for collateral, or in the secondary cash market for corporate bonds. Demand affects SL activity, as measured by borrowing costs and quantities supplied for borrowing and lending, in addition to secondary bond market liquidity and yields. Moreover, following the initial inclusion of its bond on the EA list, the issuing firm responds to increased capital market demand by increasing its issuance of bond debt, an action that influences the primary market for its corporate bonds.

First, our empirical analysis tackles the activity of eligible bonds in the SL market, by which banks that do not own Eurosystem pledgeable corporate bonds can borrow them from this secondary market for collateral in exchange for other assets that are not on the EA list.[2] Studying the activity of newly eligible bonds, we find that a large fraction of bonds that were hitherto not lendable in the SL market become lendable on or after the day these bonds are included on the EA list (more than 50% of the considered bonds). For bonds that were already lendable in the SL market, we find that ECB eligibility triggers an increase in the supply of and demand for EAs. The higher supply of EAs benefits banks, since they can access the SL market to convert their ECB-ineligible assets into eligible holdings. This improves banks' access to central bank funding and consequently their overall lending capacity for the economy. The increase in the demand for EAs also benefits long-term buy-and-hold investors, such as pension funds, insurance companies, and mutual funds, which can generate additional income from lending their passive portfolio holdings. Our results show that the borrowing costs per unit of security decrease after the eligibility event. Nevertheless, the overall lending income to the bondholders will increase due to the significant spike in demand for EAs. Observing higher demand, long-term investors are more likely to bid on the primary market for bonds that are potential candidates for eligibility (i.e., newly issued bonds of issuers with outstanding EAs), anticipating that these assets can later be repeatedly posted on the SL market in exchange for a fee.[3] Stronger investor demand in turn improves firms' access to capital markets. Overall, our SL market results suggest that eligibility relaxes the constraint of limited collateral supply and thus improves market functioning. Moreover, in the integrated capital market of the euro area, cross-border investors buying eligible bonds indirectly support the ECB's objective of moving toward a capital market union.

Second, we study the effect of eligibility on bond yields and liquidity in the secondary market. We find a significant and robust yield decline of 4.6–20 basis points (bps) for eligible bonds compared to their not-yet-eligible counterparts. This drop in the yield constitutes an "eligibility premium" that arises due to the liquidity service or fungibility of the bond used as collateral, meaning that eligible bonds acquire "cash-like" features because of their pledgeability at the ECB in exchange for overnight funding. Thus, eligibility benefits both long-term investors and banks, whose portfolio values increase. However, we find that the yield effect is mitigated by the presence of the SL market. When differentiating between lendable and non-lendable bonds in the SL market, we observe that the latter group experiences a larger eligibility-induced yield drop of 14 bps. It should be emphasized that the inclusion of a bond on the EA list should be predictable by financial market participants. Therefore, our results may well be an underestimate of the true impact of collateral eligibility on yields.

Third, we study the impact on liquidity, which is measured by changes in the bid-ask spread in the secondary market. We find that bond-level liquidity improves for non-lendable bonds and deteriorates slightly for bonds that are available for lending. This confirms both the well-known positive link between funding and market liquidity docu-

[2] We believe it is worthwhile to stress that the SL market takes on the role of an active, private over-the-counter (OTC) repo market, which does not exist to any significant extent for corporate bonds in the euro area, in contrast to the situation in the United States. Therefore, corporate bond-backed repo transactions can take place in the ECB's overnight lending facility in exchange for cash or in the SL market, where such deals are less common and bond-for-bond deals constitute the euro area standard. The presence of an active corporate repo market like the one in the United States is the exception rather than the rule, which is why the European setup serves as a model for many other jurisdictions. However, our results indicate that central bank eligibility could play a role in mitigating dysfunctional repo market dynamics, such as those observed in the U.S. Treasury repo market during the COVID-19 pandemic (Duffie, 2020).

[3] This has been confirmed to us in conversations with pension fund and insurance company representatives.

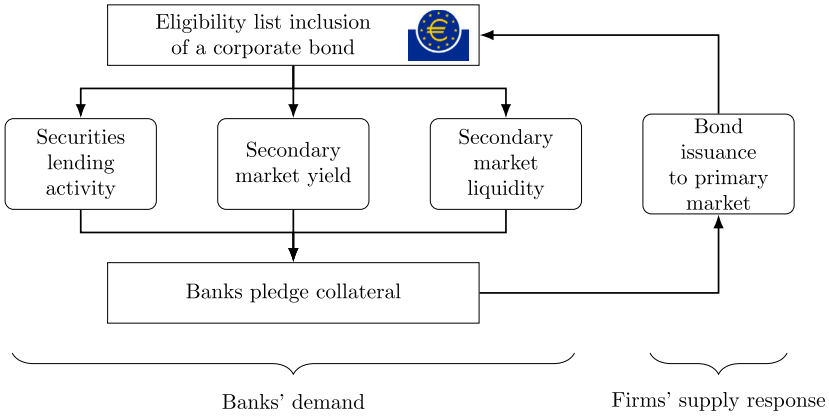

Fig. 1. *The channels of corporate bond pledgeability*. The figure depicts the channels of corporate bond eligibility and the response at the bond-issuing firm level. Banks' demand affects the secondary market for corporate bonds (yield and liquidity) and the securities lending market. Firms react to the increased demand for their bonds by adjusting their financing decisions, and further increasing bond supply that can later become eligible.

mented by Brunnermeier and Pedersen (2009) and the presence of a scarcity effect in the secondary bond cash market.

Fourth, we investigate the implications of eligibility for the primary bond market and more particularly firms' supply response to the inclusion of their first bonds on the EA list. We find that bond eligibility improves firms' access to the capital market and that this has an impact on firms' capital structure. In the four quarters following their first EA list inclusion event, firms shift their debt structure in favor of bond debt and away from bank loans. We also find that they increase their overall debt level and issue bonds with longer maturities. This latter effect is likely driven by demand from long-term investors who bid for these longer-maturity EA candidate bonds. In addition, since the yield effect of eligibility is mitigated by the presence of the SL market, firms whose bonds are not traded on the SL market might benefit more from improved funding costs. Thus, eligibility furthers capital market development and growth and reduces bond-issuing firms' dependence on bank financing. Moreover, not only is the size of the euro area corporate bond market positively affected, but its functioning is also enhanced: being able to lend (borrow) these bonds through the SL market improves immediacy and therefore the overall liquidity of non-financial corporate bonds, including those that are not eligible.

In sum, our findings indicate that eligibility can have diverse economic implications: Corporate bond eligibility increases the overall pool of fungible assets in the economy and should thus improve bank funding conditions. In addition, the effect of eligible bond-issuing firms moving away from bank financing toward bond issuance in the capital markets can have a two-fold positive effect on banks. First, it can deleverage a bank's balance sheet, since long-term investors become the new debt holders. Second, it makes room for banks to finance new and potentially innovative firms and projects, thus channeling funds to where they are most needed while diversifying banks' loan portfolios. This can both greatly improve the stability of the banking system from a macro-prudential perspective and contribute to overall financial innovation and economic growth.

The remainder of the paper proceeds as follows: Section 2 reviews the literature, and Section 3 provides a detailed account of the ESCF. Section 4 describes the data set and presents the descriptive statistics. In Section 5, we study the direct effects of eligibility on the bonds of non-financial corporations, and in Section 6, we present tests of the parallel trends assumption of treated and control bonds and of our analyses accounting for firm-level fundamentals potentially driving eligibility selection and conduct further robustness exercises. Section 7 summarizes the firm-level effects of eligibility, and Section 8 concludes.

2. Related literature

We contribute to multiple research strands. First, our study is part of a broader literature that examines the effect of monetary policy on financial markets. Part of this strand examines how banks access central bank liquidity through collateralized market funding (BIS, 2013, 2015). In the euro area, Allen and Moessner (2012) document that collateralized borrowing became more important following the global financial crisis than uncollateralized interbank lending. Consequently, eligibility under the central bank's collateral framework emerged as an economic driving force behind not only bank funding costs and interbank market rates (Cassola and Koulischer, 2019; Kacperczyk et al., 2021) but also, as our results show, prices and liquidity in the secondary cash and collateral SL markets of corporate bonds. Additionally, we find that eligibility significantly influences the composition of corporate leverage and the conditions under which firms access the capital market.

Several studies explore the collateral frameworks of central banks within a broader context (Eberl and Weber, 2014; Fecht et al., 2016; Bindseil et al., 2017), with some pointing to the potential direct effects of collateral policy on sovereign bond markets (Bindseil and Papadia, 2009; Nyborg, 2016, 2017), while we provide detailed empirical support for the non-financial corporate bond market.

Our analysis is complementary to prior event studies that concentrate on unexpected changes in collateral requirements of a given asset type, like Van Bekkum et al. (2018) for Dutch residential mortgage-backed securities, or Buraschi et al. (2014) and Corradin and Rodriguez-Moreno (2016) for USD-denominated sovereign bonds, which focused on either bank lending or bond yields and the law of one price. In contrast to these studies, we focus on the ECB's discretionary decision to include a bond on the list and use staggered events (160 in total) instead of a single announcement date, which has a significant advantage: We can alleviate concerns that contemporaneous trends may confound the treatment effect, which makes our identification strategy more robust than single-event studies. Moreover, we contribute to this research strand by examining the effect of eligibility on the collateral money market; that is, the SL market.

Considering how demand pressure on eligible collateral from banks affects asset prices,[4] our results are generally similar to studies on asset pricing and repo market specialness (Duffie, 1996; Jordan and

[4] Ai et al. (2020) investigate a stock's collateral premium and focus on firms that own assets that could be used as collateral and can thus easily relax their credit constraints. The authors investigate whether the stock market acknowledges this asset feature and show that firms with pledgeable assets on the balance sheet carry a return premium relative to other firms in the cross-section of stock returns.

Jordan, 1997), the on-the-run premium (Krishnamurthy, 2002), the convenience yield documented in U.S. Treasuries (Longstaff, 2004; Krishnamurthy and Vissing-Jorgensen, 2012) and in euro area sovereign bonds (Jiang et al., 2020), and the pledgeability premium in the corporate bond market in China (Chen et al., 2023).[5] However, unlike the literature cited above, we study the interaction between the ECB's overnight lending facility and the collateral money market, the SL market,[6] which is a funding market available for corporate bond lending and asset-for-asset collateralization.

Finally, our work relates to the growing literature on unconventional monetary policy actions. Although inclusion on the EA list is part of (normal) daily monetary policy conduct, some of its market effects are similar to those of unconventional monetary interventions. Following the inception of large-scale asset purchase programs, early research on quantitative easing aimed to disentangle the channels through which it affects asset prices and risk premia (Krishnamurthy and Vissing-Jorgensen, 2011; Krishnamurthy et al., 2013). Often, specific asset classes (Di Maggio et al., 2019) or purchase programs are considered (Eser and Schwaab, 2016; Acharya et al., 2019; von Rüden et al., 2023; Altavilla et al., 2021). More specifically, an increasing number of studies examine the Corporate Sector Purchase Programme (CSPP), some document how prices are affected by the announcement (Abidi and Miquel-Flores, 2018; Grosse-Rueschkamp et al., 2019; Todorov, 2020; Pegoraro and Montagna, 2021), and others focus on actual purchases (Arce et al., 2020; Adelino et al., 2022; Galema and Lugo, 2021).

By contrast, we investigate a monetary policy instrument that aims to provide bank funding liquidity as opposed to directly affecting long-term interest rates. The economic impact, the effect over time, and the interaction associated with the SL market are quite different in our case.

