The Liquidity Promises of QE[*]

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Abstract

Quantitative easing (QE) fundamentally changes the liquidity of eligible assets by providing implicit liquidity insurance, as the central bank absorbs bond supply under both normal and stressed conditions. Using granular portfolio data from the euro area, we show that the effectiveness of the ECB's corporate QE operates mainly through an increase in demand for eligible bonds by investors that particularly value this additional liquidity. Mutual funds—typically considered elastic investors—rebalanced toward eligible bonds rather than selling them to the central bank. As a result, a larger mutual fund presence in bond holdings amplified the effects of QE on yields. Consistent with the liquidity channel, QE affected prices primarily by widening the CDS–bond basis spread rather than by reducing default premia. Our findings provide new evidence that investors differ in how they value the contingent liquidity commitments embedded in QE, and that this heterogeneity plays a central role in shaping the transmission of monetary policy.

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A prominent explanation for the effectiveness of quantitative easing (QE) in raising asset prices centers on supply-side effects. As Philip R. Lane, Member of the Executive Board of the ECB, recently explained: "*By buying sovereign bonds and other assets, the ECB reduced the overall amount of duration [and credit] risk that had to be borne by private investors, reducing the compensation for risk.*"[1] This mechanism is well-captured by models in the spirit of Vayanos and Vila (2021), which show that preferred habitat investors—who have limited ability to rebalance their portfolios—cannot respond effectively to central bank buying pressure. Meanwhile, risk-averse arbitrageurs reduce their exposure to risk by selling to accommodate the central bank's purchases. This combination of inelastic preferred habitat investors and risk-averse arbitrageurs helps explain why quantitative easing might have a large impact on asset prices.

In this paper, we show that this supply-side explanation alone has limited ability to account for both the price impact and the heterogeneous portfolio rebalancing responses to the ECB's corporate QE, as well as their evolution in the subsequent years. The ECB's Corporate Sector Purchase Programme (CSPP), introduced in 2016, marked the beginning of large-scale corporate QE in the Euro area. This intervention was expanded significantly in 2020 with the launch of the Pandemic Emergency Purchase Programme (PEPP) in response to the COVID-19 crisis. In 2022, the ECB signalled a shift in direction by ending its QE purchases and initiating the unwinding of its balance sheet—its Quantitative Tightening (QT). In this paper, we leverage granular data on portfolio holdings in the euro area, along with a large cross-section of corporate bond prices, to study the complete *life cycle* of corporate QE in the euro area.

We argue that a key channel to explain the effect of corporate QE operates through an increase in *demand* for eligible bonds arising from their improved liquidity. Consistent with this mechanism, we document four main findings: (i) At the initial announcement, mutual funds *rebalanced toward* eligible bonds rather than selling them to the ECB, increasing their holdings by 10% relative to their pre-announcement portfolio weights, whereas insurance companies and pension funds decreased their portfolio weights on eligible bonds. (ii) Across bonds, the larger the mutual fund participation in holdings, the larger the effect of ECB purchases on spreads. A 10 percentage point higher mutual fund ownership share prior to the announcement corresponds to an approximately 3 basis point larger announcement effect on credit spreads. (iii) The QE announcement has a large and persistent impact on corporate bond spreads but a modest impact on CDS spreads. As a result, the non-default premium (the CDS-bond basis) of eligible versus ineligible bonds increased by 11 basis points,

[1]The full speech was delivered in Dublin on June 11, 2025. The transcripts are available at the ECB website.

accounting for roughly 55% of the overall spread decline. (iv) During the QT phase, eligible bonds did not experience an increase in spreads relative to ineligible bonds—implying no reversion to their pre-QE levels.

These findings may initially appear counterintuitive for several reasons. Mutual funds are typically viewed as elastic investors,[2] and would therefore be expected to sell the now expensive bonds to the ECB.[3] This stands in contrast with our results. Moreover, according to the existing literature, the presence of elastic investors should dampen the impact of QE on spreads, whereas inelastic investors should amplify its effects (Koijen et al., 2021), again at odds with our findings. Additionally, if the transmission of corporate QE operated primarily through a reduction in the supply of credit risk—and thus a decrease in the aggregate price of credit risk—both bond prices and CDS spreads should have moved similarly, leaving limited scope for changes in the CDS–bond basis. Finally, under a standard supply-side mechanism, when the ECB sells bonds during QT the effects should be *symmetric*, as investors must absorb the risk that the ECB had previously taken onto its balance sheet.

We rationalize these effects through a demand channel rather than a supply channel of QE.[4] Even if QE does not materially affect the probability of default or the default premium of corporate bonds, it fundamentally changes investors' ability to liquidate their positions, thereby altering the perceived liquidity of eligible bonds. By shifting investors' perceptions of liquidity, QE induces a heterogeneous demand response across intermediaries—depending on to what extent investors value these QE promises. The resulting increase in aggregate demand for QE-eligible securities raises their prices, even in the absence of changes in default risk, and this effect is reflected in the CDS–bond basis. Importantly, these results should not be interpreted as a decline in the overall liquidity premium, but rather as an improvement in the relative liquidity of eligible bonds compared with ineligible ones. Finally, even during QT—when the ECB unwinds its balance sheet by selling eligible bonds—investors expect the central bank to reactivate the programme if needed. This expectation prevents bond prices from returning to their pre-QE equilibrium, generating an asymmetric effect on the CDS–bond basis.

We provide additional evidence in support of this liquidity–demand channel. Mutual funds are subject to redemption risk and therefore place a premium on the ability to liquidate positions quickly and at low cost (Coppola, 2021). Using granular mutual fund holdings data, we show that funds with more volatile flows are precisely those that rebalance more strongly toward eligible bonds following the QE announcement. By revealed preference, this implies

[2]See, for example, Koijen et al. (2021); Bretscher et al. (2021).

[3]A high CDS–bond basis indicates that these bonds are expensive relative to their credit risk.

[4]Throughout the paper, whenever we use the term *QE*, we refer to *corporate quantitative easing*, unless stated otherwise.

that the now relatively more expensive eligible bonds are particularly valuable to funds exposed to volatile inflows and outflows. Because these are exactly the investors that benefit most from enhanced liquidity and reduced liquidation costs, we interpret this pattern as strong evidence for the proposed mechanism. In turn, mutual funds—especially those facing volatile redemptions—are the investors that increase demand for eligible bonds, thereby amplifying the transmission of corporate QE. While the notion that investor heterogeneity shapes the transmission of monetary policy is not new, the specific source of heterogeneity we document is novel relative to the existing literature.

We also provide direct evidence that QE enhances the liquidity of eligible bonds. Measuring expected bond liquidity is inherently challenging, particularly because we use the term liquidity in a broad sense to capture investors' ability to sell bonds at low cost—both under normal market conditions and during periods of stress, such as financial crises (Haddad et al., 2021, 2023, 2024). Our analysis, therefore, focuses on both liquidity levels and bonds' exposure to liquidity risk factors (Pástor and Stambaugh, 2003).

We begin by examining traditional liquidity measures. Consistent with Todorov (2020), our results indicate that the CSPP announcement was associated with reduced bid-ask spreads and increased secondary market turnover for eligible bonds. However, these conventional measures overlook a critical aspect of liquidity: the fire-sale discount investors face when unwinding portfolios during crises, which relates more closely to exposure to liquidity risk factors. Because QE entails an implicit promise that investors can sell bonds to the central bank during periods of market stress, it could fundamentally alter eligible bonds' loading on this systematic risk. We provide new evidence of this effect during the COVID-19 outbreak. We show that, *before* the ECB announced its Pandemic Emergency Purchase Programme (PEPP), credit spreads of ineligible bonds increased substantially more than those of eligible bonds. Investment-grade ineligible bonds experienced an 9.1% fall in prices, significantly larger than the 6.1% registered for eligible bonds. These effects are driven almost entirely by a widening of the CDS-bond basis, which was more pronounced for ineligible bonds. This evidence indicates that eligible bonds face significantly lower fire-sale risk and that holding these bonds ex-ante mitigated losses for mutual funds precisely when they were forced to sell assets due to outflows.

We continue by examining the PEPP announcement. Interestingly, the effects of PEPP—aside from the short-term movements immediately before and in the narrow window around the announcement—were substantially weaker than those observed during the initial CSPP. The short-term effects are consistent with the Federal Reserve's corporate bond purchase announcements during the COVID-19 crisis,[5] and underscore the importance of the contingent

[5]See Haddad et al. (2021); Gilchrist et al. (2024); Darmouni and Siani (2022); O'Hara and Zhou (2021);

liquidity guarantee emphasized by Haddad et al. (2021). However, when we consider broader windows, we find that PEPP did not have a material effect on the spread between eligible and ineligible bonds. This indicates that it was really the initial CSPP announcement that reshaped investors' perceptions of liquidity.

Moreover, it is important to note a key difference between the PEPP announcement during the COVID-19 crisis and the initial CSPP announcement in 2016. The CSPP announcement occurred in a relatively calm market environment rather than in the midst of a fire-sale crisis. We show that the effects during the CSPP announcement were economically significant and, once again, largely driven by changes in the CDS-bond basis. This evidence demonstrates the far-reaching impact of central bank commitments on asset prices and highlights the importance of investors' expectations regarding future interventions. Moreover, the announcement effects prove remarkably persistent: CDS-bond differentials between eligible and ineligible bonds remain elevated for years after the announcement, indicating that the ECB's market presence helped reduce dislocations not only during periods of stress but also in normal times.

Finally, we provide novel evidence on the effects of the ECB's quantitative tightening. Following the ECB's announcement of its intention to sell bonds acquired under QE, one might expect the spreads of eligible bonds to widen more than those of ineligible bonds, effectively reversing the initial announcement effects. We do not find this to be the case. In fact, in 2022, as the ECB began to tighten policy and market credit spreads widened, eligible bonds experienced smaller losses than ineligible bonds—that is, their credit spreads increased by less. Moreover, mutual funds largely retained their holdings of eligible bonds. These findings are consistent with the idea that once the central bank has intervened, markets anticipate future interventions in times of stress, thereby persistently enhancing the perceived liquidity of eligible bonds relative to ineligible ones.

All our empirical analyses rely on a difference-in-differences approach that exploits the institutional design of the policy. At the time of the announcement, the ECB stated that it would purchase only a subset of bonds—the eligible bonds—which provides a natural setting to compare eligible and ineligible securities. By contrasting the prices and holdings of eligible bonds with those of ineligible ones, this empirical design enables us to isolate the effects of the policy announcement from potential confounding influences. To implement this approach, we combine confidential sector-level portfolio holdings from the ECB's Securities Holdings Statistics (SHSS) with granular mutual fund data from Morningstar. We then match these holdings with monthly corporate bond prices and bond characteristics from the ECB's Centralised Securities Database (CSDB), complemented by high-frequency daily data

Kargar et al. (2021); Falato et al. (2021); Ma et al. (2022).

from Markit iBoxx.

Our results have profound implications for understanding monetary policy effectiveness when examining corporate bond purchases. The immediate materialization of effects on bond spreads upon announcements—which persist thereafter—reveals that the mere expectation of central bank liquidity backstops fundamentally reshapes investor behavior and asset characteristics. Rather than QE working primarily through supply changes, our results suggest that central banks' most potent tool when dealing with risky assets may be their ability to credibly signal liquidity provision, transforming how investors perceive and price the liquidity characteristics of eligible assets. Finally, because the valuation of liquidity is heterogeneous across investors, the composition of investors has a substantial impact on the effectiveness of policy transmission. These findings reframe the debate on optimal central bank communication and balance sheet policy design, suggesting that announcement effects and credible commitment mechanisms may be more important than the actual scale of asset purchases in determining policy effectiveness. Moreover, the strength of transmission may actually rise with the growing share of mutual funds, even as markets overall become more elastic.

To the best of our knowledge, we are the first to document mutual funds' rebalancing toward eligible bonds and to show how this channel strengthens policy transmission—what we label the *liquidity demand channel* of QE. While Haddad et al. (2021) also document effects on the basis and Gilchrist et al. (2024) examine effects on bond premia, our results provide new insights into how prices adjust through this channel. The Fed's announcement during the COVID-19 crisis, analyzed by Haddad et al. (2021), was intended to halt fire sales in the corporate bond market. These fire sales led to a widening of the basis, which was reversed by the Fed's intervention. By contrast, the ECB's initial Corporate Sector Purchase Programme (CSPP) was announced in March 2016, at a time of relatively calm financial markets. Its primary objective was to expand the pool of eligible assets by adding corporate bonds to the existing government bond purchase programme. This announcement reduced corporate bond spreads through a decline in the basis. Haddad et al. (2021) document that 70% of the increase in corporate bond spreads during the COVID crisis was due to a widening of the basis. This figure is close to our estimate of the share of spread reduction attributable to the basis, 55%. Our additional evidence on basis effects therefore highlights the importance of investors' expectations about future central bank actions in rationalizing announcement effects.

Our findings also shed light on the extent to which central banks can influence non-bank financial intermediaries. Breckenfelder and Hoerova (2023) show that during the COVID-19 outbreak, when corporate bond markets were in severe distress, funds holding a higher proportion of assets eligible for purchase in their portfolios before the crisis experienced improved performance and experienced smaller outflows after the announcement of the European Central Bank's large-scale asset purchase program. This aligns with the strategy of mutual funds to strategically maintain eligible bonds, even if they appear relatively expensive compared to other bonds with similar credit and duration risks. This practice serves as a safeguard against fire sale discounts, effectively acting as insurance for funds. The direct impact of monetary policy on services like liquidity value highlights the important consideration for policy makers on their impact on asset prices and capital allocation.

Our paper relates more broadly to the literature on corporate bond purchases. Todorov (2020) and Zaghini (2020) documented ECB announcement effects on corporate bond yields, with Todorov (2020) showing significant liquidity effects.[6] Several papers examined Fed announcements during the pandemic crisis, discussing how announcements provided liquidity to mutual funds during fire sales (Vissing-Jorgensen, 2021; Haddad et al., 2021; Gilchrist et al., 2024; Darmouni and Siani, 2022; O'Hara and Zhou, 2021; Kargar et al., 2021; Falato et al., 2021; Ma et al., 2022). We provide direct evidence that mutual funds played a key role in the ECB's 2016 announcement outside of recession conditions. We show that the announcement induced a rebalancing of mutual funds toward eligible bonds, thereby strengthening the transmission of the policy.

We show that an important dimension of liquidity is the ability to sell bonds during a recession. By providing evidence on the portfolio rebalancing of mutual funds and the associated price effects, we contribute to the literature on QE as a state-contingent policy advanced by Haddad et al. (2021, 2023, 2024). Our paper is also closely related to Coppola (2021), who shows that bonds held by mutual funds experience more severe losses during recessions, as mutual funds engage in fire sales. Our paper also relates to the discussion on the role of mutual funds in amplifying the transmission of monetary policy Fang (2023); Fang and Xiao (2025). In particular, we show that these amplification effects are especially pronounced in the case of corporate QE.

Our results are also relevant to demand-based asset pricing literature emphasizing heterogeneous financial intermediaries in shaping asset prices (Koijen et al., 2021; Koijen and Yogo, 2019). Low investor demand elasticity can rationalize the significant QE effects that have been documented using high-frequency identification.[7] Corporate bond investors differ significantly in price elasticities: insurance companies have low elasticity while mutual funds are more elastic (Koijen et al., 2021; Bretscher et al., 2021). These findings predict elastic investors would sell bonds to the central bank, and hence bonds heavily held by mutual

[6]Other CSPP studies include Abidi and Miquel-Flores (2018); De Santis et al. (2018); De Santis and Zaghini (2021). D'Amico and Kaminska (2019) studies UK corporate purchases.

[7]Gagnon et al. (2011); Krishnamurthy and Vissing-Jorgensen (2011) study Fed QE announcements. Altavilla et al. (2015) and Krishnamurthy et al. (2017) focus on ECB government bond purchases.

funds experiencing smaller yield declines. Breckenfelder and De Falco (2024) show that this channel is crucial for capturing the effects of QE on government bonds purchased by the ECB during the implementation phase. Koijen et al. (2021) shows that more elastic investors—such as the rest of the world and mutual funds—sold a larger share of bonds to the ECB. Our results contrast with this prediction, showing that beyond elasticities, conditional promises matter. Mutual funds place high value on these commitments and rebalanced toward eligible bonds, amplifying effects rather than dampening them.