3. The Eurosystem's collateral framework

3.1. Monetary policy implementation in the Eurosystem

The ECB employs three monetary instruments to achieve its policy goals: OMOs, minimum reserve requirements, and SFs. The most relevant tool for this study is the set of SFs that based on market conditions, provides or absorbs overnight liquidity while constraining the upper bound on overnight market interest rates. The facilities therein are (a) the deposit facility, which allows a wide range of counterparties to make overnight deposits at the central bank, and (b) the marginal lending facility, which is mostly collateralized overnight lending against EAs between the central bank and financial institutions.

Lending under the marginal lending facility takes the form of overnight repurchase agreements and overnight collateralized loans.[7] The interest rates are determined daily, and payments are made on the collateralized loan each business day. The marginal lending facility is accessible at the discretion of counterparties and provides full allotment as long as the claim can be collateralized.

To contain risk to the central bank, collateralizing temporary refinancing operations like overnight lending is essential. The Eurosystem operates and employs a single EA list in all its liquidity-providing operations, so risk mitigation and monitoring are crucial. The essential tools for this monitoring are frequent valuation and margin calls, haircuts on pledged collateral, and limits on exposure to (a) counterparties, (b) the use of collateral by individual counterparties, and (c) the total submitted collateral by an individual issuer, all of which are aimed at reducing the concentration of risk in the ECB's collateral portfolio.

3.2. The ECB's collateral policy

The ECB permits various asset types to be pledged and allows a large number of counterparties to take part in collateralized lending. The foundation of the Eurosystem's marginal lending facility is its collateral policy, a set of guidelines for adequate collateral, and a framework that is comprehensive in both scale and in scope. The ECB differs from other major central banks in that it accepts a variety of asset classes across a wide range of credit ratings, including corporate and government bonds, covered and uncovered bank bonds, and asset-backed securities. Moreover, the ECB is among the few central banks with a single collateral list that is used for both OMOs and SFs. The single-list approach greatly simplifies banks' access to this liquidity channel. Consequently, the ECB maintains a relatively large and diversified list of eligible collateral, which includes about 25,000 securities on a daily average.

Corporate bonds have been on the EA list since the ECB's inception. This policy encourages more efficient utilization of collateral for counterparties and allows the use of higher-quality collateral such as government bonds in private collateral markets like interbank repo or SL markets that are often more profitable. At the time of writing, corporate bonds comprise a significant fraction of EAs, representing around 10% of all assets pledged to the ECB at a value of about EUR 1.8 trillion. Indeed, the widespread use of corporate bond collateral has contributed to the growth of the European corporate bond market and to capital market development more generally (Bindseil et al., 2017).

In the period under consideration, a fraction (about 6%) of all assets, equivalent to a daily average of 1,450 individual securities, composes the universe of eligible corporate bonds. In recent years, the collateral eligibility criteria for corporate bonds have undergone both permanent and temporary adjustments, as depicted in Fig. 2, resulting in some fluctuations in the number of EAs. The beginning of our sample period corresponds to the introduction of the single EA list in 2007, when all Eurosystem central banks began using a single EA list published by the ECB. Our sample extends until June 2016, the onset of the CSPP. By focusing solely on the period preceding quantitative easing (QE), we can estimate the eligibility effects alone rather than the *joint* impact of eligibility and purchase announcements or, ultimately, actual asset purchases.

In general, asset eligibility is contingent on an asset's potential to trade on either a regulated or unregulated market that is accepted by the ECB. The most commonly accepted currency of EAs is the euro, and a fixed coupon is preferred.

An essential feature of EAs is credit quality, as overseen by the Eurosystem Credit Assessment Framework. This framework assigns categories called *ECB credit steps* to the following credit ratings: Step 1 includes AAA–AA, Step 2 A, and Step 3 BBB ratings. This rating scale is harmonized across the major rating agencies (S&P, Moody's, Fitch, and the Morningstar's Dominion Bond Rating Services); as a rule of thumb, the ECB always considers the *highest* available credit rating for any marketable asset.

To mitigate credit risk in its portfolio, the ECB not only requires a minimum credit rating threshold but also applies haircuts that are based on maturity, coupon payments, and asset category. In response to the financial crisis, the ECB made several changes to this rating re-

[5] In contrast to Chen et al. (2023), we address central bank collateral *eligibility* and not private repo market *pledgeability*. Although both relax credit constraints, they differ in their purpose, size, and scope. Repo market pledgeability largely depends on market conditions and the ability of a borrower to find a willing counterparty. In contrast, central bank eligibility is more reliable and less limited, since transactions are not profit-driven; hence, the composition of the EA list is stable or even accommodative to cushion market-wide funding shocks. Unlike the repo market, where both quantity and price fluctuate according to market conditions and are thus unpredictable – that is, risky – central bank eligibility is reliable in terms of both quantity and price.

[6] The SL market facilitates short-selling (Foley-Fisher et al., 2020; Muravyev et al., 2022) and provides a source of wholesale funding to financial institutions, some of which lack direct access to the repo market (Foley-Fisher et al., 2016; Huszar and Simon, 2018).

[7] This policy differs from that of the Fed, where OMOs are outright asset purchases. Furthermore, only a limited set of counterparties – namely, primary dealer banks – can access the Fed's repo facility, whereas all (private) banks can participate in the ECB's overnight collateralized lending.

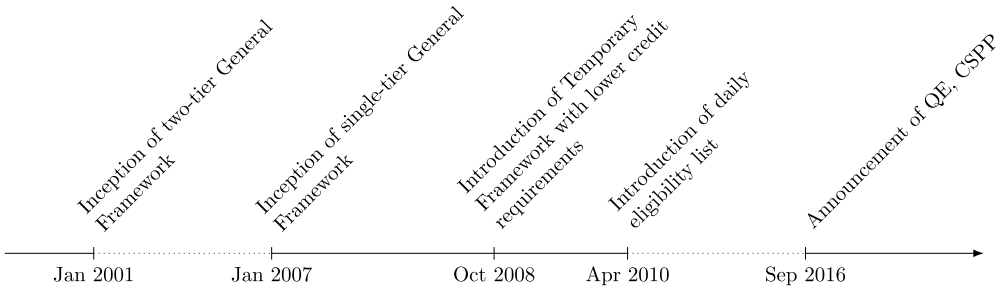

Fig. 2. *Timeline of eligibility list.* The figure depicts the evolution of the ECB's collateral framework, the set of rules that determine eligibility criteria in the Eurosystem, over time; only the most relevant changes are presented.

quirement as time passed: following the collapse of Lehman Brothers, the ECB announced its Temporary Framework in October 2008 and a reduction in the minimum rating requirement from A- to BBB- until the end of 2009. However, in May 2009, that deadline was extended, and the lower requirement remains in place.

For a more detailed overview of rules driving asset eligibility, eligible counterparties, ratings, applicable haircuts, and the overall legal framework, we refer the interested reader to Online Appendix A.1.

3.3. Identification strategy

The source of variation that we exploit for our empirical identification strategy comes from the structure of the Eurosystem's Collateral Assessment Framework (per General Documentation Guideline ECB/2014/60). This framework allows for some element of surprise in the ECB's inclusion decisions. It stipulates that (a) the ECB never confirms eligibility prior to an asset's issuance, (b) the Eurosystem reserves the right to *not* include otherwise suitable assets on the EA list due to risk management, operational, or any other discretionary reasons, and (c) an asset must meet the minimum criteria to be eligible, which means the corporate bond is (typically) a plain-vanilla bond issued in the European Economic Area, denominated in EUR, and carries a credit rating above the minimum threshold of BBB-.

To ensure a certain element of surprise for market participants, we exclude bonds entering the EA list for mechanical reasons; that is, due to rating upgrades that move them above the minimum threshold. Our investigation of the drivers of eligibility reveals that credit rating, bond age, and bond size are important determinants of eligibility, while country of origin appears not to matter. We account for this observation in our subsequent analyses. These covariates, however, cannot explain why some bonds enter the list soon after their issuance, while others become eligible only months or years later, despite their meeting all the formal eligibility criteria. We study this source of variation in detail in Online Appendix A.2 and conclude that the ECB and the national central banks occasionally exercise discretionary judgement in the eligibility assessment process. This discretionary decision making can be motivated by risk management considerations or financial stability concerns that are not explicitly revealed to the market. We therefore exploit this institutional setup and consider a bond's inclusion on the EA list as a (partially) unpredictable event.[8]

[8] Given the limited size of the non-financial corporate bond universe in the Eurozone, it is inevitable that bonds fulfilling all the eligibility criteria will enter the list at some point. The truly unpredictable part of EA inclusion is thus the timing of such inclusion. However, from the perspective of our research question, which is centered on our interest in the market and pricing impact of eligibility studied in a cross-sectional panel setting, this timing component does not affect the results. To put it differently, our analysis is agnostic about whether the uncertainty surrounding eligibility list inclusion stems from the timing of list inclusion or the actual inclusion of specific EA candidate bonds.

4. Data and descriptive statistics

The starting point of our analysis is the ECB's list of eligible collateral. We merge information from this list with bond-level characteristics, price data, and data on activity in the SL market.

4.1. The list of eligible marketable assets

Our main data set is the ECB's list of eligible marketable assets.[9] We restrict the sample to bonds issued by *non-financial corporations* and focus on the period from 8 April 2010 to 30 June 2016. For that time frame, we have daily eligibility information that allows us to observe the precise inclusion date of eligible bonds. The list includes information on the security identifier (ISIN) of an EA, asset category, issuance and maturity dates, haircuts, coupon, issuer residence, reference market, and currency denomination. For our main analyses, we restrict our sample to EUR-denominated bonds from the EU-28 countries. In the final EA sample, about 65% of corporate bonds become eligible in the first month after their issuance.

Fig. 3 illustrates the diverse composition of the EA data set in terms of country of origin, principal amount, maturity, and rating. Panel A shows that the majority of EAs originate in Germany, France, or Spain. The principal amount of EAs has decreased in recent years (Panel B), while bond maturity has increased over time (Panel C). The ratings (Panel D) indicate a decline in bond quality, a finding that is in line with the looser collateral requirements introduced in October 2008. In general, the EA list has become much broader in scope over time. Fig. 3 illustrates that the composition of the EA list evolves dynamically, suggesting that the ECB actively manages the list in response to market conditions.

4.2. Corporate bonds

For all ECB-eligible corporate bonds in our sample period, we obtain information from Bloomberg on bond characteristics, daily yield to maturity, and prices. Furthermore, we complement the sample with corporate bonds that were issued by the *same issuer* but not included on the ECB's eligibility list during our sample period. Our analysis concentrates on bonds with sufficient liquidity and trading activity, so that reported yields do not stay constant for 14 or more consecutive days within a month. In addition, we include only bonds with bid-ask price data and credit rating information available from S&P, Fitch, Moody's, or DBRS. Online Appendix B describes the bond selection procedure in detail. We complement the data with SL information from IHS Markit. The lending data contain daily aggregate values across all reported transactions of supplied and demanded quantities, as well as lending fees (borrowing costs) at the individual bond (ISIN) level.

[9] The daily historical lists and descriptions of the variables are available on the ECB website. We also have monthly data for the period from 30 May 2007 to 31 December 2009 from Eberl and Weber (2014), which we use for additional firm-level analysis.

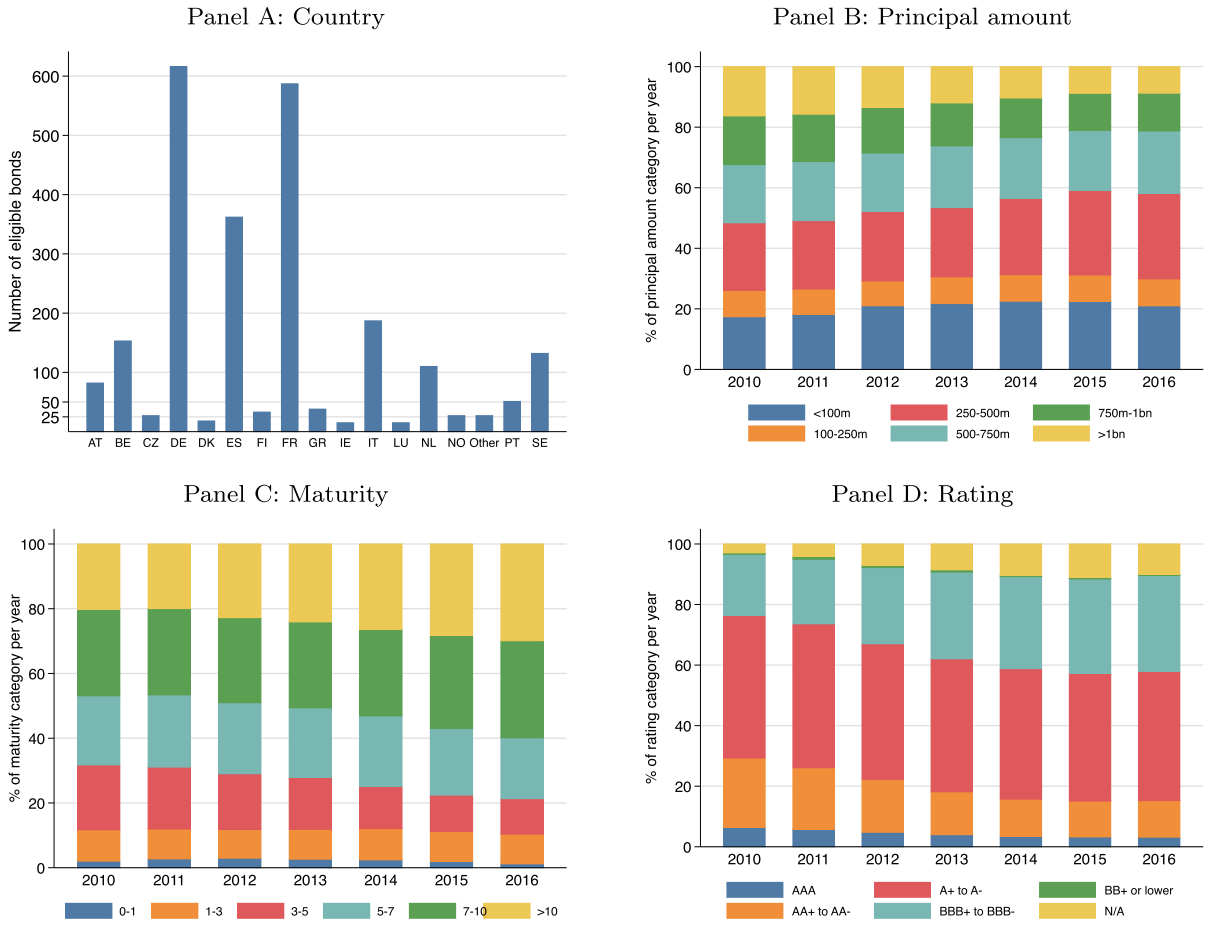

Fig. 3. *The ECB's eligibility list: Bond characteristics*. Panel A presents the distribution of eligible bonds across EEA countries. Panel B reports the distribution of bond issue size over time for the following six categories: below EUR 100 million, 100–250 m, 250–500 m, 500–750 m, and above EUR 1 billion. Panel C reports the maturity distribution of bonds over time. Maturity is measured as the difference between maturity and issuance date. The bar chart reports six maturity categories: 1 year or less, 1–3 years, 3–5 years, 5–7 years, 7–10 years, and 10 years or more. Panel D reports the initial rating distribution over time, where initial rating is defined as the highest initial bond rating given by Moody's, S&P, Fitch, or DBRS. Bonds with missing initial ratings are assigned to category "N/A". All panels are based on the period between April 2010 and June 2016. Our data come from Bloomberg.

We perform our analysis on all bonds that fulfill the ECB's eligibility criteria and therefore could become eligible at some point in time. In practice, the ECB eventually includes all eligible candidate bonds on its list, resulting in a bond panel that consists of 932 ISINs. These bonds can be divided along two dimensions: eligibility (*EA*) and availability for securities lending (*SL*). Table 1 shows the composition of the sample along these dimensions.

Looking at *EA*, 783 bonds were included on the eligibility list during the sample period (*EA = 1*), while the remaining 149 bonds (*EA = 0*) became eligible only after 30 June 2016, meaning that they met all the requirements to become eligible collateral during our sample period, but the ECB did not include them on the list due to one or more of the reasons described in Section 3.2. Next, we shift our focus to SL availability, *SL*: 811 bonds are traded on the SL market (*SL*), while 121 are not (*NoSL*). Examining the intersection of *EA* and *SL* among the 783 eligible bonds, only 699 were also lendable, of which 273 were already present in the SL market prior to the eligibility event (*SL prior EA*), while 426 bonds became eligible and lendable at or within 30 days after being included on the list (*SL at EA*). There are also 112 bonds that were traded on the SL market but not eligible during our sample period (*EA = 0*).

To measure the "pure" impact of EA inclusion, we focus on bonds that were lendable prior to their inclusion. This leaves us with 385 individual bonds, of which 273 became eligible during our sample period and 112 were not (but did become eligible after the end of our sample period). In addition, to assess the role of the SL market in Section 5.3, we supplement these bonds with 121 additional issues that were not present in the SL market.

Table 1
Sample composition.

		Total	EA = 1	EA = 0
Total		932	783	149
SL		811	699	112
	SL prior EA	*385*	*273*	*112*
	SL at/post EA	*426*	*426*	*0*
NoSL		121	84	37

The table presents the number of bonds with unique ISINs in the sample. We focus on bonds that are issued by non-financial corporate entities and are included on the ECB's eligibility list after 8 April 2010. We break down the total number of bonds (indicated in bold) along two dimensions: central bank eligibility (EA) and availability for SL. *EA* is a dummy that equals one if on a given day a bond is included on the EA list and zero otherwise. *SL* and *NoSL* denote bonds that are lendable or not present in the SL market, respectively. *SL prior EA* (*SL at/post EA*) counts the number of bonds that were available in the SL sample before (on the day of the event or shortly thereafter) they were included on the EA list. The sample period ranges from April 2010 to June 2016.

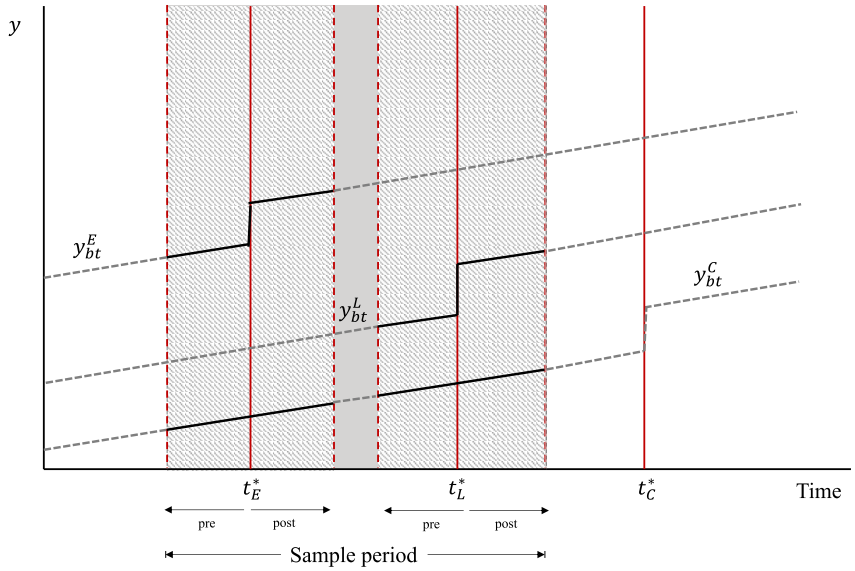

Fig. 4. *Difference-in-differences with variation in treatment timing: Illustration with three bond groups.* The figure plots the potential eligibility outcomes in three bond groups. Candidate group C comprises bonds that fulfill all eligibility criteria and yet are not treated during the sample period but only at time t^*_C; that is, they became eligible in the out-of-sample period. The early treatment group E contains bonds that receive a binary treatment at time t^*_E, and the late treatment group L comprises bonds that are treated at a later date, t^*_L. The figure also indicates the windows surrounding the event dates: t^*_E and t^*_L, for E and L bonds, respectively. In the event window, we examine the treated bonds relative to their matched counterparts, following the matching procedure described in Section 4.3. When the same control is matched to multiple treated bonds, we estimate our regressions using non-overlapping event windows.

4.3. Matching treated and control bonds

We estimate the effect of the ECB's collateral policy based on a matched sample approach. To accurately measure the impact of eligibility, we require that treated and control bonds be similar enough that any differences in outcomes are not driven by underlying bond or issuer characteristics. To achieve this, we restrict our analysis to eligible (treated) bonds such that "not-yet-eligible" bonds serve as controls. This allows us to make an "apples-to-apples" comparison since such controls are likely to be similar to their treated counterparts. At any point in time, there are numerous potential not-yet-treated bonds available. We resort to matching each treated bond to a single control bond that is most similar to the treated bond in question.

A distinctive feature of inclusion on the EA list is that it occurs frequently; that is, treatment events in our panel data are staggered throughout the sample period, as illustrated in Fig. 4. While this does not allow us to implement the canonical 2×2 difference-in-differences approach with two time periods and two groups, we can rely on the procedure proposed by Baker et al. (2022). For each treatment date – that is, the date on which a bond first appears on the EA list – we define an event window with a length of ± 30 days around the event. Each event window can be regarded as an individual, event-specific 2×2 data set, containing bonds that either are treated or can serve as potential controls. For instance, in the first event window in Fig. 4, bond "E" is treated and bonds "L" and "C" are candidate controls. Among the (many) candidate controls, we look for the single best match using the coarsened exact matching (CEM) method (Iacus et al., 2012). Assume bond "L" is a better match for bond "E". We would call all matched bonds (here, the pair "E" and "L") that are associated with the corresponding treatment window a *cohort*. The cohort variable serves as an identifier of the event-specific 2×2 data sets. In a final step, we stack the CEM-matched bond cohorts together to obtain the final data set for the analysis.

To reduce the imbalance in covariates between treated and control bonds, we apply CEM matching on three variables: *ECB credit steps*, *Issue size*, and *Time to maturity*. *ECB credit steps* is a categorical variable based on the rating categorization that the ECB uses for risk management and to assign haircuts. It relies on time-varying issuer credit ratings and takes one of four categories: AAA–AA (baseline), A, BBB, and not rated or non-investment grade. *Issue size* is measured as the logarithm of the issued amount, and *Time to maturity* is a bond's remaining time to maturity. The latter two covariates are coarsened; that is, they are divided into four bins using three uniformly distributed cut points. Since we have fewer controls than treated bonds, we allow bonds to be used multiple times as controls if the CEM algorithm identifies them as the most appropriate match.

Table 2
Quality of matching.