I. Hypothesis Development

In this section, we develop four hypotheses that we test empirically in the following sections. We begin by decomposing the credit spread into two parts: the default-risk component, captured by the CDS spread, and the residual component, known as the CDS-bond basis.[8] Although this residual measure might reflect various sources of convenience yield between corporate bonds and government bonds—such as collateral or portfolio constraints as in Corell et al. (2025)—there is a large literature that finds a strong relationship between the basis and liquidity (see e.g., Longstaff et al. (2005)). Hence, as long as we think that QE announcements do not impact these other forces, it is a good way to measure the liquidity impact of QE.

Based on this premise, if the main channel of QE were to decrease the default premium, it should affect prices mainly through the CDS. On the other hand, if the main channel of QE is to enhance liquidity, it should affect corporate bond spreads mainly through the basis. This brings us to the first prediction of our channel.

Prediction 1 (QE effect on the CDS-bond basis)**.** *If a QE programme increases the liquidity of assets eligible for purchase, the CDS-bond basis of these assets should rise.*

We test this prediction in Section 3, where we show that the announcement led to a significant increase in the CDS-bond basis of eligible bonds.

Our second prediction relates to portfolio rebalancing. Investors differ in their preference for liquidity and exposure to liquidity risk. Those who rebalance frequently place a high premium on liquidity. Mutual funds, for instance, especially those subject to constant inflows and outflows, particularly value holding liquid assets. Moreover, mutual funds as a sector are exposed to pronounced liquidity risk: during periods of market stress, large outflows

[8]Formally, the CDS-bond basis is defined as the difference between a firm's CDS spread and the credit spread implied by its cash bonds relative to a duration-matched default-free government bond. Throughout the paper, we use yields on AAA-rated euro area government bonds as the default-free benchmark.

often force them to sell assets at fire-sale prices. In contrast, long-term investors such as insurance companies and pension funds value liquidity less, given their stable liabilities and limited exposure to forced sales. When the value of liquidity rises, these investors should be willing to sell their now more expensive liquid bonds in exchange for less liquid ones. These considerations motivate our second prediction.

Prediction 2 (Heterogeneous rebalancing response to QE)**.** *Investors who value liquidity more should rebalance their portfolios toward eligible bonds, while those who value liquidity less should accommodate this demand by selling eligible bonds.*

In Section 4, we test which types of investors rebalance in this direction. Because investors differ in how they value the QE-induced liquidity, we expect heterogeneous portfolio responses. Identifying which investors shift toward eligible bonds—and which ones shift away—provides key evidence on the nature of the policy transmission channel. We find that mutual funds primarily rebalance toward eligible bonds, rather than selling them to the ECB. The effect is stronger for mutual funds with more volatile flows.

Third, we explore how QE announcements affect different bonds. Our logic is that, in a segmented market, the effects of policy on corporate bonds depend on their investor composition. As long as there are frictions preventing bonds from easily changing hands across sectors, bonds held by investors who value liquidity are more exposed to QE shocks, compared to bonds held by investors who do not. We therefore exploit the granularity and cross-sectional variation in our data to test this mechanism. If the portfolio rebalancing channel documented in Section 4 strengthens policy transmission through a positive demand shift by mutual funds, then bonds held predominantly by mutual funds should respond most strongly to QE announcements. This leads to our third prediction.

Prediction 3 (Effect of investor composition)**.** *Bonds that are mostly held by mutual funds respond most strongly to QE announcements.*

Consistent with this prediction, we find in Section 5 that the cross-sectional pattern of price responses aligns with investor composition.

Fourth, we examine whether quantitative tightening (QT) mirrors the effects of QE. While QE and QT appear symmetric, their transmission through the liquidity channel may differ substantially. The key asymmetry lies in the implicit backstop: during QT, markets understand that the ECB retains the capacity and willingness to intervene with QE if liquidity conditions deteriorate significantly. This implicit promise acts as a liquidity insurance mechanism, dampening the impact of QT on the liquidity premium and reducing investors' incentive to rebalance away from eligible bonds. Additionally, the passive nature of QT—allowing bonds to mature rather than actively selling—means the liquidity withdrawal is gradual and predictable, further limiting portfolio adjustments. This asymmetry motivates our fourth prediction.

Prediction 4 (Asymmetric effects of QT)**.** *QT has limited impact on the CDS-bond basis and generates smaller portfolio rebalancing effects compared to QE announcement.*

Identifying clear QT announcements is challenging. In Section 6, we experiment with multiple ECB announcements interpreted as QT news and find evidence consistent with the above prediction. We show that QT had limited impact on prices and portfolio rebalancing compared to QE.

We acknowledge that the policy also entails standard supply effects. Our results can therefore be interpreted as the net impact of supply changes and conditional promise effects, which implies that the portfolio rebalancing estimates in Section 4 are conservative. If the policy operated purely as a supply shock, investors would sell to the central bank, with the price impact determined by their demand elasticity. More elastic investors would reduce their holdings more sharply, requiring smaller price adjustments. Mutual funds, often regarded as relatively elastic, would thus be expected to act as prominent sellers when the ECB purchases bonds. Moreover, in segmented markets, bonds with higher mutual fund ownership should display more muted price reactions, as their supply is absorbed more elastically. The fact that we observe mutual funds buying, rather than selling, underscores the central role of conditional promises in shaping policy transmission. In the Appendix A we present a simple model that allows us to discuss these different channels in more formalized way.

II. Data

Before testing the predictions empirically, we describe the data used in our analysis.

A. Asset Prices

We construct our dataset on asset prices by combining information from several sources. Below, we provide a detailed description of the data. Table I reports summary statistics for the corporate bond samples used in the analysis, distinguishing between the CSPP and PEPP programs. For each program and data source (CSDB and iBoxx), we present statistics separately for bonds that are eligible and ineligible under the respective purchase criteria.[9]

[9] We list the specific eligibility criteria in Section 3 below.

Centralised Securities Database (CSDB) We use monthly bond-level data from the European Central Bank's Centralised Securities Database (CSDB). We restrict our sample to senior unsecured corporate bonds with fixed or zero coupon that are denominated in euro and issued by euro area entities. Moreover, we only include bonds with a residual maturity of at least one year and an outstanding amount of at least €10 million. For each bond, we collect credit ratings from four major agencies—Fitch Ratings, Moody's, Standard & Poor's (S&P), and DBRS—as well as information on the notional amount issued and the issuer's ESA 2010 sector classification. To capture liquidity conditions, we augment the dataset with monthly turnover from the TraX dataset, sourced from MarketAxess. Finally, we collect each bond's coupon schedule and compute its modified duration.

Markit iBoxx We collect corporate bond data from Markit iBoxx, restricting the sample to bonds denominated in euros. Although the coverage is narrower than that of the CSDB, the iBoxx dataset offers daily frequency, which allows for a more granular analysis of price dynamics. Available variables include bid and ask prices, accrued interest, yield to maturity, option-adjusted spreads (OAS), modified duration, and credit ratings. We use data from the periods surrounding the CSPP announcement, the PEPP announcement, and the Quantitative Tightening phase.

CDS We use daily CDS data from Markit and ICE Data Services (formerly CMA). Corporate bonds are matched to CDS contracts on the basis of issuer and seniority. For each issuer-seniority pair, we interpolate the CDS curve to obtain a spread at the exact maturity of the bond. The *CDS-bond basis* is defined as the difference between the maturity-matched CDS spread and the bond's credit spread. We interpret the CDS-bond basis as a proxy for the bond's convenience yield. Intuitively, it represents the wedge between the cost of credit protection implied by CDS contracts and the credit risk premium embedded in corporate bond yields. To remove outliers, we discard all observations with a CDS-bond basis below the 1$^{\text{st}}$ and above the 99$^{\text{th}}$ percentile within each month.

B. Holdings

We construct our dataset on asset holdings by using sector level data from SHSS and granular mutual funds holdings from Morningstar.

Securities Holdings Statistics by Sector (SHSS) We use confidential data from the ECB's Securities Holdings Statistics by Sector (SHSS) to calculate the share of each bond held by different types of financial intermediaries. SHSS provides security-level portfolio

Table I. **Bond Prices Summary Statistics** This table reports summary statistics for the corporate bond samples used in the analysis. Panel (a) presents statistics for bonds obtained from the CSDB database, while Panel (b) reports corresponding figures based on the iBoxx database. For each data source, we distinguish between the CSPP and PEPP samples. The statistics are computed using data from the month preceding each program's announcement. Within each sample, we further report statistics separately for bonds that are eligible and ineligible under the respective purchase programs.

Panel (a): CSDB Price Data

	CSPP								**PEPP**							
	Eligible				Ineligible				Eligible				Ineligible			
	Mean	Median	Std	*N*	Mean	Median	Std	*N*	Mean	Median	Std	*N*	Mean	Median	Std	*N*
Outstanding (bln)	0.67	0.60	0.48	465	0.24	0.03	0.62	2750	0.62	0.60	0.42	752	0.27	0.04	0.62	2482
Maturity	6.67	5.13	5.08	465	4.60	3.29	4.59	2750	7.26	6.13	5.09	752	6.38	4.98	5.34	2482
Duration	5.72	4.71	3.76	465	4.12	3.13	3.36	2750	6.61	5.78	4.27	752	5.89	4.83	4.43	2482
Yield-to-Maturity (%)	0.75	0.63	0.51	465	0.73	0.54	0.77	2750	0.29	0.18	0.48	752	0.45	0.34	0.61	2482
Credit Spread (%)	0.73	0.66	0.37	465	0.82	0.63	0.73	2750	0.84	0.73	0.40	752	1.02	0.93	0.57	2482
CDS-Bond basis (%)	-0.14	-0.16	0.33	465	-0.07	-0.02	0.67	2750	-0.20	-0.26	0.43	752	-0.51	-0.50	0.42	2482
Turnover (%)	2.44	1.31	4.05	370	2.97	1.34	4.78	398	4.45	1.84	7.65	593	6.29	2.81	10.02	459

Panel (b): iBoxx Price Data

Outstanding (bln)	0.78	0.75	0.31	281	0.98	0.85	0.53	201	0.77	0.70	0.33	488	0.92	0.90	0.39	265
Maturity	5.69	4.90	3.45	281	4.57	3.95	3.40	201	6.92	6.21	4.04	488	4.83	4.29	2.93	265
Duration	5.10	4.50	2.72	281	4.12	3.68	2.24	201	6.34	5.77	3.41	488	4.48	4.05	2.19	265
Yield-to-Maturity (%)	1.12	1.02	0.67	281	1.20	1.03	0.95	201	0.48	0.40	0.43	488	0.72	0.46	1.00	265
Credit Spread (%)	1.07	1.01	0.41	281	1.29	1.05	0.80	201	0.84	0.76	0.31	488	1.20	0.92	0.94	265
CDS-Bond basis (%)	-0.34	-0.33	0.22	281	-0.27	-0.29	0.42	201	-0.27	-0.27	0.18	488	-0.52	-0.46	0.27	265
Bid-Ask (bps)	0.49	0.44	0.24	281	0.40	0.33	0.27	201	0.45	0.41	0.19	488	0.39	0.31	0.27	265

holdings for all euro area investors, identified by ISIN, at a quarterly frequency beginning in 2013Q4. Holdings are categorized by investor sector and country of domicile. We aggregate across all euro area countries and focus on three main investor sectors: mutual funds, insurance companies and pension funds (ICPF), and monetary financial institutions (henceforth, banks). The dataset also includes information on securities held by the ECB. Regarding the bonds, we apply the same filters as for the CSDB data described above. Table II reports the summary statistics. In our empirical specifications, we consider two measures of sectoral holdings: (i) portfolio weights within each sector–country pair and (ii) the share of the total outstanding amount held by each sector. Accordingly, Panel (a) of Table II reports portfolio weights, while Panel (b) reports shares of outstanding amounts.

Granular Holdings We use granular information on individual mutual funds' holdings from Morningstar. We use monthly information on euro area mutual fund holdings, asset

Table II. **Summary statistics of sectoral shares by programme and eligibility** This table reports summary statistics for sectoral portfolio holdings. Panel (a) presents statistics for portfolio weights within each sector-country pair, while Panel (b) reports statistics for the shares of total outstanding amounts held by each sector. For each measure, we distinguish between the CSPP and PEPP samples. The statistics are computed using data from the month preceding each program's announcement. Within each sample, we further report statistics separately for eligible and ineligible bonds under the respective purchase programs.

(a): Portfolio Weight (basis point)

	CSPP								**PEPP**							
	Eligible				Ineligible				Eligible				Ineligible			
Sector	Mean	Median	Std	N	Mean	Median	Std	N	Mean	Median	Std	N	Mean	Median	Std	N
Banks	5.82	1.87	9.68	3043	5.38	1.47	9.55	6181	6.18	2.02	10.03	3430	5.13	1.40	9.31	5794
ICPF	8.45	4.81	9.94	7465	6.46	2.39	9.67	7122	8.52	4.75	10.14	8009	6.22	2.31	9.36	6578
MF	7.19	4.42	8.50	6739	7.17	3.75	9.42	7380	7.03	4.23	8.51	7362	7.34	3.91	9.49	6757
Other	4.36	1.49	7.84	5599	5.19	1.47	9.39	9474	4.40	1.47	7.95	5968	5.20	1.49	9.38	9105
RoW	2.85	1.87	4.29	907	1.61	0.06	4.45	3148	3.41	1.91	5.61	1055	1.35	0.05	3.80	3000

(b): Share of Amount Outstanding

Banks	0.08	0.05	0.10	443	0.43	0.22	0.43	2190	0.11	0.05	0.20	710	0.50	0.38	0.45	1841
ICPF	0.50	0.47	0.27	443	0.14	0.00	0.29	2190	0.37	0.32	0.28	710	0.19	0.00	0.33	1841
MF	0.22	0.22	0.16	443	0.07	0.00	0.18	2190	0.19	0.17	0.15	710	0.07	0.00	0.16	1841
Other	0.06	0.03	0.08	443	0.28	0.02	0.39	2190	0.04	0.02	0.07	710	0.18	0.00	0.34	1841
RoW	0.14	0.13	0.12	443	0.08	0.01	0.17	2190	0.14	0.10	0.14	710	0.07	0.00	0.15	1841

under management (AUM), and flows. We include only open-end funds and exclude closed-end, variable annuity funds, and index funds from our analysis. We merge this dataset with the CSDB data and exclude observations for which the market value is zero or where the ratio of the market value of holdings to the total market value exceeds one. The sample is further refined based on fund characteristics. Funds must have at least 1 million market value holdings in corporate bonds each month. We also drop funds where the portfolio weight in corporate bond positions is greater than one. For monthly holdings data, we only keep funds that report in all 3 months of each quarter and include only those with holdings data available for at least 6 months throughout the event window. For the quarterly table, we only include funds that report holdings for at least 2 quarters within the event window. To ensure data quality, we exclude holdings for which the amount held by the fund exceeds their total outstanding amount and truncate the share of total outstanding at the 99th percentile.

We provide a full description of the Morningstar data and a complete set of summary statistics in Appendix D.

C. Holdings of Euro area investors

We start by examining the holdings of euro area investors. Our analysis focuses on bonds eligible for purchase under the ECB's corporate asset purchase programmes, defined as investment-grade, euro-denominated bonds issued by non-financial corporations domiciled in the euro area (see Section 3 for details on the eligibility criteria). As discussed, we have further restricted the sample to senior unsecured bonds.

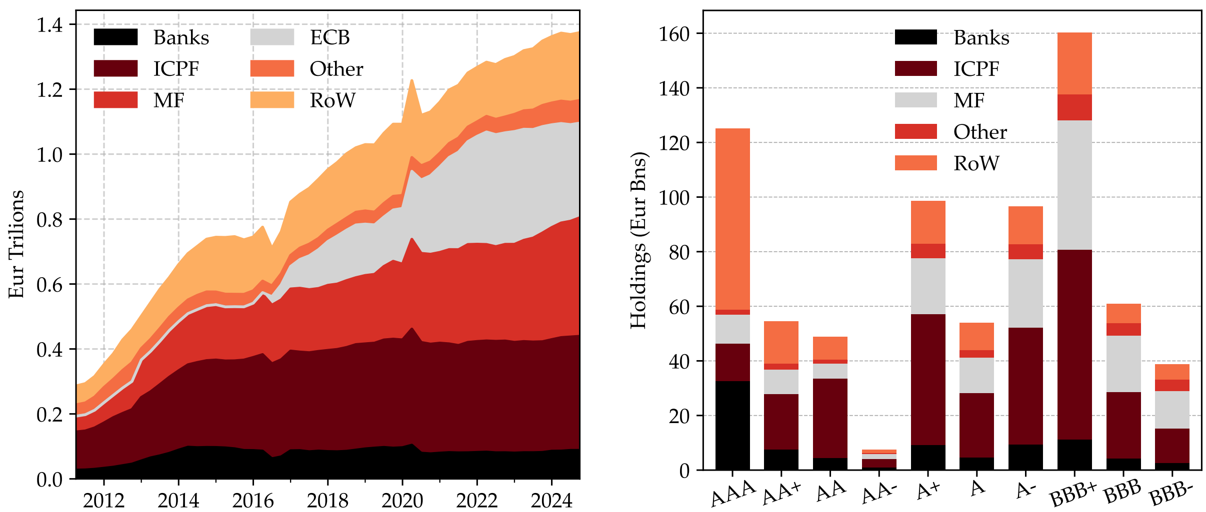
Figure 1a shows the evolution of the allocation of these bonds across investor sectors. The total outstanding amount has grown steadily, with insurers and pension funds increasing their holdings from about €120 billion in 2011 to more than €350 billion in 2024. Mutual funds expanded even more markedly, from less than €50 billion in 2011 to around €360 billion in 2024, making them the largest private-sector holders. Banks remained comparatively small, rising from about €30 billion in 2011 to less than €100 billion by the end of the sample. Foreign investors held €150–200 billion throughout, while the residual "Other" sector remained minor. Foreign holdings are computed as a residual of amounts outstanding minus euro area holdings.

The ECB entered in 2016, rapidly accumulating more than €300 billion at its peak in 2021 before gradually reducing its footprint. By 2019, it already held over 22% of the outstanding stock of eligible investment-grade bonds. Although this share began to decline, it spiked again at the onset of the Covid crisis, reaching 27% in 2023, supported by the launch of the PEPP. By 2023, ECB holdings amounted to about €400 billion.

Having documented the evolution of holdings across sectors, we next examine the distribution by credit quality. Figure 1b reports the stock of eligible bonds by rating category and investor type. The most common rating is BBB+ (€160 billion), followed by A– (€97 billion) and A+ (€98 billion). In terms of investor composition, mutual funds hold about 25% of BBB+, 26% of A–, and 21% of A+ bonds. Insurers and pension funds account for a large share of A (46%) and A+ (49%) bonds, but a smaller share of BBB bonds (35%), and only 28% of BBB–. Banks are concentrated in the safest assets, holding 26% of AAA bonds, while foreign investors dominate the AAA segment with 53%.

Figure 1. **Holdings of Corporate Bonds** Panel (a) plots the holdings in €billions by different types of intermediaries for eligible bonds, stratified by rating. The numbers reflect the allocation in 2015-Q4. Panel (b) shows the holdings of different intermediaries over time.

(a) Holdings Over Time (b) Holdings by Ratings



III. The Impact of ECB Corporate QE on Bond Prices

In this section, we provide institutional background on the ECB's corporate bond purchase programs and examine their effects on bond prices, thereby testing Prediction 1. We focus on two key announcements: the initial launch of the Corporate Sector Purchase Programme (CSPP) in 2016 and the announcement of the Pandemic Emergency Purchase Programme (PEPP) during the height of the COVID-19 crisis.

Eligibility Criteria Under both programs, the ECB restricted its purchases to investment-grade corporate bonds issued by non-bank corporations incorporated in the euro area—henceforth referred to as *eligible* bonds. Under the CSPP, a bond is considered eligible if the following conditions are met: (a) the issuer is not a credit institution and does not have a parent undertaking that qualifies as such; (b) the bond is rated by accepted external credit assessment institutions or third-party rating tools and has a minimum rating of BBB−; (c) the bond has an initial maturity of at least 367 days, with a remaining maturity between six months and 30 years and 364 days; (d) the bond is euro-denominated; (e) it is issued in the euro area; (f) the issuer is established in the euro area and the place of settlement is also located in the euro area and (g) the yield is above the ECB deposit facility rate (DFR).[10] Whether a security is considered eligible is publicly available information, as announced by

[10]This minimum yield requirement was removed in September 2019.

the ECB. The set of bonds eligible under the PEPP coincides with that of the CSPP, except that eligibility was expanded to include securities with a remaining maturity of at least 28 days.[11]

Given our sample selection criteria outlined in the previous section, the "control group" of QE-ineligible bonds largely consists of bank bonds (94% of ineligible observations in our sample) and high-yield non-bank bonds (2%).[12]

Market Neutral Approach The ECB implements its asset purchase programmes using a market-neutral approach, whereby corporate bond purchases are guided by a benchmark that mirrors the outstanding stock of eligible bonds.[13]

Our identification strategy relies on the eligibility criteria and the market-neutral implementation of the purchase program. First, we exploit the definition of eligibility to implement a difference-in-differences approach, comparing similar bonds where only one is eligible for purchase. This allows us to isolate the causal effect of the policy. Second, the market-neutral design of the program ensures that, within the set of eligible bonds, asset purchases followed pre-determined rules. As we interact policy effects with intermediary holdings, this market-neutrality guarantees that purchases are exogenous to intermediary portfolios.

A. Announcement Effects

In this section we study the effects of the announcement on the subset of eligible bonds. We begin by adopting a standard high-frequency approach to examine daily changes in credit spreads and the CDS-bond basis around the announcement dates. Specifically, we compute notional-weighted average credit spreads for bonds eligible under the ECB's purchase programs, along with the corresponding notional-weighted average CDS-bond basis. Both series are constructed from an overlapping sample restricted to bonds with available CDS data and daily pricing via the iBoxx dataset. The use of daily data follows established practice in capturing high-frequency effects of asset purchases (Krishnamurthy and Vissing-Jorgensen, 2011; Krishnamurthy et al., 2017). In Appendix C.1, we extend the analysis using monthly data covering the broader sample.

[11]Following the PEPP announcement, these securities could be purchased under both the PEPP and the CSPP, which were operating in parallel.

[12]The remaining 4% of ineligible bonds either have too long residual maturities or are issued in unconventional legal forms or traded in unregulated markets that the ECB does not consider acceptable.

[13]The original market-neutral approach was adjusted in July 2022, when the Eurosystem announced its intention to gradually decarbonize its corporate bond portfolio in line with the objectives of the Paris Agreement. This entails tilting purchases toward issuers with stronger climate performance.

CSPP The ECB announced the Corporate Sector Purchase Programme (CSPP) on March 10, 2016, as part of its broader efforts to support the eurozone economy and address low inflation. The CSPP operated alongside other programs within the Asset Purchase Programme (APP). On that day, the ECB announced it would extend its APP program from €60 billion per month to €80 billion per month and include corporate bonds. The ECB started purchasing bonds in July 2016.

The March 2016 announcement of the CSPP led to a sharp decline in corporate bond spreads, driven primarily by an increase in the CDS-bond basis. As shown in Figure 2a, credit spreads fell rapidly following the ECB's announcement: within one month, the value-weighted average bond spread declined by about 30 basis points. The figure also reports, on the right axis, the inverse CDS-bond basis (defined as the bond credit spread minus the CDS spread). It shows an increase of roughly 20 basis points in the CDS-bond basis. This evidence is consistent with Prediction 1, underscoring that the main transmission channel operated through the bond's basis, as ECB purchases enhanced the attractiveness of eligible bonds to investors.

The CSPP announcement occurred in a relatively calm market environment, rather than during a crisis. Its primary aim was to broaden the range of assets eligible for ECB purchases. This setting strengthens identification by limiting confounding factors and reducing noise in the estimation. We also draw on evidence from the PEPP announcement to show that the results extend across different policy contexts.

PEPP Amid the challenges posed by the COVID-19 pandemic in 2020, the European Central Bank (ECB) responded with a substantial policy package that included corporate bond purchases. The severity of the crisis prompted the ECB to reinforce its interventions by expanding its asset purchase program. At the Governing Council meeting on March 12, 2020, ECB President Christine Lagarde announced a set of measures aimed at supporting the euro area economy. Specifically, the ECB committed to "add a temporary envelope of additional net asset purchases of €120 billion until the end of the year, ensuring a strong contribution from the private sector purchase programmes." Following this announcement, however, bond markets fell sharply, as financial markets perceived the ECB's response as insufficient given the scale of the unfolding shocks.[14]

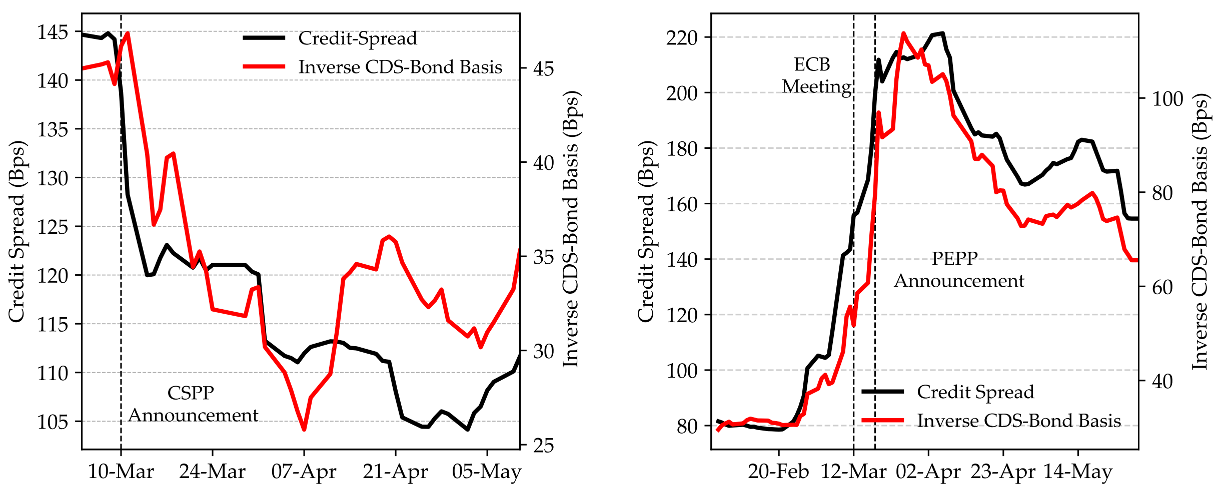
In response, the ECB took further action on March 18, 2020, outside of its regular schedule. In this unscheduled announcement, the ECB unveiled the PEPP programme, committing to a substantial expansion of its asset purchases. The program was launched

[14] The reaction was also exacerbated by President Lagarde's remark that "we are not here to close spreads," which was widely seen as undermining support for sovereign debt markets.

Figure 2. **Credit Spread and Convenience Yields around ECB Announcements** Figure 2a displays the evolution of credit spreads (left-hand axis) and the inverse CDS-bond basis (right-hand axis) of the subset of QE-eligible corporate bonds. The inverse CDS-bond basis is defined as the difference between the bond credit spread and the maturity-matched CDS spread. We plot its dynamics around the announcement of the Corporate Sector Purchase Programme (CSPP) on March 10, 2016. Similarly, Figure 2b illustrates the behavior of credit spreads and convenience yields around the announcement of the Pandemic Emergency Purchase Programme (PEPP) on March 18, 2020.

(a) CSPP Announcement

(b) PEPP Announcement



with an initial envelope of €750 billion, signaling a significant intensification of the ECB's policy response to the escalating crisis.

The two vertical lines in Figure 2b mark the dates of these pivotal events. The figure illustrates the sharp rise in credit spreads observed in March 2020, which intensified following the ECB Governing Council meeting on March 12. However, the announcement of the PEPP one week later reversed this trend, leading to a rapid decline in corporate bond spreads.

As with the CSPP, the surge and subsequent decline in credit spreads closely mirrored the evolution of convenience yields. On average, credit spreads increased by approximately 140 basis points before falling by around 60 basis points in the month following the announcement. Over the same period, convenience yields fell by 80 basis points and then rose by roughly 40 basis points. In this case, CDS spreads also contributed to the initial widening, resulting in a larger overall increase in credit spreads relative to convenience yields. Nonetheless, the PEPP episode further underscores the central role of convenience yields in the transmission of corporate bond purchases.

B. Effects on Yields

The announcement effects discussed above indicate that the ECB's interventions had sizable impacts on bond yields. Nonetheless, part of the observed yield movements could also stem from broader macroeconomic shocks. To strengthen causal identification, we exploit the institutional design of the ECB's purchase programs and the rich cross-section of corporate bonds in our sample.

Specification As a second step, and to further test prediction 1, we implement a difference-in-differences (DiD) strategy that leverages the exogenous timing of monetary policy announcements. This framework allows us to assess the effects of the CSPP and PEPP on bond yields and their components—credit spreads, CDS spreads, and the CDS–bond basis—by comparing eligible and ineligible bonds.

Our main empirical specification is:

$$y_t(n) = \theta\ Elig(n) \times Post_t + \gamma\ Elig(n) + \text{Fixed Effects} + u_t(n) \tag{1}$$

For each bond n and month t, the dependent variable $y_t(n)$ corresponds to one of the following outcomes: credit spread, CDS spread, or the CDS-bond basis. The indicator variable $Elig(n)$ equals 1 if bond n is eligible for purchase under the CSPP or PEPP, and 0 otherwise. The variable $Post_t$ is a time dummy equal to 1 for periods after the announcement of the respective purchase program, and 0 otherwise.

The identifying assumption is that, absent ECB purchases, corporate bond yields, credit spreads, CDS spreads, and the CDS-bond basis for the treatment and control groups would have evolved in parallel. In Appendix C.2, we provide evidence supporting the validity of this parallel trends assumption.

Even under the assumption of parallel trends, one might still worry that eligible and ineligible bonds differ systematically, or that ECB announcements coincide with shocks affecting the two groups differently. For instance, because such announcements often occur in response to deteriorating macroeconomic conditions—and eligible bonds tend to be of higher credit quality—they may exhibit lower sensitivity to macroeconomic risks. To mitigate this concern, our baseline specification includes rating-by-maturity-by-time fixed effects.[15] The estimated coefficients are therefore identified within the same maturity–rating bucket.[16]

[15] Specifically, we define twelve rating–maturity buckets by combining three rating categories (AAA–A, BBB, and high-yield) with four residual maturity groups (1–3 years, 3–5 years, 5–10 years, and 10–30 years).

[16] We experimented with alternative combinations of fixed effects, and our results remain virtually unchanged.

Moreover, changes in default risk are captured by CDS spreads, which are directly linked to default probabilities. The CDS-bond basis, by removing the portion of the credit spread explained by the CDS premium, allows us to further isolate variation in non-default components of bond yields.[17]

Results Panel (a) of Table III examines the impact of the CSPP announcement in March 2016. Columns 1–3, which include time and rating-by-maturity fixed effects, show that credit spreads of eligible bonds declined by about 20 basis points relative to ineligible ones. Of this decline, roughly 11 basis points—about 55%—are explained by a widening of the CDS–bond basis, while the remaining 9 basis points reflect a reduction in CDS spreads. Table I reports that, prior to the announcement, the average credit spread was 73 basis points and the average CDS–bond basis was –16 basis points. These figures indicate that the estimated effects are economically large: the 20-basis-point decline corresponds to roughly 27% of the average credit spread, while the 11-basis-point increase in the CDS–bond basis represents about 70% of its pre-announcement level. Overall, the results suggest that the CSPP announcement had a substantial impact on both the CDS–bond basis and, ultimately, the credit spreads of eligible bonds.

Our baseline estimates are consistent with the high-frequency results in Figure 2a, where the measured effect is somewhat larger because the high-frequency design does not take spillovers to non-eligible bonds into account. This reinforces the interpretation that announcement effects drove the bulk of the transmission of the policy to asset prices. This finding is consistent with Haddad et al. (2023, 2024) and D'Amico and King (2013); De Santis and Holm-Hadulla (2020). We further confirm this in Appendix C.2 by documenting that the wedge between eligible and non-eligible bonds widened at the announcement and remained stable thereafter.