Variable	Treated (EA = 1)	Control (EA = 0)	Difference	p-Value
ECB credit steps	1.883	1.888	-0.005	0.954
Issue size	712.270	712.800	-0.529	0.983
Time-to-maturity	7.019	5.015	2.004	0.000
Age	0.337	2.963	-2.626	0.000

The table presents the mean values of the matching variables across treated (EA = 1) and control (EA = 0) bonds, as a result of the CEM matching described in Section 4.3. *ECB credit steps* is a categorical variable based on the rating categorization that the ECB uses for risk management (to assign haircuts) and is based on time-varying issuer credit ratings in four categories (AAA–AA, A, BBB, and not rated or non-investment grade). *Issue size* is measured as the logarithm of the issued amount in EUR millions. *Time to maturity* and *Age* are measured as years until maturity and since issuance, respectively. The *p*-values correspond to two-sided *t*-tests. The sample period ranges from April 2010 to June 2016. The data come from Bloomberg and IHS Markit.

After applying this matching procedure, our data set shrinks to 268 individual bonds: 196 of which are treated, i.e., eligible in the sample period. In total, there are 160 unique eligibility events, with multiple bonds being treated on the same day.[10] Table 2 reports the quality of the resulting matching: it compares the mean values of the matching variables across treated and controls bonds using two-sided t-tests.

[10] Online Appendix B.3 provides additional tests on the representativeness of the different subsamples relative to the total universe of non-financial corporate bonds that became eligible during the period between April 2010 and June 2016.

Table 3
Descriptive statistics of corporate bonds.

Panel A: Lendable EUR-denominated bonds after matching						
Variable	Obs.	Mean	SD	p5	Median	p95
Issue size	11,534	718.291	242.742	400.000	750.000	1250.000
Coupon	11,534	4.276	1.746	1.477	4.375	7.250
Time to maturity	11,534	5.709	2.879	0.893	5.581	10.162
Time to maturity/tenor	11,534	0.722	0.277	0.180	0.790	0.998
Initial rating	11,452	A-	-	BBB-	BBB	A
Yield spread	11,534	1.620	1.143	0.581	1.184	3.904
Bid-ask spread	11,534	0.471	0.261	0.128	0.432	0.913
Lendable value	11,534	106.768	66.121	23.212	93.359	233.368
On Loan	11,534	8.306	9.927	0.541	4.853	27.092
Indicative fee	11,534	72.071	34.065	50.000	62.500	137.500
Panel B: Lendable and non-lendable EUR-denominated bonds						
	Obs.	Mean	SD	p5	Median	p95
Issue size	13,902	611.164	324.579	50.000	600.000	1000.000
Coupon	13,902	4.201	1.695	1.375	4.154	7.250
Time to maturity	13,902	6.630	4.305	0.989	6.000	14.671
Time to maturity/tenor	13,902	0.740	0.270	0.189	0.828	0.998
Initial rating	11,956	A-	-	BBB-	BBB	A
Yield spread	13,902	1.628	1.128	0.581	1.217	3.897
Bid-ask spread	12,753	0.480	0.264	0.128	0.441	0.923
Panel C: GBP-denominated bonds						
	Obs.	Mean	SD	p5	Median	p95
Issue size	5,065	460.000	241.000	200.000	400.000	975.000
Coupon	5,065	6.078	1.001	4.875	5.875	8
Time to maturity	5,065	11.427	8.837	1.488	8.493	28.337
Time to maturity/tenor	5,065	0.616	0.225	0.186	0.638	0.939
Initial rating	4,923	A	-	BBB-	A-	AA-
Yield spread	5,065	1.339	1.007	0.762	1.136	3.165
Bid-ask spread	5,065	0.805	0.549	0.191	0.680	1.904
Lendable value	4,855	241.000	193.000	54.300	202.000	624.000
On Loan	4,594	14.100	13.500	319.056	9.263	40.300
Indicative fee	4,594	63.115	42.401	50.000	50.000	100.000

The table presents summary statistics for corporate bond-level variables for the period from April 2010 to June 2016, differentiating between lendable EUR, non-lendable EUR, and GBP-denominated bonds (Panels A, B, and C, respectively). *Issue size* is measured in EUR (GBP) million, *Coupon* rate is a percentage, while *Age* and *Time to maturity* are measured as years since issuance and until maturity, respectively. *Time to maturity/tenor* is the ratio of time to maturity to original maturity, a variable between zero and one that captures the age of a bond. The *Initial rating* is defined as the highest initial bond rating given by S&P, Moody's, Fitch, or DBRS. *Yield spread* is the difference between yield to maturity and the maturity matched risk-free rate derived from the German Bund curve. *Bid-ask spread* is the difference between bid and ask prices. *Lendable value* is the supply and *On loan* the demand in the securities lending market, both measured in USD million. *Indicative fee* captures the borrowing costs, measured in basis points. The sample period ranges from April 2010 to June 2016. The data come from Bloomberg and IHS Markit.

We find that the credit rating and the issue size are statistically indistinguishable between the treated and control groups, while the remaining time to maturity of control bonds is consistently lower. This is due to the fact that these bonds are generally older and thus mechanically lead to this difference because they have less time to maturity. Although we do not use the *Age* variable for matching, we report it in the table to confirm this observation.

In fact, our treated bonds tend to be younger and often on the run, with longer remaining maturity, while control bonds are seasoned and older. The shorter maturity of the controls might create a bias in the yield, driven by their lower yield with respect to the treated bonds and their longer maturity. This goes *against* our prediction that treated bonds should have lower yields than controls. Second, the higher age of controls might create a bias in liquidity. Seasoned bonds might have lower liquidity than their newly issued counterparts, so the controls in our sample might have lower liquidity than the treated bonds. Again, this would go *against* our prediction that treated bonds should have higher bid-ask spreads than the controls.

4.4. Descriptive statistics

Table 3 reports the summary statistics for our bond panel. Panels A and B correspond to the benchmark analysis of lendable bonds (SL), and a sample extended by non-lendable bonds (NoSL), respectively. Panel C provides the statistics for bonds denominated in pound sterling (GBP) and used for further analysis in Section 6.3.

The summary statistics of Panel A indicate that, on average, a bond in the sample has an issue size of EUR 718 million, about 5.7 years to maturity, and a coupon rate of 4.27%. These variables are quite dispersed, especially *Size*, whereas *Time to maturity* suggests that initial bond tenors are between 1 and 15 years. The ratio of time to maturity to initial maturity, *Time to maturity/tenor*, indicates whether the bond is newly issued or seasoned. In the analyses, we not only consider the overall sample but also compare new to seasoned/old bonds; we set the cutoff value at 0.95. The average value of *Time to maturity/tenor* suggests that most bonds enter the sample shortly after issuance, although some are included on the list about halfway through their tenure. The average *Initial rating* in our sample is A-, but credit ratings range from BBB- to A. The average yield is 1.62% above the maturity-matched risk-free (Bund) curve, but this varies widely. The average *Bid-ask spread* is 47 bps. In the SL market, we observe an average borrowing cost, the *Indicative fee*, of 72.07 bps. This variable indicates the current market rate and is calculated based on observed borrowing costs between lenders and prime brokers, along with hedge funds. Average lending supply, which is captured by *Lendable value*, is about USD 106.77 million,

whereas demand, as captured by *On loan*, is about USD 8.31 million. That is, the ratio between supply and demand is roughly 12 to 1. *Lendable value* is defined as the value of stock inventory available to lend on a given day, and *On loan* is the total value of stock on loan, net of double counting (as reported in IHS Markit's data dictionary).

5. The secondary market for collateral and corporate bonds

Financial institutions should prefer to hold collateral-eligible or fungible assets that can be easily converted into cash to hedge against funding liquidity shocks. If faced with an adverse liquidity shock, banks will tap the corporate bond market and boost the demand for ECB-eligible bonds (see, e.g., Hildebrand et al., 2012; BIS, 2013; Acharya and Merrouche, 2013; Gale and Yorulmazer, 2013; Crosignani et al., 2020; Boermans and Vermeulen, 2020). Allen and Moessner (2012) show that, following the financial crisis, European banks increased their reliance on collateralized market funding, an action that drove up demand and hence the value of pledgeable collateral. In extreme cases, this increased demand could reduce the bond supply to an extent that leads to a scarcity of high-quality liquid assets (HQLAs).

Banks have multiple channels through which they can obtain adequate collateral (see Fig. 1): They can either purchase such bonds on the secondary (cash) market or borrow them on the collateral (SL) market. Thus, banks do not necessarily need to hold ECB-eligible bonds, because they can also borrow them on the SL market in exchange for other, ineligible assets in their portfolios. For this reason, we investigate in this section not only how increased demand for pledgeable collateral around an eligibility event affects secondary (cash) market liquidity and prices but also its spillover into the collateral SL market.

In equilibrium, these linkages affect both the secondary (cash) market yield and the liquidity of corporate bonds, along with the quantities supplied and demanded and the fees charged in the SL market. To illuminate the economic mechanism reinforcing these linkages, we provide a bare-bones model in Online Appendix C, where we derive the bond-eligibility component of the premium.[11] Our model predicts that the inclusion of a bond on the eligibility list reduces the borrowing constraints of banks. For this reason, even if the cash flows of that bond are identical to those of another bond not included on the EA list, the price of the eligible bond is higher; conversely, its yield is lower. In the following subsection, we provide evidence of the economic magnitude of this yield reduction.

However, many previous theoretical models have ignored the possibility that banks can hedge against funding liquidity shocks even if they do not hold ECB-eligible corporate bonds on their balance sheets. This assumption is grounded in the fact banks can convert other, ineligible, on-balance-sheet assets into ECB-eligible ones via money markets like the SL market and then use these fungible assets to borrow at the ECB. We fill this gap by allowing banks to borrow an ECB-eligible bond in the SL market in exchange for another not-yet-eligible bond for a fee (and with a haircut). This valuable opportunity increases banks' demand for ECB-eligible bonds in the SL market while reducing their demand in the secondary (cash) bond market. This has a positive impact on the borrowing activity in the collateral (SL) market and leads to a diminished eligibility premium in the secondary bond market. Our model predicts that the price difference between two bonds with identical cash flows might still represent an eligibility premium, but this premium is lower if the bond is available in the SL market. The intuition behind the price differential between the two bonds is that a bank's borrowing constraints could be relaxed due to the option of borrowing from the SL market. This flexibility reduces the extent to which borrowing constraints are binding and therefore their impact on the price. We test these predictions by performing the following analyses.

5.1. The secondary market for collateral

Regulatory reforms following the financial crisis have increased the need for collateral in the form of HQLAs. Amid the resulting HQLA shortage, a secondary market for collateral emerged, with the OTC repo and SL markets facilitating the short- and long-term borrowing of collateral. According to Aggarwal et al. (2021), market participants in the euro area access the SL market mainly to obtain eligible collateral via borrowing or collateral swaps rather than to directly seek short-term funding (cash).