In Panel (b), we turn to the PEPP, announced in March 2020. As discussed earlier, if investors had already priced in the effects of QE on corporate bonds, we would expect weaker announcement effects for eligible relative to ineligible bonds. This hypothesis is borne out in the data. Around the PEPP announcement, the CDS spreads of eligible bonds increased by about 12 basis points relative to ineligible bonds. However, eligible firms did not experience a corresponding rise in bond yields, as their CDS–bond basis also increased relative to ineligible bonds, offsetting part of this effect. We estimate a statistically significant increase of 9 basis points in the basis. The net effect on credit spreads—the sum of these two components—is not statistically different from zero and amounts to an estimated 3-basis-point increase (i.e.,

[17]Non-default factors—such as counterparty risk in the CDS market—would need to differ systematically between treated and control bonds to bias our estimates, which we view as unlikely.

the credit spreads of eligible bonds rose by 3 basis points more).

Overall, the findings suggest that—consistent with Prediction 1—the policy primarily affected characteristics related to *services* rather than traditional sources of fixed-income risk, leading to an increase in the basis of eligible bonds. As we show later in the paper, the program improved bond liquidity and reduced exposure to liquidity risk. Hence, it is natural that a substantial share of the policy's effects is reflected in a reduction of the CDS–bond basis.

Most of the existing literature on QE identifies its effects using high-frequency movements around policy announcements.[18] An exception is Todorov (2020), who exploits cross-sectional variation between eligible and ineligible CSPP bonds over a longer horizon. An open question in the empirical QE literature is whether the announcement effects are temporary, persistent, or evolve over time. Our paper contributes to this debate by combining both approaches—high-frequency identification and cross-sectional analysis—showing that the impact of QE announcements is not only immediate but also persistent and stable over time.

[18]See, among others, Krishnamurthy and Vissing-Jorgensen (2011); Altavilla et al. (2015); Krishnamurthy et al. (2017).

Table III. **The Effect of Corporate QE on Corporate Bond Yields** This table reports estimates from equation (1) using different measures of bond yields as dependent variables. The first row in each panel presents difference-in-differences estimates capturing the price effect of the respective corporate QE program. All regression include rating-by-maturity-by-time fixed effects. Standard errors are double-clustered at the time and issuer level.

(a) CSPP: September 2015 – September 2016

	(1) Credit Spread	(2) CDS	(3) Basis
Post × Eligible	-0.198***	-0.089***	0.109*
	(0.034)	(0.006)	(0.055)
Eligible	-0.054	-0.240***	-0.186***
	(0.069)	(0.060)	(0.052)
Rating x Maturity x Time FE	✓	✓	✓
R^2	0.39	0.47	0.12
Observations	37,994	37,994	37,994

(b) PEPP: September 2019 – September 2020

	(1) Credit Spread	(2) CDS	(3) Basis
Post × Eligible	0.030	0.116*	0.086*
	(0.042)	(0.057)	(0.042)
Eligible	-0.288***	0.002	0.290***
	(0.054)	(0.063)	(0.079)
Rating x Maturity x Time FE	✓	✓	✓
R^2	0.50	0.42	0.24
Observations	42,373	42,373	42,373

IV. The Impact of ECB Corporate QE on Portfolio Rebalancing

Our next step is to examine *why* ECB eligibility raises the convenience yield of eligible bonds. Prediction 2 states that, after an ECB policy announcement, investors who place higher value on the enhanced non-pecuniary services of eligible assets shift their portfolios more heavily toward them, thereby increasing their portfolio weight.

To analyze the mechanism through which the ECB's corporate QE programs influence corporate bond prices, we begin by examining aggregate portfolio rebalancing around the CSPP and the PEPP. Panel (a) of Table IV reports changes in aggregate holdings from the quarter preceding the CSPP announcement (2015Q4) to one and three quarters afterward (2016Q2 and 2016Q4). The ECB initiated corporate bond purchases in June 2016, acquiring approximately €6 billion in the second quarter and a total of €46 billion by year-end.

During the second quarter of 2016, mutual funds sharply increased their holdings of eligible corporate bonds, purchasing €21 billion. In contrast, they acquired only €4 billion of ineligible corporate bonds while selling €39 billion of sovereign bonds. This reallocation raised the share of eligible bonds in their overall bond portfolios, which include both corporate and sovereign securities, by 2.63 percentage points.

The shift persisted through the end of 2016. Mutual funds maintained elevated holdings of eligible bonds, further reduced their exposure to sovereign bonds, and reallocated part of their portfolios toward ineligible corporate bonds. Overall, the portfolio share of eligible bonds increased by 2.74 percentage points over the year (see Table F1 in Appendix **??**). These patterns suggest that the policy made eligible bonds particularly attractive to mutual funds. While purchases of eligible bonds were significantly larger than those of ineligible bonds—indicating a portfolio rebalancing toward eligible securities—the table also shows that the main source of reallocation was a reduction in sovereign bond holdings. Mutual funds sold sovereign bonds to buy corporate bonds, with these purchases disproportionately concentrated in eligible bonds. This pattern suggests that the ECB's policies had a wider market impact on corporate bonds, making the asset class as a whole more attractive to mutual funds.

Insurance companies and pension funds also increased their holdings of eligible bonds, although to a smaller extent. By the end of the year, they had purchased €24 billion of eligible bonds. The corresponding increase in the share of eligible bonds within their overall bond portfolios was limited to 0.7 percentage points, as they simultaneously accumulated substantial amounts of ineligible corporate bonds and sovereign bonds. This pattern indicates that these investors expanded their bond portfolios broadly, without a pronounced tilt toward eligible securities.

Table IV. **Portfolio rebalancing around the two corporate QE programs.** The table reports changes in nominal corporate bond holdings (EUR billions) during the ECB's CSPP and PEPP. For each program, portfolio rebalancing is shown over two horizons: a short-run window (from the quarter before the announcement to one quarter after) and a longer-run window (to three quarters after for the CSPP and to four quarters after for the PEPP). Results are reported separately for eligible and ineligible corporate bonds as well as sovereign bonds. We also report net issuance. The final column reports initial holdings in 2015Q4.

(a) CSPP

	2015Q4–2016Q2			2015Q4–2016Q4			2015Q4
	Eligible	Ineligible	Sovereign	Eligible	Ineligible	Sovereign	Holdings
Banks	-2	4	-10	-20	5	-95	1215
ICPF	20	6	39	24	9	37	1535
MF	21	4	-43	21	9	-56	950
Other	-3	-14	-33	-4	-26	-55	566
ECB	6	0	211	46	0	402	682
RoW	-1	17	-94	-37	33	-121	2195
Net issuance	-41	-16	-70	-30	-30	-112	

(b) PEPP

	2019Q4–2020Q2			2019Q4–2020Q4			2019Q4
	Eligible	Ineligible	Sovereign	Eligible	Ineligible	Sovereign	Holdings
Banks	26	29	120	21	40	33	1185
ICPF	19	5	-33	22	8	-68	1839
MF	36	-4	-14	49	-0	-33	1039
Other	0	-7	102	4	-12	84	490
ECB	59	5	245	117	3	527	1658
RoW	45	-16	94	45	7	-34	2457
Net issuance	-185	-12	-513	-257	-46	-509	

By contrast, the main sellers to the ECB were banks and foreign investors (Rest of the World). The overall pattern of portfolio rebalancing is broadly consistent with the evidence for the PSPP programme in Koijen et al. (2021). However, we uncover a key difference: under the PSPP, mutual funds sold sovereign bonds to the ECB, whereas under the corporate bond programme, they bought alongside the ECB rather than sold. This finding underscores the liquidity-enhancing role of the corporate QE programme.

Panel (b) reports portfolio rebalancing around the PEPP. In this case, the role of mutual funds as buyers of eligible bonds is even more pronounced. They purchased €49 billion of eligible bonds while simultaneously reducing their holdings of both ineligible corporate bonds and sovereign bonds. Similar to the CSPP episode, this increase in eligible bond holdings remained stable both in the short run (within one quarter) and in the longer run (within one year). By contrast, insurance companies and pension funds increased their holdings of eligible bonds by only €22 billion during the same period.

A. Effects on Portfolio Rebalancing

The preceding evidence indicates that portfolio rebalancing differed markedly across sectors. In particular, mutual funds shifted substantially toward eligible bonds. To formally assess the causal impact of the ECB's corporate bond purchase programs on investor behavior, we now turn to micro-level holdings data. Prediction 2 predicts that investors who derive greater benefits from the policy should increase the share of eligible bonds in their overall bond portfolios.

We adopt an empirical strategy similar to that in Section 3 to estimate how the ECB's policy announcements affected investor portfolio rebalancing. To study the impact of the CSPP on corporate bond holdings, we use the most granular version of the SHSS data, which classifies investors by both type and country. The unit of observation is therefore the holdings of bond n by investor type j in country c for a given quarter—for example, the holdings of the mutual fund sector in Italy in a specific quarter. For each investor type-country pair, we compute the portfolio share of each bond n within that sector-country's corporate bond portfolio, expressing these shares in basis points since portfolios are large relative to any individual bond.[19] We focus on the intensive margin by excluding cases where the portfolio share is zero, as rebalancing typically occurs by adjusting the size of existing positions.[20]

Before the CSPP, the median portfolio share in eligible bond was 1.87 bps for banks, 4.42 bps for mutual funds, and 4.81 bps for insurance companies and pension funds (ICPF) (see Panel (a) of Table II). These medians are small, indicating that most single-bond positions represent only a small fraction of the relevant portfolio, and they provide a natural benchmark against which to scale the estimated effects of the program.

We then estimate, separately for each investor type, the following difference-in-differences specification:

$$x_{j,c,t}(n) = \theta_j \, Elig(n) \times Post_t + \gamma_j \, Elig(n) + \text{Fixed Effects} + u_{j,c,t}(n), \tag{2}$$

where $x_{j,c,t}(n)$ denotes the portfolio share of bond n held by investor type j in country c at time t, $Elig(n)$ is an indicator equal to one if the bond is eligible for the CSPP (or PEPP), and $Post_t$ is an indicator equal to one in the quarters following the CSPP (or PEPP) announcement. The interaction coefficient θ_j captures the differential change in

[19] Differently from the discussion in the previous subsection, we now restrict attention to corporate bonds, as this provides the most relevant treatment and control groups.

[20] To limit the influence of extreme values, we drop observations above the 97th percentile of portfolio shares across all investors.

portfolio shares of eligible bonds after the start of the program for investor type j.

All regressions include holder–country–by–time fixed effects and rating–by–maturity–by–time fixed effects. The holder–country–by–time fixed effects absorb any time-varying shocks at the investor–country level—such as shifts in funding conditions or aggregate portfolio reallocations toward corporate bonds—ensuring that identification arises from within–investor–country comparisons between eligible and ineligible bonds. The rating–by–maturity–by–time fixed effects, in turn, control for changes in the relative attractiveness of bonds with different credit quality and duration profiles over time.

Focusing first on mutual funds, column (2) of Table V shows that the estimated post-announcement effect is 0.3 bps and is statistically different from zero. Relative to the pre-CSPP median portfolio share of 4.42 bps, this corresponds to an increase of roughly 6.8% in the typical holding of an eligible bond. This is an economically meaningful rebalancing, given the small size of the median position.

For insurance companies and pension funds (ICPF), the estimated effect is 0.081 bps and is not statistically different from zero. Relative to their pre-CSPP median portfolio share of 4.81 bps, this corresponds to a negligible change of approximately 1.7%. By contrast, banks exhibit a decline of −0.485 bps, which is also statistically insignificant. Relative to their median overall bond portfolio share of 1.87 bps, this translates into a reduction of about 26%. Other domestic investors display a statistically significant decrease of −0.314 bps, or roughly 21% relative to their median portfolio share of 1.48 bps. Finally, the rest of the world also reduced their holdings of eligible bonds in a statistically significant way.

Overall, the CSPP appears to have led to a meaningful rebalancing toward eligible bonds among mutual funds, while banks, other domestic sectors and foreign investors reduced their relative exposure while insurers showed no statistically significant change.[21]

Turning to the PEPP, the results (reported in Panel (b) of Table V) broadly confirm the patterns observed for the CSPP. Mutual funds again display a statistically significant increase in their holdings of eligible bonds, with an estimated effect of 0.11 bps. Relative to their pre-PEPP median portfolio share of 4.23 bps (Table II), this corresponds to an increase of about 2.6%. Insurance companies and pension funds, by contrast, rebalance out of eligible bonds, with a statistically significant coefficient of −0.21 bps. Compared to their pre-PEPP median share of 4.75 bps, this represents a reduction of roughly 4.4%. Banks again appear to be net sellers of eligible bonds, while the rest of the world and other domestic investors show positive but statistically insignificant changes.

[21] We also consider a slightly longer sample, reported in Appendix Table F2. The results remain broadly consistent with the baseline.

Consistent with Prediction 2, the evidence from Table IV and the difference-in-differences results point to a strong shift in the service characteristics of eligible bonds. For some investors, particularly mutual funds, these effects more than offset the supply-driven channel, which would have predicted that mutual funds act as the main sellers of corporate bonds. Instead, they purchased eligible bonds despite the increase in prices and the associated decline in spreads, as documented in the previous section. These findings highlight that mutual funds derived particular value from the policy.

We interpret the main transmission mechanism as an insurance channel provided by the central bank, which enhances the hedging and liquidity properties of eligible bonds. Mutual funds are prone to sell bonds when they face investor outflows, which typically occur during recessions (Coppola, 2021), precisely when bond prices are falling. If investors expect the ECB to intervene in adverse states of the world, the vulnerability of eligible corporate bonds to such fire sales is reduced. The benefits, however, are likely to vary across mutual funds. Funds with a stable investor base and low flow turnover are less exposed to this risk, whereas funds with volatile flows stand to gain more from the insurance channel.

To further corroborate our findings and to more precisely identify the underlying mechanism, we now turn to granular data on mutual fund holdings.

B. Granular Mutual Funds Portfolio Rebalancing

Our results so far indicate that mutual funds tend to rebalance their portfolios toward eligible bonds rather than selling them. We argue that this behavior reflects the value mutual funds place on the ECB's policy: they can sell these bonds to the ECB if they face outflows and need to liquidate assets. Consequently, *within* the mutual fund sector, we expect funds experiencing greater volatility in net flows to be particularly sensitive to ECB announcements. In this section, we test this prediction using granular information on mutual fund holdings from Morningstar.

We start by constructing a fund-level measure of capital flightiness, using the volatility of fund flows as a proxy. We define $CapitalFlightiness_i$ as the volatility of $F_{i,t}$ over the two years leading up to the QE announcements (CSPP and PEPP) for each fund. Our measure is normalized by the average AUM to control for fund size. We retrieve fund net flows $F_{i,t}$ (in euros) from Morningstar.[22] In summary, in our empirical specification, we measure $CapitalFlightiness_i$ separately for the CSPP and the PEPP:

[22] To maintain consistency across monthly observations, we include only fund/month observations for which $\frac{F_{i,t}}{AUM_{i,t-1}}$ is within the range -0.5 to 0.5. Additionally, we only include funds with valid AUM data for at least 6 months over the two years preceding the QE announcements (CSPP and PEPP). The sample covers, on average, 3567.5 funds for the two events in the quarterly sample and 2,515 funds in the monthly sample.

Table V. **The effect of corporate QE on portfolio share.** This table displays the results of estimating equation (2) separately for five holdings sectors: Banks, mutual funds, insurance companies & pension funds, others (incl. households and non-financial corporations), and rest of the world (i.e., non-euro area holdings estimated as the residual).

(a) CSPP: 2015q3 – 2016q3

	(1) Banks	(2) MF	(3) ICPF	(4) Other	(5) RoW
Post=1 × CSPP eligible=1	-0.485**	0.293**	0.081	-0.314**	-0.442**
	(0.15)	(0.08)	(0.08)	(0.08)	(0.15)
CSPP eligible=1	-1.537**	-0.769*	0.420	-0.947**	1.873**
	(0.48)	(0.33)	(0.35)	(0.28)	(0.45)
Holder country x Time FE	✓	✓	✓	✓	✓
Rating x Maturity x Time FE	✓	✓	✓	✓	✓
R^2	0.25	0.19	0.22	0.15	0.04
Observations	45,088	70,878	74,195	73,539	20,258

(b) PEPP: 2019q3 – 2020q3

	(1) Banks	(2) MF	(3) ICPF	(4) Other	(5) RoW
Post=1 × PEPP eligible=1	-0.265	0.109*	-0.214***	0.156**	0.138
	(0.15)	(0.04)	(0.05)	(0.04)	(0.16)
PEPP eligible=1	-0.438	-1.310***	-0.072	-1.021***	1.936***
	(0.41)	(0.20)	(0.22)	(0.21)	(0.40)
Holder country x Time FE	✓	✓	✓	✓	✓
Rating x Maturity x Time FE	✓	✓	✓	✓	✓
R^2	0.32	0.17	0.20	0.14	0.08
Observations	53,419	104,684	113,044	79,343	20,819

$$CapitalFlightiness_i = \frac{\sigma(F_{i,t-2yr\to t})_i}{mean(AUM_{i,t-2yr\to t})_i} \tag{3}$$

Building on the difference-in-difference specification (2), we implement a triple difference specification. For each fund i in country c at month t, the dependent variable, the portfolio weight x, is defined as the ratio of the market value of fund i's holdings in bond n to the market value of the fund's total corporate bond holdings. Specifically, we run the regression.

$$\begin{aligned} x_{ict}(n) = \psi_1 Elig(n) \times Post_t \times CapitalFlightiness_i + \psi_2 Elig(n) \times Post_t + \\ \psi_3 CapitalFlightiness_i \times Post_t + \text{Fixed Effects} + \text{Controls} + \varepsilon_{ict}(n) \end{aligned} \tag{4}$$

In our specification we include holder country-time fixed effects to absorb time-varying country-specific demand, fund fixed effects to absorb time-invariant fund fundamentals, and rating × maturity fixed effects to capture duration and credit risk. The results are reported in Table VI.[23]

Column (1) reports results for regression (2), but at the fund-level. Using more granular data from a different source, we confirm the findings of Table V. Mutual funds respond to the QE announcement by purchasing more eligible securities. Columns (2)–(3) show that the effect is more substantial for funds with higher capital flightiness. In particular, these results show that a one standard deviation increase in asset flightiness increases mutual funds' portfolio weight in eligible bonds by 4% (= 0.031 × 1.444). We view this as corroborating evidence that the perceived extra liquidity of ECB-eligible bonds is key in explaining why the corporate QE announcement had such a substantial impact on prices.

Where Does the Money Come From? We investigate the ways mutual funds reallocate their resources between ECB-eligible corporate bonds and other asset classes in this section. We begin by constructing the key variable: the portfolio weight $x_{i,m,t}$, defined as the market value of fund i's holdings in asset class m, normalized by the fund's total asset under management (AUM) in month t. The change in portfolio weight across the QE announcement for fund i in asset class m is defined as the difference in portfolio weight between the first and last periods of the event window for that asset class.[24] This measure is performed separately for the CSPP and the PEPP.

$$\Delta x_{i,m}^{CSPP} = x_{i,m,pre} - x_{i,m,post}$$

$$\Delta x_{i,m}^{PEPP} = x_{i,m,pre} - x_{i,m,post}$$

We run the following regression on all fund × asset class pairs.

$$\begin{aligned}\Delta x_{im} = \alpha + \beta_1 HighCapF_i \times \Delta x_{i,elig} + \beta_2 \Delta x_{i,elig} + \\ \beta_3 HighCapF_i + \gamma_1 log(AUM)_{i,pre} + \gamma_2 x_{i,pre}^{corpbond} + \alpha_c + \epsilon_{im}\end{aligned} \tag{5}$$

We control for the fund's pre-period AUM and corporate bond share to account for differences in fund size and exposure to assets most affected by QE. We include holder country fixed effects to absorb time-invariant country-specific demand. We report results in Table VII.

[23]The sample is monthly. We winsorize portfolio weight, *CapitalFlightiness*, and βs at 1% and 99% to remove outliers.

[24]We trim the distribution of Δx_{im} by keeping observations within the interval [-100, 100], and winsorize at the 1st and 99th percentiles to remove outliers. To avoid data errors or extreme outliers, we restrict the analysis to observations with portfolio weights x_{imt} bounded within the unit interval [0,1].

Table VI. **The effect of corporate QE on mutual funds holdings.** This table displays the results of estimating equation (4) for mutual funds in euro area. Panel (a) reports estimations on CSPP (September 2015 – September 2016), and Panel (b) reports estimations on PEPP (September 2019 – September 2020). The dependent variable is the portfolio weight x of fund i in bond n, defined as the share (in %) of the market value of fund i's holdings in that bond to the fund's total market value holdings across all corporate bonds. The key independent variable *CapitalFlightiness* is computed from equation (3). *HighCapF* is a dummy indicator reflecting whether the fund's *CapitalFlightiness* falls within the top 75th percentile. Standard errors are clustered at the fund × time level.

(a) CSPP: September 2015 – September 2016

	Portfolio weights(%)					
	(1)	(2)	(3)	(4)	(5)	(6)
Elig=1 × Post=1 × CapitalFlightiness		1.444***			1.567**	
		(0.537)			(0.747)	
Elig=1 × Post=1 × HighCapF=1			0.122***			0.121**
			(0.037)			(0.053)
Post=1 × CapitalFlightiness		−3.165***			−2.317***	
		(0.452)			(0.680)	
Post=1 × HighCapF=1			−0.198***			−0.128***
			(0.029)			(0.046)
Elig=1 × Post=1	−0.021	−0.093***	−0.059***	0.016	−0.054	−0.015
	(0.019)	(0.032)	(0.022)	(0.026)	(0.041)	(0.028)
Holder Country × Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Rating × Maturity FE	Yes	Yes	Yes	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes
ISIN FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	692,771	692,771	692,771	291,886	291,886	291,886
R^2	0.788	0.788	0.788	0.809	0.809	0.809

(b) PEPP: September 2019 – September 2020

	Portfolio weights(%)					
	(1)	(2)	(3)	(4)	(5)	(6)
Elig=1 × Post=1 × CapitalFlightiness		0.764***			1.752***	
		(0.214)			(0.412)	
Elig=1 × Post=1 × HighCapF=1			0.032*			0.045
			(0.017)			(0.029)
Post=1 × CapitalFlightiness		−1.445***			−2.465***	
		(0.200)			(0.407)	
Post=1 × HighCapF=1			−0.091***			−0.106***
			(0.015)			(0.028)
Elig=1 × Post=1	0.001	−0.029**	−0.007	0.033**	−0.032	0.022
	(0.008)	(0.012)	(0.009)	(0.015)	(0.022)	(0.017)
Holder Country × Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Rating × Maturity FE	Yes	Yes	Yes	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes
ISIN FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,281,421	1,281,421	1,281,421	518,250	518,250	518,250
R^2	0.788	0.788	0.788	0.807	0.807	0.807

Table VII. **Mutual Funds Money Rebalancing.** This table displays the results of estimating equation (5) for mutual funds in euro area. Panel A reports estimations excluding the fund asset flightiness metric and panel B reports estimations considering the fund asset flightiness. Portfolio weights are represented in percentage points. $x_{i,other}$ includes fund positions in derivatives, real estats, private equity, commodities, etc. $Log(AUM)_{i,pre}$ and $x_{i,pre}^{corpbond}$ refer to the fund's assets under management and corporate bond share at the onset of the events (September 2015 for CSPP and September 2019 for PEPP). *HighCapF* is a dummy indicator reflecting whether the fund's *CapitalFlightiness* falls within the top 75th percentile. Data is monthly.

(a) CSPP: September 2015 – September 2016

	$\Delta x_{i,inelig}$ (1)	$\Delta x_{i,cash}$ (2)	$\Delta x_{i,sov}$ (3)	$\Delta x_{i,equity}$ (4)	$\Delta x_{i,other}$ (5)
$\Delta x_{i,elig}$	-0.014	-0.150^{*}	-0.427^{***}	-0.048^{*}	-0.347^{***}
	(0.053)	(0.084)	(0.071)	(0.026)	(0.103)
$Log(AUM)_{i,pre}$	-0.052	0.102	0.105	0.001	-0.231
	(0.109)	(0.174)	(0.147)	(0.053)	(0.214)
$x_{i,pre}^{corpbond}$	-9.954^{***}	1.812	5.995^{***}	0.215	2.001
	(0.896)	(1.425)	(1.206)	(0.439)	(1.751)
Holder Country FE	Yes	Yes	Yes	Yes	Yes
Observations	1,174	1,174	1,174	1,174	1,174
R^2	0.168	0.020	0.065	0.020	0.060

(b) PEPP: September 2019 – September 2020

	$\Delta x_{i,inelig}$ (1)	$\Delta x_{i,cash}$ (2)	$\Delta x_{i,sov}$ (3)	$\Delta x_{i,equity}$ (4)	$\Delta x_{i,other}$ (5)
$\Delta x_{i,elig}$	-0.095^{***}	-0.188^{***}	-0.274^{***}	-0.011	-0.409^{***}
	(0.036)	(0.064)	(0.057)	(0.021)	(0.078)
$Log(AUM)_{i,pre}$	0.143	-0.175	0.018	-0.006	-0.003
	(0.089)	(0.156)	(0.141)	(0.051)	(0.192)
$x_{i,pre}^{corpbond}$	0.506	1.328	0.808	0.585	-2.908^{*}
	(0.718)	(1.263)	(1.141)	(0.414)	(1.554)
Holder Country FE	Yes	Yes	Yes	Yes	Yes
Observations	1,434	1,434	1,434	1,434	1,434
R^2	0.030	0.060	0.058	0.018	0.060

V. Heterogeneous Transmission of QE

In Section 3 we showed that announcements of corporate bond purchases had significant effects on credit spreads and convenience yields. In Section 4 we documented that investors who valued the enhanced liquidity and hedging properties of eligible corporate bonds—most notably mutual funds—rebalanced strongly toward these assets. This additional demand acted as a "helping hand" for monetary policy transmission (Fang and Xiao, 2025), thereby amplifying the effect of the purchases on bond prices. The implication is that a higher share of investors who value the policy strengthens its transmission to asset valuations. Testing this channel would ideally require comparing several announcements that are identical in all respects except for investor composition. In practice, however, this is not feasible.[25]

To address this challenge, we exploit the granularity of our data and the large cross-section of corporate bonds, together with the segmented structure of the bond market, following a similar approach to Coppola (2021).[26] In practice, such segmentation may arise from factors such as home bias, regulatory constraints, or the pattern of net inflows.[27] Moreover, due to frictions such as information and monitoring costs, investors typically adjust their portfolios by scaling positions in assets they already hold rather than by acquiring new securities.[28]

Section 4 shows that mutual funds expand their existing holdings of eligible bonds. Under this form of segmentation, Prediction 3 implies a stronger decline in spreads for bonds held by investors who value the insurance channel, such as mutual funds. However, these effects may be partly offset because such investors are also relatively elastic, which dampens the strength of transmission. Our estimates therefore capture the net effect of these two opposing forces. In fact, absent a positive demand shift, bonds with higher mutual fund ownership should experience a *weaker* effect on bond yields. This latter prediction is consistent with the calibrated demand system in Koijen et al. (2021), where mutual funds dampen the transmission of sovereign bond purchases due to their higher elasticity.

[25] In our setting, only two major announcements are available—the CSPP and the PEPP—which occurred under substantially different macro-financial conditions and against distinct market expectations.

[26] In the appendix, we show how to motivate this regression using our stylized model. In particular, following Koijen and Yogo (2019) and Bretscher et al. (2021), the model extension in Appendix A.4 assumes that investors consider only a subset of available assets.

[27] For example, insurance companies often concentrate their purchases on primary issuances and tend to buy these securities when they receive inflows from policyholders (Coppola, 2021).

[28] Such frictions have been documented in several contexts, including mutual fund flows (Coval and Stafford, 2007), insurance company fire sales (Ellul et al., 2011), and demand-based asset pricing (Koijen and Yogo, 2019; Bretscher et al., 2021).

A. Announcement Effects

We begin with evidence from the raw data, showing that bonds responded heterogeneously in the two weeks following the announcement depending on their mutual fund ownership. We use daily data from iBoxx.[29] Figure 3 plots the reduction in bond yields (y-axis) against the share of bonds held by mutual funds (x-axis). Bonds are grouped into 50 bins based on their announcement yield reactions, and for each group we compute average mutual fund ownership. The figure therefore displays 50 dots, each representing one group. Panel 3a reports the results for the CSPP. Bonds with higher mutual fund ownership experienced larger declines in credit spreads, ranging from about 5 basis points for bonds with 20% ownership to about 70 basis points for bonds with 50% ownership. These magnitudes are substantial, given that the average effect across all bonds was approximately 30 basis points. Figure F.1 in the Appendix, shows similar results for the CDS-bond basis, where the pattern is nearly identical.

Panel 3b reports the results for the PEPP. As discussed earlier, the announcement effects are considerably noisier, with estimated changes ranging from about -100 to 150 basis points, which makes it more difficult to discern a clear pattern.

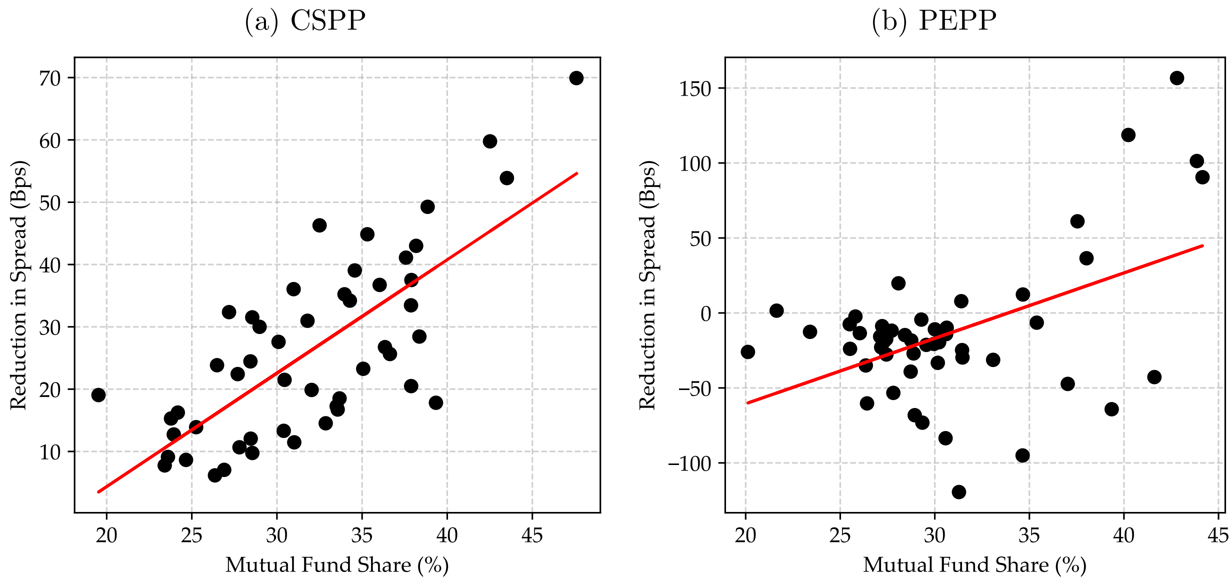
One might be concerned that the patterns observed in the raw data reflect (i) differences in the types of bonds held by mutual funds relative to other investors (e.g., insurance companies and mutual funds), or (ii) temporary effects that fade quickly after the announcement. In this section, we address both concerns. We show that the effects remain significant after controlling for bond characteristics and that they persist over longer horizons.

B. Heterogenous Impact on Yields

We extend the baseline difference-in-differences framework in equation (1) by interacting bond eligibility and the post-announcement period with the pre-intervention holdings of mutual funds' (MFs) share of a bond's outstanding amount. Mutual funds have been the primary focus of the paper, but we also extend the analysis to insurance companies and pension funds (ICPF) to compare the two main investor types in corporate bonds. Note that the definition of share in this specification differs from the portfolio shares used in equation (2): here, the share measures the fraction of a bond's outstanding amount held by a given investor type, rather than the share of the investor's portfolio accounted for by a given bond. , mutual funds hold about 24% of a bond's outstanding amount, with a standard deviation of about 18 percentage points, indicating substantial cross-sectional variation. Insurance companies and pension funds hold on average about 28% of a bond's

[29] In order to increase the number of observation the figure is based on both senior and subordinate bonds.