In addition to the repo and SL markets, many central banks are using their growing balance sheets to maintain their lending facilities for liquidity provision to banks. Even though these facilities may appear to be a redundant platform to obtain liquidity, they play an important role by providing both a benchmark for borrowing costs and a far greater liquidity capacity than bonds available in the private money markets. Moreover, the ECB facility for the corporate bond market in Europe is not redundant; on the contrary, a repo market for European corporate bonds is virtually non-existent.[12]

5.1.1. The securities lending market

The SL market has grown substantially in both scale and scope in the past decade (IHS Markit, 2020). On the supply side of the market, lenders that are typically large passive investors, such as mutual funds, pension funds, and insurance companies, offer their long-term holdings for lending. On the demand side, borrowing institutions typically seek HQLAs, but they also seek other specific assets; for example, hedge funds may short certain stocks, and dealers/market-makers may fill orders on assets that are not in their inventory.[13]

To examine the effect of the initial inclusion of a bond on the EA list on the SL market, we use proprietary SL data from IHS Markit. The advantage of performing this analysis is that we are able to disentangle the *direct* effect of ECB eligibility on the SL market, given the virtual absence of a (private) corporate bond repo market in Europe. The first evidence of the linkage between eligibility and SL market can be found in Table 1, where we observe that 426 of 811 bonds were offered for lending shortly after they became eligible. However, we cannot use these bonds for either the SL market analysis (since there are no data for the pre-eligibility period) or the yield and liquidity analysis (since the results would be affected by the joint effect of eligibility and inclusion in the SL market). We therefore focus on bonds that were already present in the SL market prior to the eligibility event and estimate the following model:

$$Y_{btc} = \alpha_{bc} + \alpha_{tc} + \beta_1 EA_{bc} \times Post_{btc} + X_{btc} + \epsilon_{btc}, \quad (1)$$

where Y_{btc} is the SL market variable at time t of bond b that belongs to cohort c. Cohorts are defined in Section 4.3; EA_{bc} is an indicator that equals one for bonds that are on the EA list (*treated*) throughout the event window of cohort c and zero otherwise. $Post_{btc}$ is a dummy variable that equals one for the post-treatment period and zero otherwise. X_{btc} controls for the different ECB credit step categories. α_{bc} and α_{tc} are bond-cohort and day-cohort fixed effects, respectively.

[11] The model's prediction is largely in line with the "specialness" premium (Duffie, 1996; Jordan and Jordan, 1997), the on-the-run-premium (Krishnamurthy, 2002), the convenience yield documented in U.S. Treasuries (Longstaff, 2004; Krishnamurthy and Vissing-Jorgensen, 2012), and the pledgeability premium due to borrowing constraints (see, e.g., Gârleanu and Pedersen, 2011; Chen et al., 2018, 2023).

[12] Nyborg and Rösler (2019) report that only about 1% of the total volume of general collateral repo transactions are based on pledged corporate bond collateral. This suggests that the (private) corporate bond repo market is virtually *absent* from the euro area, except for collateralized lending operations provided by the ECB.

[13] We refer the interested reader to Online Appendix D, where we provide details on SL market size, the institutional background, and the characteristics of lendable bonds.

Table 4
The effect of corporate bond eligibility on the securities lending market.

	Overall sample		New bonds		Seasoned bonds	
Panel A: Lendable value						
EA*Post	0.229***	0.238***	0.357***	0.356***	0.013	0.012
	[0.016]	[0.017]	[0.023]	[0.023]	[0.009]	[0.008]
Observations	8,688	8,688	7,467	7,467	1,192	1,192
R-squared	0.983	0.983	0.982	0.982	0.995	0.995
Panel B: On loan						
EA*Post	0.419***	0.506***	0.682***	0.697***	0.009	0.122
	[0.081]	[0.085]	[0.117]	[0.117]	[0.077]	[0.090]
Observations	8,688	8,688	7,467	7,467	1,192	1,192
R-squared	0.865	0.867	0.872	0.873	0.847	0.848
Panel C: Indicative fee						
EA*Post	-0.205***	-0.204***	-0.280***	-0.279***	-0.084***	-0.048*
	[0.021]	[0.022]	[0.030]	[0.030]	[0.025]	[0.027]
Observations	8,688	8,688	7,467	7,467	1,192	1,192
R-squared	0.772	0.772	0.766	0.766	0.823	0.824
Controls	No	Yes	No	Yes	No	Yes
Day-cohort FE	Yes	Yes	Yes	Yes	Yes	Yes
Bond-cohort FE	Yes	Yes	Yes	Yes	Yes	Yes

The table presents the results of daily panel regressions of the 30-day event study on the effect of ECB eligibility list inclusion on bond-level SL market proxies. In panel A, the dependent variable is *Lendable value*, the lending market supply that we proxy as the natural logarithm of the $ amount (stock) of a given bond available for lending. In panel B, the dependent variable is *On loan*, the lending market demand defined as the logarithm of the total USD amount of the bond borrowed on a given day. In panel C, the dependent variable is *Indicative fee*, defined as the logarithm of the lending fee or borrowing cost measured in bps. *EA* is a dummy that equals one if a bond is included on the EA list on a given day and zero otherwise. *Post* is the 30-day post-treatment dummy. Controls are dummy variables for the ECB credit steps. Bond-cohort and day-cohort fixed effects are included where indicated, with cohorts defined for each eligibility treatment date. Three samples are considered: all bonds, newly issued bonds, and seasoned bonds. The sample period ranges from April 2010 to June 2016. The data come from Bloomberg and IHS Markit. Robust standard errors are reported in parentheses. Statistical significance is denoted by ***, **, and * at the 1%, 5%, and 10% levels, respectively.

We have three key variables of interest: lending demand, proxied by *On loan*; lending market supply, as captured by *Lendable value*; and *Indicative fee*, which represents borrowing costs on a given day for a specific security. Table 4 presents the results for the period between April 2010 and June 2016.

In panel A of Table 4, we see that an eligibility event triggers an increase in the *Lendable value* of eligible bonds relative to their matched but not-yet-eligible counterparts in the overall sample. This increase in supply might be generated due either to existing lenders raising the amount allocated for lending or to new lenders entering the market to capitalize on the income-generating potential of SL. However, once we differentiate between new and old bonds, we see that the lending supply increase is largely concentrated in the new bond segment (with a roughly 35.6% increase upon eligibility).[14] Demand, proxied for by *On loan*, also increases, as shown in panel B. While the first two columns of the overall sample suggest a 41.9%–50.6% increase in demand, the rest of the table shows that new bonds account for 68.2%–69.7% of the shift, while the implied increase for seasoned bonds is both negligible and statistically insignificant. Table 3 suggests that even though the percentage change is larger in terms of demand, the overall lending supply is an order of magnitude larger, which is why we observe an average short-term drop of 20% in *Indicative fees*, with about 28.0% for newly issued bonds (see panel C). Nevertheless, the increase in the total volume should compensate lenders for the drop in fees, making post-eligibility lending more profitable overall.

[14] In general, our main findings are robust with respect to the inclusion of a "week since issuance" categorical control variable. These results are available upon request.

Our results suggest that the secondary (cash) corporate bond market alone cannot meet the increased demand for collateral, as SL activity is on average more concentrated around newly issued bonds. With the participation of collateral-seeking banks in the SL market, corporate bond lending opens a channel through which collateral shortages can be mitigated. Eligibility not only promotes SL but also improves market functioning. Moreover, we observe that many bonds in our sample become eligible and lendable at roughly the same time. Although we exclude these bonds from our analysis, since we cannot measure the "pure" effect of eligibility inclusion, their presence serves as further evidence for the spillover between the ECB's monetary policy and the secondary market for collateral; that is, the SL market for corporate bonds.

5.2. The secondary (cash) market for corporate bonds

5.2.1. Secondary market yield reaction

Following the inclusion of a bond on the EA list, bond demand from banks seeking adequate collateral will increase in the secondary cash and collateral markets. Hedging demand against unexpected funding liquidity shocks and the buildup of precautionary collateral reserves by banks are likely to put downward pressure on bond yields. Moreover, ECB eligibility should also decrease yields, as an EA provides a liquidity service, allowing for it to be repeatedly pledged at the central bank against overnight funding (cash). As predicted by our model in Online Appendix C, this feature should increase the price of the bond, pushing down its yield to account for the present value of its fungibility. However, this effect should be mitigated by the possibility of exchanging an ineligible bond for an eligible one in a collateral swap on the SL market.

Table 5
The effect of corporate bond eligibility on the secondary market yield and liquidity.

	Overall sample		New bonds		Seasoned bonds	
Panel A: Yield spread						
EA*Post	-0.078***	-0.046***	-0.005	-0.006	-0.201***	-0.090***
	[0.011]	[0.010]	[0.012]	[0.012]	[0.022]	[0.014]
Observations	8,688	8,688	7,467	7,467	1,192	1,192
R-squared	0.994	0.994	0.996	0.996	0.971	0.975
Panel B: Bid-ask spread						
EA*Post	0.046***	0.058***	0.095***	0.096***	-0.040***	-0.008
	[0.006]	[0.006]	[0.008]	[0.008]	[0.008]	[0.007]
Observations	8,688	8,688	7,467	7,467	1,192	1,192
R-squared	0.931	0.932	0.939	0.939	0.901	0.903
Controls	No	Yes	No	Yes	No	Yes
Day-cohort FE	Yes	Yes	Yes	Yes	Yes	Yes
Bond-cohort FE	Yes	Yes	Yes	Yes	Yes	Yes

The table presents the results of daily panel regressions of the 30-day event study on the effect of eligibility list inclusion on secondary market bond yield and liquidity. In panel A, the dependent variable is *Yield spread*, defined as the difference between the bond's daily mid yield to maturity and the matched risk-free yield that is derived from the German Bund curve provided by Bundesbank. In panel B, the dependent variable is *Bid-ask spread*, defined as the difference between the bond's quoted bid and ask prices. *EA* is a dummy that equals one if a bond is on the EA list on a given day and zero otherwise. *Post* is the 30-day post-treatment dummy. Controls are dummy variables for the ECB credit steps. Bond-cohort and day-cohort fixed effects are included where indicated, with cohorts defined for each eligibility treatment date. Three samples are considered: all bonds, newly issued bonds, and seasoned bonds. The sample period ranges from April 2010 to June 2016. The data come from Bloomberg and IHS Markit. Robust standard errors are reported in parentheses. Statistical significance is denoted by ***, **, and * at the 1%, 5%, and 10% levels, respectively.

To investigate the eligibility premium for bonds made available in the SL market, we use *Yield spread* as the dependent variable in equation (1); it is defined as the difference between the bond's end-of-day yield to maturity and the maturity-matched risk-free rate, derived from the German Bund yield curve.[15]

Panel A of Table 5 presents the results for the *Yield spread*. In the overall sample, we find that the *EA*Post* coefficient is negative, statistically significant, and robust to the inclusion of controls and fixed effects. This suggests that once a bond becomes eligible, its yield decreases by 4.6–7.8 bps on average relative to its matched, not-yet-eligible counterpart. Untabulated regression results suggest that *Time to maturity/tenor* is also significant, hinting that an examination of the yield effect in the subsamples of new versus more mature bonds is warranted. We find that the yield drop is smaller for newly issued bonds and not statistically different from zero, compared to the 9.0–20.1 bps observed for their older, seasoned counterparts. This pattern likely emerges because of the large amount of new bonds being supplied and demanded in the SL market after the eligibility event, consistent with the evidence in the previous section. By contrast, the eligibility of seasoned bonds can revive their trading activity by focusing investors' attention on them, given the lack of a significant SL market response.

Our findings confirm the presence of an eligibility premium in line with the previous literature on bond specialness, convenience yield, and pledgeability premium. The observed decline in yields is a form of compensation for the fungibility of adequate collateral. This means that once a bond is eligible, it acquires cash-like features because it is easier to sell and can be pledged at the ECB in exchange for overnight funding.[16] We find that the two important aspects driving the size of the eligibility premium are (a) the relevance of the absence of the private corporate repo market and (b) the importance of activity in the SL market. Regarding the latter, we have shown that the demand pressure on EAs in the SL market is larger for new bonds, which could explain why the eligibility premium is substantially larger for older bonds, where SL activity is less pronounced, even following an eligibility event. In the absence of the SL market's mitigating effect, we can capture the unbiased size of the eligibility premium.