Figure 3. **Mutual Funds Holdings and Credit Spread Response** The figure depicts the relationship between the reduction in spreads (y-axis) around ECB announcements and the corresponding mutual fund holdings (x-axis). Bonds are ranked according to the magnitude of their spread reactions and sorted into 50 groups with comparable responses. For each group, we compute the average mutual fund share. Panel (a) presents the results for the CSPP announcement, while Panel (b) reports the results for the PEPP announcement.



outstanding amount. These shares are measured in 2015Q3, just prior to the start of our sample in September 2015.[30]

Formally, we estimate the following specification:

$$y_t(n) = \gamma_j \; Post_t \times Elig(n) + \theta_j \; Post_t \times Elig(n) \times \tilde{x}_j(n) + \text{Fixed Effects} + u_t(n), \qquad (6)$$

where $\tilde{x}_j(n)$ is the share of the bond's outstanding amount held by investor j prior to the intervention. We consider mutual funds ($j = \text{MF}$) and insurance companies and pension funds ($j = \text{ICPF}$). We restrict the sample to bonds in which both mutual funds and insurance companies and pension funds hold a positive share.[31]

Because mutual funds and ICPFs systematically hold different sets of bonds, we include ISIN fixed effects to control for time-invariant bond-level characteristics—such as credit quality, sector, or issuance features—that may be correlated with both investor composition

[30]Portfolio holdings are highly persistent, so the precise timing of the measurement has little impact on the results.

[31]We winsorize the holdings at the investor level by trimming the top 1%.

and price changes. This specification ensures that identification comes from within-bond variation over time, net of any persistent differences across securities. In addition, we include maturity–rating–time fixed effects to capture time-varying shocks that may differentially affect bonds with similar risk and duration profiles.

The key prediction is that, conditional on similar observable characteristics, the CSPP effect on yields should depend on the ex-ante investor base. The coefficients θ_j on the triple interaction terms capture whether the CSPP effect was amplified or dampened for bonds more heavily held by a given investor type.

The summary statistics for $\tilde{x}_j(n)$, the share of the outstanding amount, are presented in Panel (b) of Table II. Mutual funds hold 22% of the outstanding amount of eligible bonds, whereas insurance companies hold 47%.

Table VIII presents the estimation results. Columns (1)–(6) report separate regressions for mutual funds, insurance companies, and pension funds. Columns (7)–(9) include both mutual funds and insurance companies in the same regression, allowing their effects to be estimated jointly.

For mutual funds, the coefficient in column (1) is negative and statistically different from zero, indicating that credit spreads decline more for bonds predominantly held by mutual funds. The magnitude implies that a 10 percentage point increase in mutual fund holdings amplifies the CSPP effect on credit spreads by about 2.4 basis points. Given the standard deviation of mutual fund holdings (16 percentage points), a one–standard–deviation increase in mutual fund share implies an additional compression of roughly 3.8 basis points. Column (3) shows that this effect is mirrored in the CDS–bond basis, which increases by about 3.5 basis points for a 10 percentage point increase in mutual fund holdings, or about $\frac{16}{10} \times 3.5 \approx 5.6$ basis points for a one–standard–deviation change. This pattern is consistent with the CSPP effect operating primarily through the convenience–yield channel—reducing yields without a commensurate change in CDS spreads, as shown in column (2).

In contrast, the interaction terms for ICPF holdings are small and statistically insignificant across all specifications, suggesting that insurance companies and pension funds did not drive the observed CSPP price effects.

We assess the robustness of our results by extending the event window, as reported in Table E1. In this specification, the interaction coefficient for mutual funds becomes even larger. For credit spreads, the coefficient is -3.2, implying that a 10 percentage point increase in mutual fund holdings amplifies the CSPP effect on credit spreads by about 3.2 basis points. Similarly, a 10 percentage point increase in mutual fund holdings amplifies the effect on the CDS–bond basis by about 4 basis points.

The effects for the PEPP policy are qualitatively similar but smaller in magnitude and

Table VIII. **Intermediary Effects, Difference-in-Differences Approach** The table reports the estimates of Equation 6. The triple interaction coefficients θ_{MF} and θ_{ICPF} capture the additional effects of the policies for bonds that, ex-ante, had a higher share held by mutual funds or by insurance corporations and pension funds, respectively. We use rating-by-maturity-by-time fixed effects and ISIN FE. Standard errors are double-clustered at the time and issuer level.

(a) CSPP: September 2015 – September 2016

	MF			ICPF			MF & ICPF		
	(1) CS	(2) CDS	(3) Basis	(4) CS	(5) CDS	(6) Basis	(7) CS	(8) CDS	(9) Basis
Post × Eligible × MF Share	-0.237*	0.108	0.345**				-0.288*	0.150	0.438**
	(0.125)	(0.102)	(0.131)				(0.156)	(0.104)	(0.173)
Post × Eligible × ICPF Share				0.126	0.007	-0.118	0.014	0.046	0.031
				(0.082)	(0.045)	(0.089)	(0.076)	(0.056)	(0.090)
Post × Eligible	-0.077*	-0.121**	-0.043	-0.179**	-0.104**	0.075	-0.059	-0.148**	-0.088
	(0.043)	(0.041)	(0.050)	(0.069)	(0.037)	(0.073)	(0.068)	(0.053)	(0.082)
ISIN FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
Rating x Maturity x Time FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
R^2	0.93	0.92	0.82	0.91	0.93	0.79	0.91	0.93	0.80
Observations	12,557	12,557	12,557	15,211	15,211	15,211	17,379	17,379	17,379

(b) PEPP: September 2019 – September 2020

	MF			ICPF			MF & ICPF		
	(1) CS	(2) CDS	(3) Basis	(4) CS	(5) CDS	(6) Basis	(7) CS	(8) CDS	(9) Basis
Post × Eligible × MF Share	-0.124	-0.131	-0.006				0.087	-0.157	-0.244
	(0.153)	(0.113)	(0.120)				(0.137)	(0.166)	(0.165)
Post × Eligible × ICPF Share				0.121	0.274	0.153	0.157	0.150	-0.007
				(0.139)	(0.185)	(0.113)	(0.138)	(0.214)	(0.168)
Post × Eligible	0.051	0.069	0.019	-0.034	-0.063	-0.029	-0.071	0.039	0.109
	(0.063)	(0.068)	(0.062)	(0.069)	(0.056)	(0.070)	(0.059)	(0.098)	(0.118)
ISIN FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
Rating x Maturity x Time FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
R^2	0.90	0.89	0.81	0.90	0.89	0.80	0.89	0.89	0.80
Observations	16,374	16,374	16,374	18,709	18,709	18,709	21,053	21,053	21,053

estimated with less precision. In particular, we find a comparable coefficient for the triple interaction term for mutual funds (-0.124), although it is not statistically significant. The corresponding coefficient for the CDS–bond basis is also insignificant. As discussed throughout the paper, the PEPP period was characterized by substantially higher volatility, and much of the price adjustment had already occurred following the CSPP.

VI. Quantitative Tightening

The ECB's monetary policy tightening and the transition to quantitative tightening (QT) in 2021–2022 were accompanied by a pronounced widening of credit spreads. In this section, we examine the differential effects on eligible versus ineligible bonds during this phase. This analysis provides insight into how investors perceived the QT policy and helps us rationalize, *ex post*, the dynamics documented at the time of the initial corporate QE announcement. Specifically, this section tests Prediction 4. The key idea is that if investors anticipate that the ECB will intervene again in the future, asset prices should not revert to their pre-QE announcement equilibrium. Likewise, mutual funds—which place a high value on liquidity—should not divest from previously purchased bonds, given the expectation that the ECB can *reactivate* its purchase programme in the event of market stress.

Unlike the CSPP, the QT phase was not marked by a single, distinct announcement. We therefore begin by discussing its timeline before presenting the empirical results.

Tightening Timing At the end of 2021 and the beginning of 2022, the ECB gradually shifted its communication regarding the future of its quantitative easing programmes. Unlike the CSPP and PEPP announcements, which were communicated to markets on clearly defined dates, the transition toward Quantitative Tightening (QT) did not occur through a single announcement. Instead, it unfolded progressively through a series of policy communications.

The first indication came during the press conference of 16 December 2021, when the ECB stated: "In the first quarter of 2022, we expect to conduct net asset purchases under the pandemic emergency purchase programme (PEPP) at a lower pace than in the previous quarter. We will discontinue net asset purchases under the PEPP at the end of March 2022." (ECB Press Conference). The same communication also signaled a gradual reduction in purchases under the APP.[32] In subsequent meetings, the ECB continued to signal its intention to end APP purchases in the third quarter of 2022, while emphasizing a data-dependent approach. Finally, at the meeting of 9 June 2022, the ECB formally announced that net asset purchases under the APP would end as of 1 July 2022.

Overall, the transition toward QT was therefore characterized by a gradual tightening of the monetary policy stance rather than a single, discrete event. At the June meeting, the ECB also announced its intention to raise policy rates at the July 2022 meeting, which indeed materialized.[33]

[32] Press release from the December 2021 meeting: "The Governing Council decided on a monthly net purchase pace of €40 billion in the second quarter and €30 billion in the third quarter under the APP."

[33] Press release from the June 2022 meeting: "Accordingly, and in line with the Governing Council's policy

It is worth emphasizing that by *QT* we refer to the period in which the ECB communicated to markets its intention to slow or halt bond purchases. In practice, the actual run–off of the ECB's balance sheet began only in 2023, when the ECB stopped reinvesting the principal of maturing bonds. In effect, this constitutes a form of "passive QT."

Market Expectations The main rationale for focusing on announcement effects in the literature is that asset prices respond primarily to changes in market expectations. Consequently, most studies identify policy shocks as changes in asset prices observed around major announcements. In the case of QT, however, communication was more gradual, making this approach less straightforward. We make progress on this front by relying on survey data from market participants. In particular, the ECB's *Survey of Monetary Analysts (SMA)* provides information on market expectations regarding the future path of the stock of bonds held under the APP and PEPP programmes.

The evolution of these expectations is illustrated in Figure 4. Each line in the plot corresponds to a different survey round, with the dark gray lines indicating the months when expectations remained broadly unchanged. To make the numbers comparable across survey rounds, we focus on expectations regarding the stock of bonds held by the ECB in December 2026. Consistent with the policy timeline, the first notable shift in expectations occurred in December 2021, when market participants began to anticipate a smaller stock of bonds—about €5.1 trillion compared with €5.3 trillion expected in November 2021. A second major revision took place in early 2022, with expectations declining to around €4.2 trillion by February 2022, and a further adjustment later in the year, reaching about €3.6 trillion by October 2022. Interestingly, following this trough, expectations partially reversed, with market participants anticipating a higher stock of roughly €3.9 trillion by December 2026. These shifts mark the main episodes of changing market perceptions about the pace and extent of quantitative tightening.

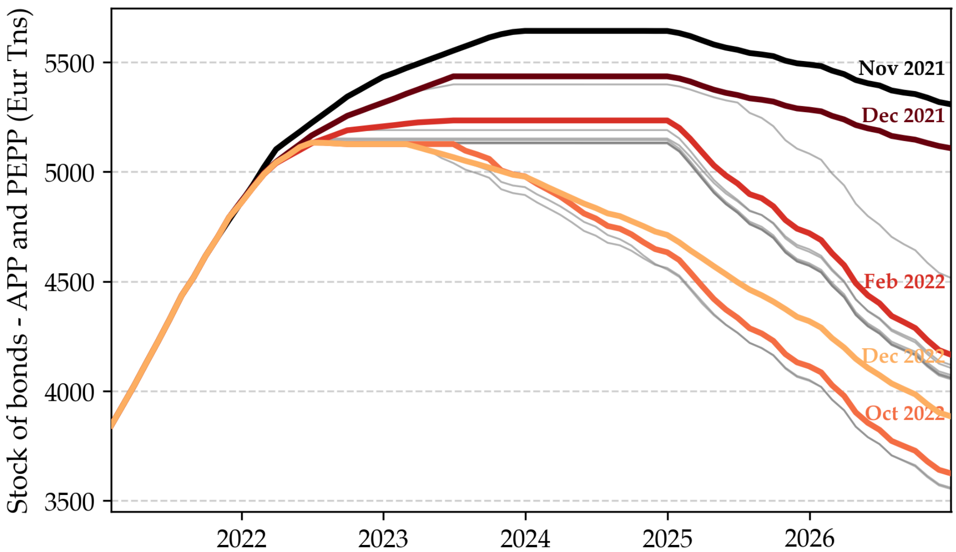
Building on the timeline of QT announcement and the corresponding revisions in market expectations, we now examine how these developments affected bond yields and portfolio rebalancing dynamics.

A. QT Effects on Bond Yields

We begin by examining the evolution of bond yields during the QT period. Since there was no single fixed announcement date, we focus on the dynamics in daily data to capture the gradual adjustment of market expectations. We then extend our difference-in-differences

sequencing, the Governing Council intends to raise the key ECB interest rates by 25 basis points at its July monetary policy meeting."

Figure 4. **Path of Stock Bonds under APP and PEPP** The figure shows market expectations on the path of purchases under the combined APP and PEPP programme. Market surveys take place each month. Each line in the plot corresponds to a different time when the expectations were elicited. The dark grey lines are months where there were not major changes in market expectations.



approach to analyze the QT phase.

Daily Time Series We use daily data from *iBoxx* covering all euro-denominated corporate bonds. To control for differences in duration and credit quality, we adopt a non-parametric fixed-effects approach. Specifically, for each trading day t, we group all bonds i into cells defined by their rating $r(i)$ and duration bucket $d(i)$. Within each day and cell, we compute the cross-sectional mean of the variable of interest (either the credit spread or the CDS–bond basis) and subtract it from each individual observation. Formally, for variable $y_{i,t}$, we construct $\tilde{y}_{i,t} = y_{i,t} - \bar{y}_{r(i),d(i),t}$, where $\bar{y}_{r(i),d(i),t}$ denotes the average of y across all bonds on day t with the same rating and duration bucket. This residualization procedure is equivalent to estimating daily cross-sectional regressions with rating and duration fixed effects, without imposing any parametric restrictions across days.

We then aggregate the residuals $\tilde{y}_{i,t}$ separately for eligible and ineligible bonds, using notional amounts as weights.

$$\bar{y}_t^{\text{group}} = \frac{\sum_{i \in \text{group}} \tilde{y}_{i,t} \cdot na_{i,t}}{\sum_{i \in \text{group}} na_{i,t}},$$

where $na_{i,t}$ denotes the notional amount outstanding of bond i at time t. To recover fitted levels, we add back the overall average y for all bonds together (i.e., the overall average credit spreads and basis for the market). This procedure yields time series of spreads and bases for eligible and ineligible bonds that are directly comparable, as they net out differences in rating and duration composition across days.[34]

Figure 5 plots the residualized credit spreads and CDS–bond basis for eligible (black) and ineligible (red) bonds. Following the December 2021 meeting, we observe a gradual increase in credit spreads (see Figure 5a) for both groups of bonds. This upward trend becomes more pronounced over the course of 2022, with a sharp acceleration in June 2022, when the ECB explicitly announced its intention to conclude the APP as of July 2022. It is evident from the figure that the rise in credit spreads (and the corresponding decline in the bond basis) was substantially more pronounced for ineligible bonds than for eligible ones. To the best of our knowledge, this is the first evidence documenting such a differential response. The gray dashed line in the figure plots the spread between ineligible and eligible bonds, which began to widen in December 2021 and continued to increase throughout the following year. Overall, the credit spreads of ineligible bonds rose by a peak of 146 basis points in October 2022, compared with an increase of 102 basis points for eligible bonds over the same period—resulting in a substantial gap of about 48 basis points.

Similarly, Figure 5b plots the inverse CDS-bond basis. We observe a decline in the basis that is significantly more pronounced for ineligible bonds than for eligible ones. The CDS–bond basis of ineligible bonds fell by 82 basis points through October 2022, compared with a decline of 63 basis points for eligible bonds over the same period.

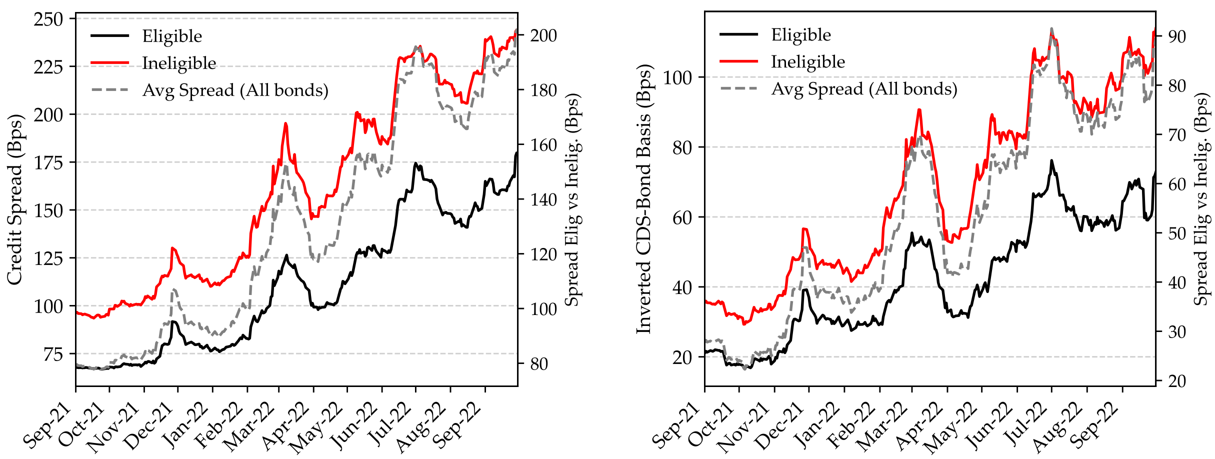
DiD We estimate the effect of QT on eligible versus ineligible bonds using the difference-in-differences specification in Equation 1. Because there is no single, well-defined announcement date, we rely on the three months in which the SMA survey indicates a substantial shift in investor expectations: December 2021, February 2022, and October 2022. For each of these dates, we run a separate DiD regression. Consistent with our baseline specification, all regressions include rating-by-maturity-by-time fixed effects. Given the uncertainty surrounding the exact timing of the tightening, we adopt a conservative approach and estimate each DiD over an extended window from 2021 through 2023.

Table IX reports the results for credit spreads, CDS spreads, and the CDS–bond basis. Across all three dates, eligible bonds exhibit a more muted increase in credit spreads following

[34] We restrict the sample to investment-grade bonds to ensure comparability of spread changes. High-yield bonds, which are ineligible, experienced even larger increases; hence, our estimates are conservative. We also compute the results including euro-denominated bonds issued by non-euro area firms, which allows us to add industry fixed effects. The results remain virtually unchanged.

Figure 5. **Credit Spread and Basis of Eligible vs Ineligible bonds during Quantitative Tightening** The figure shows the evolution of credit spreads and the CDS–bond basis for eligible and ineligible bonds around the ECB Quantitative Tightening. All variables are residualized with respect to rating and duration.

(a) Credit Spread (b) CDS-Bond Basis



QT. The estimated coefficients are negative and statistically significant, ranging from -0.14 (December 2021) to -0.25 (October 2022). This pattern indicates that, even as credit spreads widened overall, eligible bonds outperformed ineligible bonds on a relative basis.

The coefficient on the CDS–bond basis is positive, ranging from $+0.05$ (December 2021) to $+0.15$ (October 2022). For October 2022, the estimate is statistically significant, whereas the coefficients for the other two dates are not. These results indicate that, during the corporate bond sell-off over this period, eligible bonds experienced a smaller widening of the basis relative to ineligible bonds. Overall, the findings reinforce the patterns documented in Figure 5.

Mechanism and Implications These results are crucial for understanding the transmission of monetary policy. If the effects operated solely through changes in bond supply, we would expect to observe a larger increase in spreads for eligible bonds, which were more likely to be sold by the central bank. Instead, these bonds experienced a significantly smaller rise in spreads. This suggests that the ECB's *label* of eligibility fundamentally altered the market's perception of these securities. Investors continued to view eligible bonds as safer assets, and even as overall credit risk premia increased, these bonds were comparatively less affected.

The behavior observed during the QT period also provides evidence that investors expect

Table IX. **The Effect of QT on Corporate Bond Yields** This table reports estimates from equation (1) using different measures of bond yields as dependent variables. The first row in each panel presents difference-in-differences estimates capturing the price effect of the QT program. Standard errors are double-clustered at the time and issuer level.

(a) QT: January 2021 – December 2023

	(1) CS	(2) CDS	(3) Basis	(4) CS	(5) CDS	(6) Basis	(7) CS	(8) CDS	(9) Basis
Post Dec 2021 × Eligible	-0.139**	-0.094	0.045						
	(0.052)	(0.083)	(0.100)						
Post Feb 2022 × Eligible				-0.153***	-0.071	0.082			
				(0.054)	(0.079)	(0.092)			
Post Oct 2022 × Eligible							-0.245***	-0.094*	0.151**
							(0.043)	(0.051)	(0.072)
Eligible	-0.211***	0.081	0.293***	-0.211***	0.062	0.273***	-0.209***	0.055	0.264***
	(0.042)	(0.089)	(0.099)	(0.041)	(0.082)	(0.091)	(0.046)	(0.067)	(0.068)
R^2	0.51	0.54	0.27	0.51	0.54	0.28	0.51	0.54	0.28
Observations	131,944	131,944	131,944	131,944	131,944	131,944	131,944	131,944	131,944

the ECB to intervene again and repurchase these bonds in the event of adverse market conditions (Haddad et al., 2024). In this sense, the transmission mechanism appears to be highly asymmetric. When the ECB initiated its purchases, eligible bonds exhibited a strong reaction, with a significant reduction in spreads and an increase in the basis relative to ineligible bonds. One might expect that, once the ECB began to unwind its portfolio, the corporate bond market would revert to its pre-CSPP equilibrium, with eligible bonds catching up by experiencing larger increases in spreads and a decline in the basis. However, our results strongly reject this hypothesis. By purchasing these bonds—even once—the ECB appears to have altered their perceived liquidity properties, leading investors to regard them as safer assets.

B. Rebalancing

Table X presents the rebalancing behavior of different investor types. We examine portfolio adjustments starting in 2021Q3—prior to the widening of spreads—and trace their evolution over subsequent quarters. The table highlights the dynamics during the tightening phase. Notably, mutual funds do not appear to sell eligible bonds; rather, they increase their holdings of such securities. This purchasing behavior is also particularly pronounced in the case of sovereign bonds.

These findings further underscore the importance of the liquidity channel in shaping the transmission of corporate quantitative tightening and highlight the need to account for this mechanism when quantifying its effects. In the two years following the start of the tightening, mutual funds purchased approximately €46 billion of eligible bonds and €114 billion of sovereign bonds, while selling ineligible securities. The results we presented on the evolution of bond yields during the QT period imply that mutual funds with a higher share of eligible bonds would have experienced comparatively higher returns and were likely less exposed to outflows. By contrast, funds holding larger shares of ineligible bonds, which suffered more pronounced price declines, were more likely to face redemptions and forced sales of these assets.

These results also suggest that, ex ante, the decision by mutual funds to purchase relatively expensive bonds following the announcement of the CSPP was optimal. Holding these securities provided protection against outflows, as such bonds experienced smaller price declines during periods of market stress, such as the COVID-19 crisis or the subsequent tightening phase.

It is worth noting that mutual funds also increased their purchases of sovereign bonds. This pattern is consistent with the standard view that mutual funds act as elastic investors, absorbing the larger net supply as the ECB reduced and ultimately ceased its purchases. The dynamics in the sovereign bond market align closely with the evidence reported by Koijen et al. (2021). By contrast, in the corporate bond market we observe an asymmetric response: mutual funds purchased when the ECB first announced CSPP but did not sell proportionally during QT. These results suggest that the transmission mechanism of corporate bond purchases operates through channels that differ substantially from those affecting sovereign bonds. The table also shows that investors from the rest of the world increased their bond purchases alongside mutual funds. This behavior is consistent with the standard demand–elasticity mechanism, whereby foreign investors tend to sell when prices are high and purchase when prices are low.

To further corroborate our findings, we apply our difference-in-differences design and estimate equation (2) for the QT period. We use the sample from 2021Q1 to 2023Q4 and consider different post dates. Table XI reports the results using 2022Q2 as the post date. In addition, we present the results for each quarter from 2021Q4 through 2022Q4 in the Appendix (Tables F3–F7).

The difference-in-differences specification includes both holder-country-by-time and rating-by-maturity fixed effects. These fixed effects control for investor trading behavior driven by factors unrelated to ECB policies. The regression thus isolates whether, for bonds with the same credit rating and maturity, investors disproportionately buy or sell eligible relative to ineligible bonds.

We find that, in this exercise, mutual funds were slightly reducing their portfolio weight in eligible bonds. The coefficient for mutual funds is -0.06. The magnitude is about one fifth of the net positive rebalancing observed during the CSPP period (see Table V). This pattern suggests that, while these funds increased their holdings during the CSPP and PEPP phases, as discussed earlier in the paper, they did not reduce their exposure to eligible bonds proportionally once the QT phase began.

QT and Market Expectations The results in this section highlight the importance of corporate bond purchases. Once a bond is designated as eligible, it exhibits markedly different price dynamics compared to ineligible securities. Investors are aware of this distinction and tend not to sell eligible bonds even after the central bank announces the end of its purchase program. In this sense, QE and QT announcements are inherently asymmetric. Moreover, the expectation that the central bank would intervene again in the event of market stress makes these bonds more attractive to flight-sensitive investors, even when the central bank is no longer actively purchasing—or is even selling—such securities.

Market expectations were later confirmed by ECB communication. In July 2022, the ECB complemented its rate lift-off with the introduction of the new Transmission Protection Instrument (TPI), primarily focused on sovereign bonds but not excluding private-sector securities: "TPI purchases would be focused on public sector securities [...] Purchases of private sector securities could be considered, if appropriate."[35] Private-sector securities—namely, corporate bonds—were therefore explicitly acknowledged as potential targets for ECB purchases under the new program.

Furthermore, the ECB reaffirmed this stance in its monetary policy strategy assessment, concluded at the end of June: "... The primary monetary policy instrument is the set of ECB policy rates. The Governing Council may also employ other instruments, as appropriate, to steer the monetary policy stance when the policy rates are close to the lower bound or to preserve the smooth functioning of monetary policy transmission. Such instruments include longer-term refinancing operations, asset purchases, negative interest rates, and forward guidance." This communication thus reiterated that—if deemed appropriate—the ECB stands ready to purchase both sovereign and corporate bonds.

Overall, the reactions of both markets and financial intermediaries appear consistent with the ECB's communication. The evidence further highlights the importance of interpreting QE policies in a dynamic and state-contingent framework (Haddad et al., 2023, 2024). In a purely static setting, asset purchases and sales under QE and QT would be expected to have symmetric effects. In practice, however, the initial CSPP announcement had markedly

[35]The full text of the communication is available at `https://www.ecb.europa.eu/press/pr/date/2022/html/ecb.pr220721~973e6e7273.en.html`.

Table X. **Portfolio rebalancing around QT Announcement.** The table reports changes in nominal corporate bond holdings (EUR billions) during the period when the ECB started QT. For each program, portfolio rebalancing is shown over different horizons. Results are reported separately for eligible and ineligible corporate bonds as well as sovereign bonds. We also report net issuance.

	2021Q3–2022Q2			2021Q3–2022Q4		
	Eligible	Ineligible	Sovereign	Eligible	Ineligible	Sovereign
Banks	-5	1	15	-7	12	-79
ICPF	16	1	-36	17	3	-67
MF	3	-17	-1	7	-13	33
Other	5	11	1	8	27	47
ECB	57	-1	160	57	-2	121
RoW	13	7	-124	27	18	-88
Net issuance	-89	-3	-15	-109	-46	33
	2021Q3–2023Q2			**2021Q3–2023Q4**		
	Eligible	Ineligible	Sovereign	Eligible	Ineligible	Sovereign
Banks	6	17	-8	8	3	24
ICPF	20	13	-29	22	17	-4
MF	22	-9	92	46	-7	114
Other	17	48	73	29	56	118
ECB	59	-2	71	48	-2	48
RoW	40	26	152	43	14	267
Net issuance	-165	-94	-351	-196	-81	-567

different implications. The subsequent introduction of the PEPP further reinforced the effectiveness of such policies by demonstrating the scope and scale of intervention that central banks can deploy in periods of market stress.

Table XI. **The effect of corporate QT on portfolio share.** This table reports the results from estimating equation (2) for the QT period. We use athe sample window 2021Q1–2023Q4. The regression is estimated separately for five investor sectors: banks, mutual funds, insurance companies and pension funds, other domestic investors (including households and non-financial corporations), and the rest of the world (non-euro area investors, computed as the residual).

QT: 2021q1 - 2023q4 (Post Dummy: 2022q2)

	(1) Banks	(2) MF	(3) ICPF	(4) Other	(5) RoW
Post Q2 2022 × Eligible	-0.084***	-0.066***	-0.213***	0.244***	0.053
	(0.02)	(0.02)	(0.01)	(0.06)	(0.05)
Eligible	-0.532	-1.301***	-0.326	-0.542**	1.732***
	(0.37)	(0.20)	(0.20)	(0.18)	(0.39)
Holder country x Time FE	✓	✓	✓	✓	✓
Rating x Maturity FE	✓	✓	✓	✓	✓
R^2	0.31	0.17	0.21	0.12	0.11
Observations	153,127	302,466	315,957	234,022	65,140

VII. Liquidity and Fire Sales

We have shown that the announcement of the ECB's CSPP led to a significant reduction in credit spreads, primarily driven by the CDS-bond basis component. The effects are amplified in the presence of mutual funds. The effect is not reversed even in the presence of QT. We interpret these results as evidence that the ECB QE increases the perceived liquidity of eligible bonds. We now show direct evidence that the ECB announcement improved bond market liquidity and mitigated fire sales during periods of market stress.

Liquidity Measure We employ two standard indicators of bond market liquidity: the bid–ask spread and turnover. Data on turnover are sourced from *TraX*, while bid–ask spreads are obtained from *iBoxx*. The bid–ask spread is defined as the difference between the bid and ask quotes, divided by the bid price. We compute the monthly bid–ask spread by averaging the available observations within each month.

Turnover is measured as the monthly trading volume of each bond divided by its notional amount. Using granular data on ECB holdings, we also construct a measure of turnover net of ECB purchases. We apply this adjustment because the increase in trading activity from the pre- to post-CSPP period partly reflects the mechanical effect of ECB buying flows.[36]

We then estimate our baseline regression model, as defined in Equation 1, using each

[36]ECB holdings are available at quarterly frequency; we assume that purchases occur uniformly across the months within each quarter.

of the two liquidity measures as the dependent variable. Both variables are expressed in percentage points.[37] The results are presented in Table XII. All specifications include rating-by-maturity-by-time fixed effects.

Column (1) reports the results for the bid–ask spread. The CSPP announcement reduced bid–ask spreads for eligible bonds by approximately 0.038 basis points. For comparison, the median pre-announcement bid–ask spread was 0.44 basis points (see Table I). The effect is both statistically and economically meaningful, representing roughly 8.5% of the pre-announcement median. Note that the bid–ask spread regression is estimated on the sample of bonds covered by iBoxx. Taken together, these results indicate that the CSPP announcement materially improved corporate bond market liquidity through a reduction in bid–ask spreads.

We also use turnover as an additional proxy for bond liquidity. The results reported in columns (2) and (3) of Table XII indicate a further improvement in liquidity. Column (2) uses the turnover measure directly from *TraX*, while Column (3) relies on turnover net of ECB purchases. We find a baseline estimate of 44 basis points in the first specification and a slightly lower value of 32 basis points in the second. The median trading volume amounts to 1.3% for eligible bonds (see Table I). Overall, the results for this second measure are also statistically and economically significant, reinforcing the conclusion that the CSPP enhanced bond market liquidity.

Taken together, these results indicate that bond market liquidity improved following the policy announcement. The bid-ask spread and turnover reflect the ease of trading under normal market conditions. However, as discussed earlier, such policies are also expected to mitigate fire-sale dynamics during episodes of market stress. The COVID-19 crisis provides a natural laboratory to study this mechanism, as it was characterized by a sharp deterioration in market liquidity and a widening of credit spreads. We exploit the unfolding of the COVID crisis—and the sequence of ECB interventions that followed—to examine fire-sale dynamics and evaluate the extent to which the ECB's *conditional promises* of market support were respected.

Fire Sales. We now examine the behavior of eligible and ineligible bonds at a daily frequency during the COVID—19 crisis. To construct comparable measures of credit spreads and the CDS–bond basis across the two groups, we control for observable bond characteristics such as rating and duration using the same procedure described in Section 6.

The results are presented in Figure 6. Figure 6a depicts the evolution of credit spreads in the period surrounding the PEPP announcement for eligible (in black) and ineligible (in red) bonds.

[37]We trim observations in the bottom 1 and top 1 percentiles of each liquidity measure.