5.2.2. Secondary market liquidity reaction

While extending the range of ECB-eligible assets constitutes a positive shock to funding liquidity, the accompanying impact on bond-level market liquidity is less clear. We expect that when a corporate bond becomes eligible collateral for (central bank) repo transactions, its liquidity should improve in line with Brunnermeier and Pedersen (2009), who argue that market liquidity and funding liquidity are tightly linked. As such, when a bond becomes good collateral, it will not be subject to fire sales, thus making it less costly for dealers to hold that bond in their inventory. All these mechanisms appear to suggest that market liquidity should improve after eligibility. On the contrary, as a hedge against future liquidity shocks, banks may have an incentive to lock EAs into their portfolios by increasing their holdings (Hildebrand et al., 2012; Acharya and Merrouche, 2013; Gale and Yorulmazer, 2013; Crosignani et al., 2020), which would reduce the free float of eligible bonds in the market. This "hoarding effect" decreases bond-level liquidity and could lead to scarcity and eventually a drying up of liquidity if the bond supply remains unchanged. However, an increase in the lendable value in the SL market should mitigate the scarcity channel, as suggested by the theoretical model in Huh and Infante (2021). An alternative explanation

[15] The risk-free rate is based on the Nelson-Siegel-Svensson yield curve, with the parameters estimated from the Bund yield curve and taken from the Deutsche Bundesbank website. We compute the yield spread following Dick-Nielsen et al. (2012) and Friewald et al. (2012). See Online Appendix B for more information.

[16] In terms of economic magnitude, the eligibility premium is comparable to the estimates for sovereign bonds by Buraschi et al. (2014) and Corradin and Rodriguez-Moreno (2016), who find an effect of 13 bps for eligible USD bonds during the global financial crisis. However, this comparison is somewhat superficial due to the confounding effect of the active private repo market of sovereign bonds. For these bonds, inclusion on the ECB's eligible list has a similar effect to that on the highly overlapping general collateral list of the repo market (see Nyborg and Rösler, 2019). Therefore, it is difficult to distinguish whether the observed premium is driven by the ECB's lending facility or by the private repo market.

Table 6
The effect of corporate bond eligibility in the absence of securities lending.

	Yield spread			Bid-ask spread		
EA*Post*NoSL		-0.108***	-0.139***		-0.058*	-0.070**
		[0.026]	[0.026]		[0.033]	[0.033]
EA*Post	-0.077***	-0.079***	-0.048***	0.052***	0.046***	0.058***
	[0.009]	[0.011]	[0.010]	[0.007]	[0.007]	[0.006]
Observations	10,609	10,609	10,609	9,350	9,350	9,350
R-squared	0.994	0.994	0.994	0.927	0.926	0.927
Controls	Yes	No	Yes	Yes	No	Yes
Day-cohort FE	Yes	Yes	Yes	Yes	Yes	Yes
Bond-cohort FE	Yes	Yes	Yes	No	Yes	Yes

The table presents the results of daily panel regressions of the 30-day event study on the effect of eligibility list inclusion in conjunction with availability for securities lending. The dependent variable *Yield spread* is defined as the difference between the bond's daily mid yield to maturity and the matched risk-free yield that is derived from the German Bund curve provided by Bundesbank. The *Bid-ask spread* is the difference between the bond's quoted bid and ask prices. *EA* is a dummy that equals one if a bond is included on the EA list on a given day and zero otherwise. *Post* is the 30-day post-treatment dummy, and *NoSL* is a dummy that equals one for the subset of corporate bonds that are not available for securities lending. Controls are dummy variables for the ECB credit steps. Bond-cohort and day-cohort fixed effects are included where indicated, with cohorts defined for each eligibility treatment date. The sample period ranges from April 2010 to June 2016. The data come from Bloomberg and IHS Markit. Robust standard errors are reported in parentheses. Statistical significance is denoted by ***, **, and * at the 1%, 5%, and 10% levels, respectively.

could involve the changing composition of traders. A bank that holds an eligible bond and is subject to a liquidity shock will pledge it with the ECB to borrow cash instead of selling it in the secondary market. This should reduce the number of traders engaged in bond transactions for liquidity purposes and tilt the composition of traders toward those that are motivated to trade for informational reasons.[17] As a consequence, the bid-ask spread offered by market-makers should increase. In the event that a bank is holding an eligible bond without an immediate need for liquidity, it can decide to post the bond on the SL market, which increases the lendable bond supply in the SL market. In this case, we should therefore observe, unlike what is theoretically predicted in Huh and Infante (2021), that an increase in the bid-ask spread is associated with an increase in the lendable value on the SL market. Clearly, the interaction of these elements is quite complex, and we leave it to the empirical evidence to indicate which one prevails.

We investigate whether liquidity significantly changes around EA list inclusion in a setting similar to equation (1). We use *Bid-ask spread* as our liquidity measure, a standard proxy for trading costs and dealer inventory risk, measured as the difference between a bond's quoted bid and ask prices. Panel B of Table 5 presents the results.

We find that *Bid-ask spread* exhibits either a positive or non-significant impact across most specifications. Once included on the EA list, bonds experience an increase in trading costs on average, as their *Bid-ask spread* widens by about 4.6–5.8 bps relative to not-yet-eligible bonds. This effect is more pronounced for newly issued bonds. Therefore, in this case, the empirical evidence points to the traders' composition hypothesis.[18] For seasoned bonds, we observe a slight improvement in liquidity, which becomes insignificant in the most conservative model specification, in line with the funding and market liquidity channel documented by Brunnermeier and Pedersen (2009) and positive but not significant changes in the supply and demand of these bonds in the SL market, slightly supporting the theoretical predictions in Huh and Infante (2021). These results confirm that there are several forces at play in the complex interactions around the market liquidity of bonds' secondary market, and there is no dominant effect for all bonds.

[17] We thank the anonymous referee for pointing out this potential effect.

[18] Unfortunately, due to a lack of data, we cannot test or quantify this effect because we do not have access to good data on trade volumes and trader identification. The corporate bond market in Europe is largely an OTC market and there are no data available in the manner that TRACE provides for the United States.

5.3. Bonds without securities lending activity

In the previous subsections, we argue that the size of the eligibility premium is different for bonds that are also available in the SL market, a statement theoretically based on our model. We test this empirical prediction by repeating the yield and liquidity analyses through the inclusion of a set of bonds that are not available for SL. Overall, we have 121 such bonds in our data set, of which 84 entered the EA list during the sample period, while the remaining 37 became eligible after June 2016. After applying the matching algorithm, our sample consists of 36 pairs of treated and control bonds.

We expect that for bonds without the mitigating effect of the SL market, both the secondary market liquidity reaction and the yield impact should be more pronounced. Empirical support for this hypothesis would verify our claim that the presence of an SL market for euro area corporate bonds alleviates the collateral shortage by offering investors access to short-term eligible collateral borrowing. We perform this analysis on an extended sample that contains lendable securities as well as non-lendable matched bond pairs. To capture the differential effect stemming from SL, we include the dummy variable *NoSL* that equals one for bonds that are not available for SL and its interaction with *EA*Post*. Table 6 presents the results.

Table 6 replicates the analyses presented in Table 5 but studies the effect of eligibility in conjunction with a bond's availability in the SL market. Our variable of interest is the triple interaction term *EA*Post*NoSL*, which captures the differential impact between lendable and non-lendable bonds. The negative and statistically significant coefficient on this term confirms our expectation that the yield effect is more substantial for non-lendable bonds. While the average yield reaction of bonds available for lending is 4.6–7.8 bps, this effect is larger for non-lendable bonds, with 18.7 bps (i.e., a difference of about 14 bps). Again, the results are driven by seasoned bonds. We also test the potential differential liquidity impact between lendable and non-lendable bonds and find that while eligibility slightly increases the *Bid-ask spread*, this effect is reversed for the non-lendable bonds. That is, a bond that is not traded in the SL market and is therefore less liquid might experience liquidity improvement due to increased investor attention resulting from the positive eligibility news.

6. Further evidence on causality and robustness

In the following, we summarize our findings on additional analyses and robustness exercises. First, we investigate the presence of parallel

trends between eligible and control bonds prior to treatment. Second, we affirm the robustness of the main findings with respect to event window length and sample period choice. Third, we account for effects stemming from firm fundamentals by focusing on a subset of bond issuers who issue EAs in multiple currencies. Fourth, we study the introduction of a new haircut regime to address any concerns regarding biases stemming from haircut changes. Finally, we switch perspectives and delve into the impact of bank liquidity shocks.

6.1. Parallel trends

To test the matching quality and argue that our results can be regarded as causal evidence, we show the existence of parallel trends in treated and control bonds prior to treatment. For this test, we focus on a nine-week window around the eligibility event. Similar to equation (1), we regress our variables of interest on *EA* and their interaction with dummies for each week in the event window, in addition to bond-cohort and day-cohort fixed effects.

Panel A of Fig. 5 plots the impact of collateral eligibility on *Lendable value*. We find that the SL market supply is somewhat (although not significantly) lower for treated bonds than for controls, most likely because the majority of treated bonds are new issues, and it takes time for lending supply to build up. Following the eligibility event, the difference reverses and increases significantly, indicating that eligible bond holders post more of these more desirable EAs for lending. For lending demand (*On loan* amount) in panel B, treated bonds have somewhat higher demand in the four weeks prior to eligibility; that is, around the time of issuance for most bonds. This difference declines in the weeks preceding the treatment date and widens significantly after EA list inclusion. As depicted in panel C, for the borrowing cost measure *Indicative fee*, the pre-eligibility trend is less clear prior to treatment, which is followed by a sharp decline in the fees of control bonds due to eligibility. Panel D depicts the *Yield spread*, which gradually declines following treatment, while in panel E, the *Bid-ask spread* increases slightly for treated bonds relative to the pre-treatment period, in line with the results of Sections 5.2.1 and 5.2.2. Generally, we conclude that the pre-treatment trends of eligible and not-yet-eligible control bonds are rather similar, supporting the causal nature of the empirical evidence presented in Section 5.

6.2. Event and rolling window analyses

To confirm that the choice of event window length does not affect the results, we run the main analysis with a shorter window length of ±15 days. The results are both qualitatively and quantitatively similar to the benchmark specifications (see Online Appendix E.1).

There may be concerns that the eligibility effect observed during the sample period is driven by the ECB's adoption of an increasingly accommodating monetary policy to combat the euro area debt crisis and the period that followed. To address these concerns, we conduct an analysis of sub-periods. The purpose of this approach is to disentangle the potentially disparate effects of two major events that could affect our results: The period between 2010 and 2014 is likely to be influenced by the effects of the euro area debt crisis, while post-2014, the Targeted Longer-Term Refinancing Operations could bias our findings. We run three-year rolling window regressions and confirm that our main results are robust with respect to different periods of financial and economic stress in the euro area. Online Appendix E.2 presents and discusses these findings in more detail.

6.3. GBP-denominated eligible bonds

In this section, we address the potential concern that the issuing firms' fundamental characteristics could significantly contribute to the selection of EAs and thus affect or even drive our results. We turn to a particular subset of bond issuers that issue EAs in multiple currencies. For these multi-currency issuers, we compare the eligibility effect across different currency denominations, controlling for within-firm effects, among other factors.[19] This analysis is close in spirit to the approach of Chen et al. (2023), who address the endogeneity stemming from the correlation in changes in asset fundamentals with changes in asset pledgeability.

The ECB is the *only* major central bank that as a general rule does not accept foreign currency-denominated bonds as collateral at all times (ECB, 2013). It first accepted foreign currency, more specifically, USD-, pound sterling (GBP)-, and Japanese yen (JPY)-denominated assets that were issued and held in the euro area as part of the Temporary Framework that was in effect between 17 November 2008 and 31 December 2010. Following the termination of the framework, the eligibility of these assets was discontinued until their reintroduction to the EA list in 2012. This (re)inclusion was announced on 6 September 2012, while the first non-EUR collateral-eligible assets were included on the list on 8 November 2012. Since then, the ECB has considered USD-, GBP-, and JPY-denominated collateral for eligibility, in addition to the euro. For our analyses, we focus on GBP corporate bonds, which constitute over 95% of non-EUR EAs in the sample. Panel C of Table 3 reports descriptive statistics for the GBP bonds.

This institutional setup allows us to test various features of foreign currency-denominated collateral. More specifically, we can examine the effect of non-technical (i.e., not related to a rating downgrade or maturity expiration) *exclusions* from the EA list, as well as the effect of *inclusion announcements*. However, compared to previous analyses, our identification strategy has to be adjusted to accommodate the debt portfolio composition of multi-currency issuers.[20]

We measure the effect of the eligibility event using a simple difference-in-differences regression: the treated bonds are denominated in GBP, while the control group is comprised of *already-eligible* EUR-denominated bonds issued by the same firm. When conducting this analysis, we focus on 133 bonds of 11 firms that have at least two eligible EUR-denominated and at least two eligible GBP-denominated bonds. In addition, we include daily time, bond, and firm fixed effects. Controlling for bond fixed effects is important in this setting because different levels of haircuts apply to different bond features, such as currency denominations, in the eligibility framework. Firm fixed effects are included to absorb all information related to firm fundamentals that could help drive bond selection or the eligibility effect. In this setup, the observed SL and secondary market effects can be interpreted as the difference between the newly eligible GBP bonds relative to the previously eligible EUR-denominated bonds.

6.3.1. The effect of list exclusion

For the EUR bonds in the main analysis, it is not possible to test the effect of removal from the EA list, as bonds are excluded only for technical reasons; that is, when they either no longer fulfill the eligibility criteria because of declining credit quality or when they reach maturity. By contrast, the ECB's decision to accept (or reject) collateral denominated in foreign currencies is a monetary policy question that is not necessarily linked to the fundamental characteristics of the relevant asset or its issuer and constitutes a shock to both market participants and bond-issuing firms.

We can thus examine the effect of eligibility delisting in the sample of GBP bonds. We observe 70 event dates for the 169 treated bonds, with 48 exclusion events due to the suspension of the Temporary Framework. When we match these treated bonds with EUR counterparts

[19] We observe that the group of multi-currency issuers is heterogeneous: they are typically large, can be domiciled in either the United Kingdom or continental Europe, and come from a variety of sectors.

[20] We also examine the inclusion of GBP bonds on the eligibility list and find qualitatively similar eligibility effects to the main analysis; these results are available on request.

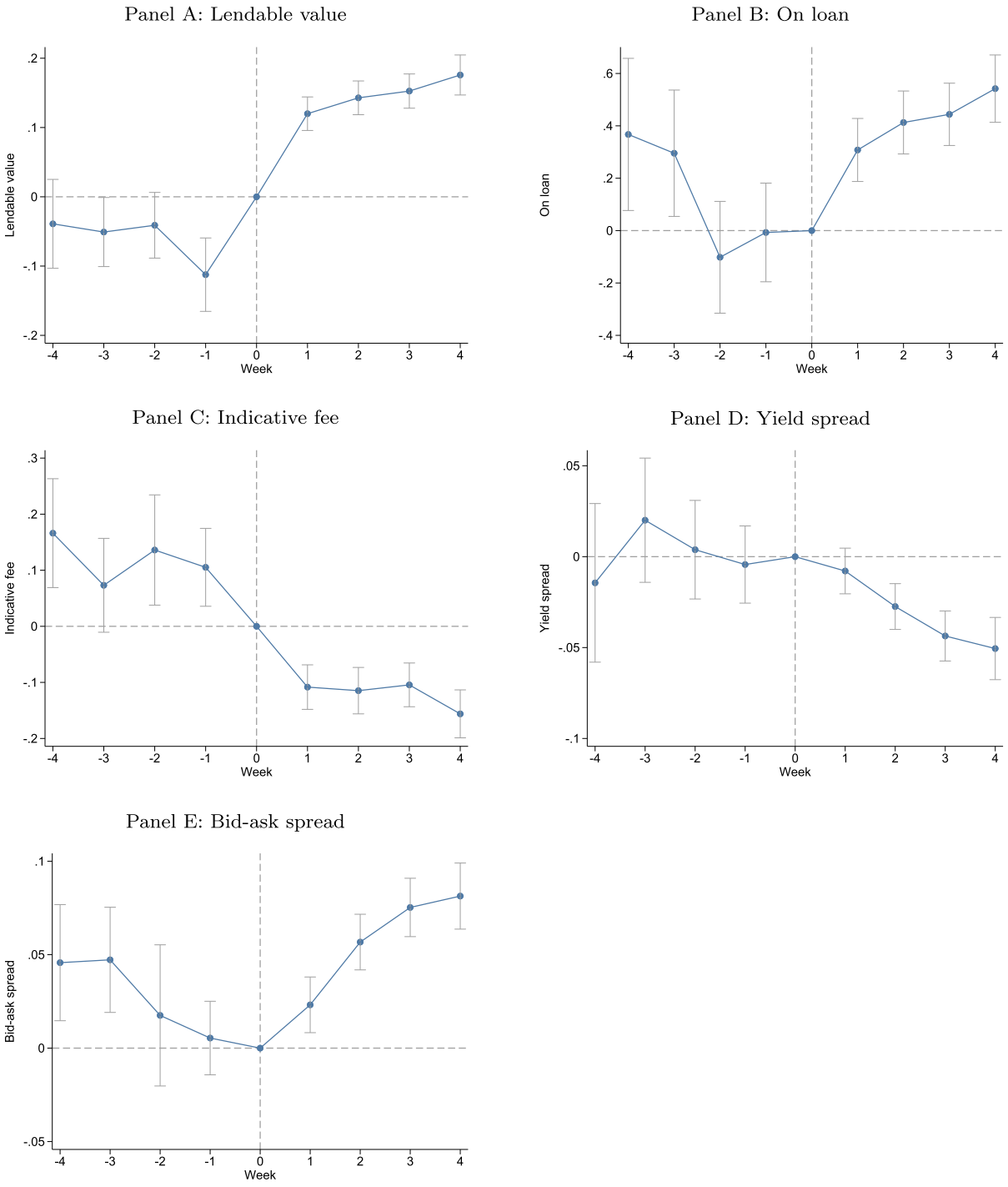

Fig. 5. *Dynamic coefficient plots*. The figure plots the impact of collateral eligibility on bonds' securities lending activity (Panels A to C), secondary market yield spreads (Panel D), and liquidity (Panel E). We consider a nine-week window from four weeks before and after the week of the eligibility event. The vertical gray lines represent 95% confidence intervals. The estimated coefficients come from the following regression: $Y_{btc} = \alpha_{bc} + \alpha_{tc} + \beta_1 EA_{bc} \times Week(-4) + \beta_2 EA_{bc} \times Week(-3) + \ldots + \beta_9 EA_{bc} \times Week(+4) + X_{btc} + \epsilon_{btc}$, where Y_{btc} is the securities lending or secondary market variable at time t of bond b of cohort identifier c. EA_{bc} is a time-invariant indicator that equals one for bonds that are on the eligibility list (*treated*) and zero otherwise. $Week(i)$ is a dummy variable for week i, where i measures the distance to the event week. Controls are dummy variables for the ECB credit steps. Bond-cohort and day-cohort fixed effects are also included. We plot the difference in estimated coefficients relative to the announcement week $i = 0$. The control group comprises coarsened exact-matched bonds that are eligible candidate bonds; that is, those that fulfill all eligibility criteria but are not yet treated. All panels are based on the period between April 2010 and June 2016. The data come from Bloomberg and IHS Markit.

Table 7
The GBP exclusion.

	Lendable value	On loan	Indicative fee	Yield spread	Bid-ask spread
EA*Post	-0.026***	-0.176***	0.009	0.060***	-0.016***
	[0.004]	[0.030]	[0.012]	[0.004]	[0.004]
Observations	2,949	2,949	2,949	2,949	2,949
R-squared	0.995	0.902	0.777	0.993	0.955

The table presents the results of daily panel regressions of the event study on the effect of the exclusion of multi-currency issuers' GBP-denominated bond from the EA list on 31 December 2010. The dependent variables are *Lendable value*, *On loan*, *Indicative fee*, *Yield spread*, and *Bid-ask spread*. *Lendable value* is the natural logarithm of the value of a given bond available for lending. *On loan* is the logarithm of the amount of the bond borrowed on a given day. *Indicative fee* is the logarithm of the indicative lending fee in bps. *Yield spread* is the difference between the bond's daily mid yield to maturity and the matched risk-free yield that is derived from the German Bund curve provided by Bundesbank. *Bid-ask spread* is the difference between the bond's quoted bid and ask prices. *EA* is a dummy that equals one for GBP-denominated bonds that are affected by the announcement and zero otherwise. *Post* is the 30-day post-treatment dummy. For each measure, we report the results for firms that have at least two GBP and at least two EUR bonds on the eligibility list. The sample period ranges from 1 December 2010 to 1 January 2011. The data come from Bloomberg and IHS Markit. Firm, bond, and daily time fixed effects are included in all regressions. Robust standard errors are reported in parentheses. Statistical significance is denoted by ***, **, and * at the 1%, 5%, and 10% levels, respectively.

issued by the same issuer, we end up with 36 separate events that take place on 31 December 2010, with an average of 2.5 previously eligible EUR control bonds per firm. In this subsample, we run an analysis similar to that in Tables 4 and 5, except that in this case we are looking at the *delisting* effect. Table 7 presents the results.

The first three columns of Table 7 present the delisting effect on measures of SL activity. The descriptive statistics in Panel C of Table 3 demonstrate that, on average, both lending market supply and demand of GBP bonds are higher than those of EUR-denominated bonds, while *Indicative fees* differ by 10 bps across the two subsamples. In light of this finding, negative coefficients on the *Lendable value* and *On loan* suggest that differences in lending market activity of GBP- and EUR-denominated bonds of the same firm decrease in the 30 days following a bond's exclusion from the EA list by 2.6% and 17.6%, respectively. The *Indicative fee* does not change. Shifting our focus to the respective secondary bond market measures, we expect a bond's exclusion from the EA list to widen the cross-currency yield differential, as the yield of EUR bonds is lower due to the eligibility premium, while the exclusion should cause a similar effect to vanish in GBP yields. Indeed, we observe that the relative *Yield spread* increases, or the price declines, when a bond loses its eligibility status and its corresponding liquidity service to banks. Furthermore, the *Bid-ask spread* indicates that list exclusion leads to an improvement in liquidity, a finding that is in line with the scarcity channel explanation from Section 5.2.2 (i.e., banks stop hoarding these bonds and release them back into the market). Each specification controls for daily time, bond, and – most importantly – firm fixed effects to filter out any information related to having a common issuer of the treated and control bonds.

6.3.2. The eligibility announcement

The ECB has included corporate bonds on its EA list almost since the list's inception; thus, we could not investigate any announcement effect. Nevertheless, the introduction of foreign currency collateral constitutes a change to the collateral framework; therefore, these instances were covered in ECB press releases. Although the announcements about the introduction and final suspension of the Temporary Framework fall outside our observation period, the re-inclusion of foreign collateral as a change in ECB monetary policy was announced on 6 September 2012, two months before the new rule came into effect.

We study this event by identifying those bonds that were previously eligible but were excluded with the suspension of the Temporary Framework. This covers 43 announcement events, all of which took place on 6 September 2012. For the treated bonds, we can match three or more eligible EUR control bonds per firm. In this setup, we expect that the difference-in-differences analysis of the announcement event would highlight a reduction in the difference between the treated and the control groups for all measures considered. Table 8 reports the results.

The first three columns of Table 8 present the announcement effect on measures of SL activity. Considering the difference in lending market activity levels, we expect that the eligibility announcement will further increase the existing differential supply and demand in the SL market. In line with this result, we observe that in the 30 days following the eligibility announcement, the GBP relative to the EUR lending market supply, as captured by the *Lendable value*, increases by 5.1%, along with the demand (*On loan*), which also expands by about 22.1%. The relative borrowing costs (*Indicative fee*) also exhibit a highly significant positive reaction following the announcement. The secondary bond market measures show that the announcement causes the difference in the *Yield spread* to decrease, whereas liquidity does not change.

Overall, the foreign currency subsample helps us demonstrate that the effect of eligibility – whether that is actual collateral list inclusion, delisting, or the announcement of a near-future inclusion – is not driven by firm-level fundamentals. Ultimately, even after accounting for these factors, we find statistically and economically meaningful effects of EA list inclusion.

6.4. Haircut analysis

There may be concerns that haircut changes could affect our results. In general, haircut adjustments are infrequent and occur for mechanical reasons like credit rating changes, a phenomenon that is absorbed by our control variables. Nevertheless, the announcement and implementation of a new haircut regime in 2010 and 2011 might have an impact on our findings. We focus on these two events and conduct an analysis akin to the one performed on GBP-denominated bonds. Our findings suggest that the haircut policy change should not bias our main findings due to three reasons. First, the effect of a haircut change is generally smaller than the eligibility effect. Second, the given haircut policy change is a one-time occurrence, whereas the eligibility events are spread out from 2010 to 2016. Third, the rolling window analysis suggests that the eligibility effect also holds for sub-periods, excluding the years 2010 and 2011. Online Appendix F presents and discusses these findings in more detail.

6.5. Shock to bank liquidity

To this point, we have focused on eligibility as a signal to the market. As a final exercise, we now shift our perspective and examine how

Table 8
GBP eligibility announcement.

	Lendable value	On loan	Indicative fee	Yield spread	Bid-ask spread
EA*Post	0.051***	0.221***	0.122***	-0.055***	0.010
	[0.005]	[0.045]	[0.015]	[0.013]	[0.007]
Observations	2,619	2,619	2,619	2,619	2,619
R-squared	0.996	0.833	0.622	0.981	0.982

The table presents the results of daily panel regressions of the event study on the effect of the announcement prior to EA list inclusion for GBP-denominated bonds of multi-currency issuers on 6 September 2012. The dependent variables are *Lendable value*, *On loan*, *Indicative fee*, *Yield spread*, and *Bid-ask spread*. *Lendable value* is the natural logarithm of the value of a given bond available for lending. *On loan* is the logarithm of the amount of the bond borrowed on a given day. *Indicative fee* is the logarithm of the indicative lending fee in bps. *Yield spread* is the difference between the bond's daily mid yield to maturity and the matched risk-free yield that is derived from the German Bund curve provided by Bundesbank. *Bid-ask spread* is the difference between the bond's quoted bid and ask prices. *EA* is a dummy that equals one for GBP-denominated bonds that are affected by the announcement and zero otherwise. *Post* is the 30-day post-treatment dummy. For each measure, we report the results for firms that have at least two GBP and at least two EUR bonds on the eligibility list. The sample period ranges from 7 August 2012 to 6 October 2012. The data come from Bloomberg and IHS Markit. Firm, bond, and daily time fixed effects are included in all regressions. Robust standard errors are reported in parentheses. Statistical significance is denoted by ***, **, and * at the 1%, 5%, and 10% levels, respectively.

a sudden change in banks' liquidity requirements would impact the SL and price response of eligible bonds.[21] As a suitable event, we take the largest debt restructuring in the history of sovereign defaults and the first such instance in the euro area: the European Council's 21 July 2011 decision on restructuring Greek debt. Given that Greek debt was primarily held by non-Greek banks within the euro area (Zettelmeyer et al., 2014), this decision heightened the fragility of the European financial system and raised concerns about its overall stability. We would thus expect higher demand for eligible corporate bonds following the announcement, and our results support this hypothesis. We observe increased SL activity, which is reflected by a significant rise in the lendable amount and a drop in lending fees, and there is a secondary market reaction in terms of lower yield spreads. Online Appendix G presents and discusses these findings in more detail.

7. Firm-level implications of eligibility

In addition to the market-level analysis, we investigate firms' supply response to inclusion on the EA list, as illustrated in Fig. 1. We study changes in the debt structure of firms that experience first-time eligibility inclusion of their bonds under the collateral framework. In this context, first-time eligibility at the firm level refers to a bond's inclusion on the EA list, assuming the firm's other outstanding bonds were not eligible for a minimum of two years preceding that inclusion. Due to space constraints, we briefly outline the main findings here and present a thorough analysis in Online Appendix H.

Our results indicate that ECB eligibility triggers a corporate debt restructuring process at the ultimate parent firm level. More specifically, during the four quarters following EA list inclusion, affected bond-issuing firms simultaneously increase their bond debt and reduce their bank debt. Eligibility creates a more favorable market environment for future debt issuances; that is, lower yields and increased bond demand. This, in turn, leads to a corporate debt structure that is tilted more toward bond debt and potentially carries reduced refinancing risk. As a result, firms not only replace bank loans with corporate bond issuance but actually increase their overall supply of marketable bonds, particularly those with longer maturities.

Our findings suggest that eligibility improves firms' access to the capital market, thus helping them to maintain higher levels of leverage. These results are comparable to studies on the announcement (Abidi and Miquel-Flores, 2018; Grosse-Rueschkamp et al., 2019; Todorov, 2020) and implementation (Arce et al., 2020; Galema and Lugo, 2021) effects of the CSPP. The significance of eligibility, however, stems from its nature: It is a more frequently occurring event that affects a wide(r) range of corporate issuers and has impacts along the entire business cycle.

Overall, corporate bond eligibility appears to help capital market development by ameliorating firms' dependence on bank funding and has ultimately proven to be an effective tool to achieve the goal of a capital market union in the euro area. Indeed, collateral pledgeability of corporate bonds has already bolstered the development of the European corporate bond market, which has doubled in size in the past decade, reaching EUR 1.3 trillion, or about 10% of the euro area gross domestic product, by 2017 (EC, 2017). Moreover, the euro area corporate bond market not only grew in size but also improved in market quality: being able to lend or borrow these bonds through the SL market improved immediacy and therefore the overall liquidity of non-financial corporate bonds across all market segments. Lending bonds also strengthened market integration between the secondary (cash) bond and SL (funding) markets.

8. Conclusion

We examine the array of implications of a central bank's collateral policy as a monetary tool. More specifically, we study the extent to which central bank eligibility of non-financial corporate bonds affects collateral availability, secondary bond and collateral market prices, and primary bond market activity. By analyzing the ECB's collateral framework, we disentangle the extent to which eligibility affects the euro area capital market and the subsequent debt financing decisions of non-financial firms. Moreover, we can identify the *direct* effect of central bank operations on the SL market, thereby showcasing how the collateral framework improves market functioning, in particular by the spillover between the ECB's overnight lending facility and a funding market segment.

Our empirical analysis identifies a persistent eligibility premium in bond yields following a bond's inclusion on the ECB collateral list. This premium is a compensation for the fungibility of pledgeable collateral. Studying the liquidity of eligible bonds, we find that newly issued bonds especially experience a deterioration in liquidity. Increased demand from banks seeking pledgeable assets also spills over into the SL market, where we find increased lending market activity in terms of both prices and quantities traded. In the absence of an active OTC repo market for corporate bonds in Europe, central bank eligibility significantly increases demand for corporate bonds in the SL market. We also show that

[21] We thank the anonymous referee for this suggestion.

the possibility of borrowing an eligible bond on the SL market reduces its eligibility premium in the secondary market of corporate bonds.

Additionally, we investigate financing decisions of firms after they experience a first-time eligibility event under the collateral framework. Our findings suggest that the affected firms tilt their financing toward bond debt while reducing their bank debt. Although the primary role of the collateral policy is to stimulate bank lending, we document that such eligibility also provides firms with a more favorable market environment for future debt issuances, leading to a corporate debt structure that favors bond debt. We further observe that firms not only replace bank debt with bond debt but also increase the overall volume of marketable bonds, especially those with longer maturities.

Our empirical results highlight the relevance of corporate bond eligibility and its externalities, which have clear policy implications. Policymakers in general and those in the Eurosystem in particular are advised to take account of our documented effects on the corporate bond market when managing the size of their EA pools. In particular, aside from the effects on SL market activity, bond yields, and liquidity, central bank pledgeability triggers a change in the relative production of collateral. Firms with bonds that become eligible capitalize on their improved access to the credit market immediately and in their future financing decisions.

Overall, our analysis confirms that central bank eligibility is a counter-cyclical monetary policy tool that has a positive market impact, especially during periods of relaxed eligibility criteria. However, it is advisable to keep the size of the EA pool at a moderate level during calm market periods in order to leave room for expansion during periods of stress. The effectiveness of this monetary policy tool also allows for intervention during crises as a macro-prudential device, as is demonstrated by the ECB's immediate reaction to the COVID-19 pandemic: it expanded its collateral list in April 2020, paving the way for other central banks like the Fed to act similarly.

CRediT authorship contribution statement

Loriana Pelizzon: Writing – review & editing, Supervision, Project administration, Methodology, Funding acquisition, Conceptualization. **Max Riedel:** Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Zorka Simon:** Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Marti G. Subrahmanyam:** Writing – review & editing, Supervision, Resources, Project administration, Methodology, Funding acquisition, Conceptualization.

Declaration of competing interest

Loriana Pelizzon acknowledges that she has been appointed for the next four years as a full member and Co-Chair of the Advisory Scientific Committee of the European Systemic Risk Board. Marti G. Subrahmanyam acknowledges that until recently he was on the board of Nomura Asset Management USA Inc., and was the Chairman of the Risk Committee of Nomura Global Alpha Inc., which participate in sovereign debt markets by themselves or through their various affiliates. He was also the Chairman of the Board and committees of AION India Investment Advisers Private Ltd., a private equity firm, and was on the board and committees of ICICI Venture Funds Management Co. Ltd., another venture capital-private equity firm, which may also participate in sovereign debt markets. He is on the Financial Markets Consultative Committee of the Reserve Bank of India, India's central bank, which deals with the regulation of sovereign debt markets and institutions, as well as the management of its own reserves. He is on the board of the United Nations Foundation, whose endowment may have investments in sovereign bond markets. He serves or has recently served on the boards and advisory boards, and the board committees, of several other companies, including ICICI Prudential Life Insurance Co. Ltd., LIC Nomura Mutual Funds Asset Management Co. Ltd., ICICI Bank Ltd., and Infosys Ltd., which also participate in sovereign bond markets.

Data availability

The data that has been used is confidential.

Replication Code/Pseudo Data for: "Collateral Eligibility of Corporate Debt in the Eurosystem" (Reference Data) (Mendeley Data)

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Appendix A. Supplementary material

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.jfineco.2023.103777.

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