Table XII. **The Effect of Corporate QE on Corporate Bond Liquidity** This table reports estimates from equation (1) using different measures of bond liquidity as dependent variables. The first row in each panel presents difference-in-differences estimates capturing the price effect of the respective corporate QE program. Columns 1 to 3 show the results for Bid-Ask under different set of fixed effects. Column 4 to 6 show the results for turnover under different set of fixed effects. Standard errors are double-clustered at the time and issuer level.

(a) CSPP: September 2015 – September 2016

	(1)	(2)	(3)
	Bid-ask	Turnover	Turnover (Net of ECB)
Post × Eligible	-0.038***	0.441***	0.323**
	(0.012)	(0.141)	(0.140)
Post			
Eligible	0.087***	-0.575**	-0.537**
	(0.020)	(0.200)	(0.193)
Rating x Maturity x Time FE	✓	✓	✓
R^2	0.67	0.06	0.06
Observations	6,342	9,128	9,128

It is evident that the credit spreads of ineligible bonds increased substantially more than those of eligible bonds, *before* the announcement. The spread between eligible and ineligible bonds (gray dashed line) began to widen at the end of February, roughly three weeks before the announcement of the PEPP.

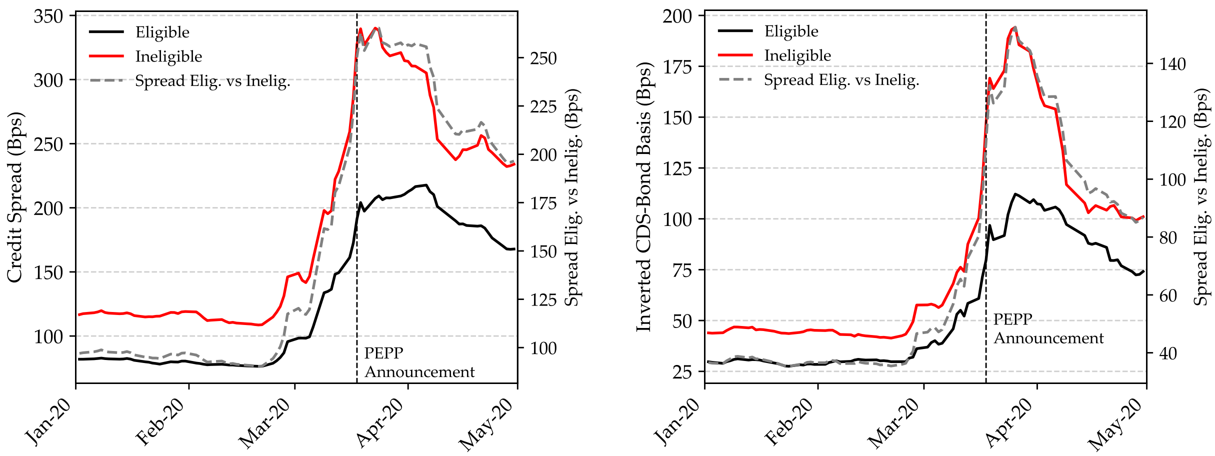
The increase in credit spreads for ineligible bonds amounted to 191 basis points, compared with 128 basis points for eligible bonds, indicating a sizable gap of 63 basis points, which is approximately 30% of the total increase in spreads registered by ineligible bonds. Importantly, this difference arises after controlling for rating and duration fixed effects.

Given a median duration of approximately five years, we find that, for bonds with comparable duration and credit rating, ineligible bonds experienced an additional drawdown of roughly 3%, relative to a total drawdown of 9.1% for ineligible bonds overall.footnoteThe drawdown measures the decline in an investment's value from its peak to a subsequent trough, expressed as a percentage. This represents a material difference in performance during the crisis period. The significant difference in drawdowns indicates that eligible bonds are substantially safer than ineligible bonds, conditional on observable characteristics.

Figure 6b plots the inverse CDS-bond basis for eligible and ineligible bonds (the average basis is negative), so that an upward movement in the figure corresponds to a reduction in the basis. The bond basis is residualized using the same set of fixed effects as for the credit spread analysis. As with credit spreads, there is a pronounced gap in the evolution of the basis during the COVID-19 crisis. For ineligible bonds, the basis decreased by 140 basis

Figure 6. **Credit Spread and Convenience Yields of Eligible vs Ineligible bonds during Covid Crisis** The figure shows the evolution of credit spreads and the CDS–bond basis for eligible and ineligible bonds around the PEPP announcement. All variables are residualized with respect to rating and duration.

(a) Credit Spread (b) CDS-Bond Basis



points, compared with a smaller decline of 81 basis points for eligible bonds. These results suggest that market conditions for eligible bonds deteriorated less than for ineligible bonds, *even before the announcement*, consistent with the interpretation that eligible securities were less affected by fire-sale dynamics during the crisis.

The results presented in this section show that the ECB's corporate bond purchases improved market liquidity and mitigated fire-sale dynamics in corporate bond markets. These effects are particularly valuable for mutual funds, which trade more frequently and may be forced to liquidate assets when facing outflows. As Coppola (2021) document, such outflows tend to intensify during recessions, leading mutual funds to sell corporate bonds at depressed prices—unlike insurance companies, whose funding is more stable. This mechanism helps explain why mutual funds rebalanced toward eligible bonds (Section 4). The improvement in liquidity and the reduction in fire-sale risk are therefore priced into bond valuations. As shown in Section 3, the price effects operate primarily through the CDS-bond basis. This measure captures liquidity conditions and typically declines during recessions, when corporate bond spreads widen more than CDS spreads, raising the perceived riskiness of these securities. It is thus natural that an increase in demand for eligible corporate bonds would be reflected in the announcement effects we document.

VIII. Alternative Channels

We propose a liquidity channel as the primary mechanism driving mutual funds' portfolio rebalancing. While several alternative explanations could, in principle, account for the observed patterns, we find these alternatives unconvincing. In what follows, we discuss each potential channel in turn and explain why both our empirical evidence and existing findings in the literature suggest that they are unlikely to play a dominant role.

One potential mechanism is that mutual funds purchased bonds in anticipation of selling them to the ECB once prices increased following the start of purchases.

First, although we find that mutual funds increased their purchases of eligible bonds after the announcement, there is no evidence that they subsequently sold these bonds once the ECB began its purchases.

We then examines who held the specific corporate bonds (ISINs) that the ECB later purchased, both before and after the start of purchases. In this analysis, we exploit granular information on the ECB's holdings. Figure 7 displays the investor composition of the corporate bonds included in the ECB's portfolio at the end of 2016Q3 (i.e., after one quarter of purchases). The pie charts show that almost every sector reduced its share of these bonds to accommodate the roughly 6% of the amount outstanding purchased by the ECB by that time. The mutual fund sector is the only exception, increasing its share by about one percentage point. This pattern alleviates concerns that mutual funds may have attempted to "front-run" the ECB by purchasing large quantities of eligible bonds before the programme officially began, only to sell them back shortly thereafter. In such a scenario, we would have observed mutual funds reducing their holdings of eligible bonds after purchases commenced.

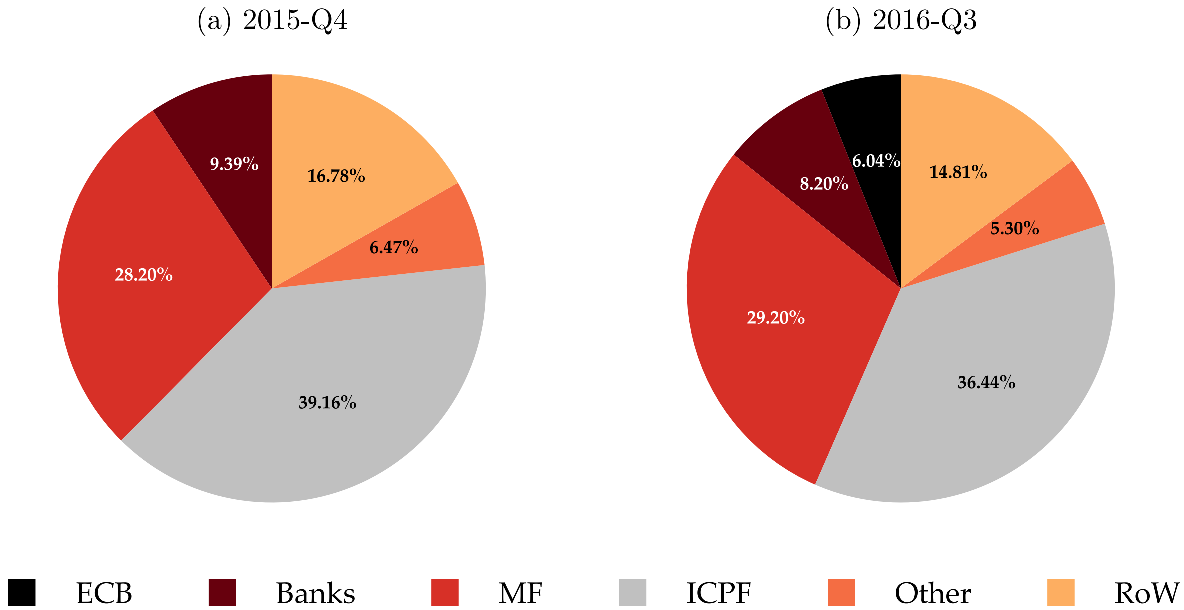
Since bond prices increased immediately after the announcement, these securities were already expensive and offered low yields by the end of 2016Q3. This suggests that mutual funds, typically viewed as relatively elastic investors, were nonetheless willing to continue holding bonds that had become more expensive.

Table V reports a consistent pattern. Between 2015Q4 and 2016Q2, mutual funds increased their holdings of eligible bonds by approximately €21 billion, and this position remained virtually unchanged by the end of 2016Q4, indicating that they did not sell these bonds to the ECB.

Finally, we find that mutual funds with more volatile capital flows were those most actively purchasing eligible bonds. If the primary motive was simply to front-run the ECB, it is not clear why investors facing higher redemption risk would be the ones accumulating these positions.

Another potential transmission channel operates through mutual fund flows, as docu-

Figure 7. **Holder composition of ECB-purchased corporate bonds.** These pie charts illustrate which investor sectors held ECB-purchased bonds before the CSPP announcement (i.e., in 2015q4) and after (2016q3) purchases had started. The sample consists only of ISINs that the ECB had purchased under the CSPP by the end of 2016q3, i.e., after one quarter of purchases. Holding shares are obtained by dividing the nominal value held by the total outstanding amount.



mented by Fang (2023); Fang and Xiao (2025). Such flows may account for part of the observed price effects via price pressure. However, in our portfolio rebalancing analysis, we find that mutual funds increased their holdings of eligible bonds relative to ineligible bonds. This represents a *within*-fund rebalancing, which cannot be explained solely by fund-level inflows or outflows. Instead, mutual funds appear to have reallocated toward eligible bonds, likely reflecting their improved liquidity following the CSPP announcement.

Another possible explanation relates to bond supply. If firms whose bonds are typically held by mutual funds were more likely to issue new debt, and mutual funds simply purchased these new issues, this could mechanically increase their ownership of eligible bonds. However, this explanation is unlikely. Our rebalancing effects emerge within one quarter after the announcement, whereas De Santis and Zaghini (2021) document that it took at least six months for the increase in bond issuance by eligible firms to materialize.

Taken together, the evidence suggests that, although alternative mechanisms may have contributed to the observed patterns, the liquidity channel provides the most coherent explanation across all empirical findings.

IX. Conclusion

This paper has examined the transmission of the ECB's corporate bond purchase programs, highlighting the central role of conditional policy promises in shaping investor behavior and bond market outcomes. Using granular data on prices and holdings, we provide new evidence that the main channel of transmission operates through changes in the perceived liquidity services provided by eligible bonds rather than through default risk.

Our analysis shows that announcement effects were both immediate and persistent. Credit spreads of eligible bonds declined sharply following the CSPP and PEPP announcements, with the bulk of the adjustment explained by movements in the CDS-bond basis. This finding indicates that QE policies enhanced the convenience yield of targeted bonds, reducing the compensation investors required for holding securities exposed to liquidity and fire-sale risk. The results confirm that policy announcements themselves—rather than the gradual implementation of purchases—were the key driver of transmission.

Portfolio rebalancing further underscores the role of heterogeneous investors. Mutual funds, which are especially vulnerable to funding outflows in downturns, valued the "liquidity insurance" component of QE the most. They not only increased their holdings of eligible bonds but did so by reallocating away from sovereign and liquid assets, demonstrating that they viewed targeted corporate bonds as close substitutes for safe assets. Bonds with higher mutual fund ownership experienced disproportionately larger spread declines, confirming that intermediary composition is a critical determinant of policy effectiveness.

Taken together, these results highlight three broad lessons. First, corporate QE should be understood not merely as a supply shock, but as a policy that changes the perceived characteristics of assets by providing state-contingent insurance. Second, heterogeneity in investor bases amplifies these effects, with fragile intermediaries playing a pivotal role. Finally, the effectiveness of future interventions will depend less on the size of announced purchases and more on the extent to which they exceed investor expectations and alter convenience yields.

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I. Model

n this section, we present an asset pricing model similar to that in Corell et al. (2025), in which investors value financial assets not only for their cash flows but also for the service flows they provide. We generalize their approach to accommodate market segmentation. The model is in reduced form and does not directly model liquidity needs. Many models in the literature generate similar predictions, so ours serves as a catch-all framework. Our goal is to characterize optimal portfolio allocation and equilibrium convenience yields, and to study shocks to asset-specific service flows, which we map to QE shocks in the empirical section.

The key insight is that liquidity is one of the primary drivers of the relative convenience yields between Treasuries and corporate bonds. In the model, the CDS-bond basis maps to this relative convenience, making it our price instrument for understanding how the ECB affects the liquidity of eligible versus ineligible bonds.

A. Setup

Consider a market with N risky assets indexed by $n \in \{1, \dots, N\}$ and a continuum of heterogeneous investors i. Investors differ in their risk tolerance and in how strongly they value service benefits from holding assets.

Investor i chooses portfolio weights $x_{it} \in \mathbb{R}^N$, defined as risky holdings relative to total wealth. The mean–variance problem is

$$\max_{x_{it}} \, (\boldsymbol{\mu}_t + Z_t \boldsymbol{\lambda}_{it})^\top \boldsymbol{x}_{it} - \frac{a_{it}}{2} \, \boldsymbol{x}_{it}^\top \Sigma_t \boldsymbol{x}_{it},$$

where $a_{it} > 0$ is the mean–variance risk aversion, $\boldsymbol{\mu}_t$ is the $N \times 1$ vector of expected excess returns, and Σ_t is the $N \times N$ positive definite covariance matrix. We represent asset-specific characteristics associated with service flows by Z_t, an $N \times K$ matrix that stores the quantity of each of the K services that may provide investors with utility beyond expected returns. Investors value these services differently, with loadings $\boldsymbol{\lambda}_{it}$, a $K \times 1$ vector. Throughout, we refer to Z_t as *services*, and $\boldsymbol{\lambda}_{it}$ investor i's preference for them.

B. Optimal Portfolio Allocation and Expected Returns

The first–order condition on investor portfolio optimization implies

$$\boldsymbol{x}_{it} = \frac{1}{a_{it}} \Sigma_t^{-1} \big(\boldsymbol{\mu}_t + Z_t \boldsymbol{\lambda}_{it} \big). \tag{7}$$

Let w_{it} be investor i's wealth, $w_t = \int_0^1 w_{it}\, di$ total wealth, and $\tilde{w}_{it} = w_{it}/w_t$ the wealth share. Define the wealth-weighted average risk tolerance and the corresponding average service taste

$$\bar{a}^{-1} := \int_0^1 \frac{1}{a_{it}} \tilde{w}_{it}\, di, \qquad \bar{\boldsymbol{\lambda}}_t := \frac{\int_0^1 \frac{1}{a_{it}} \tilde{w}_{it} \boldsymbol{\lambda}_{it}\, di}{\bar{a}^{-1}}. \tag{8}$$

Let $\boldsymbol{x}_{mt}$ be the market portfolio of risky assets. Market cleaning ensures that

$$\boldsymbol{x}_{mt} = \int_0^1 \tilde{w}_{it} \boldsymbol{x}_{it}\, di$$

Aggregating (7) yields

$$\boldsymbol{x}_{mt} = \bar{a}^{-1} \Sigma_t^{-1} \big(\boldsymbol{\mu}_t + Z_t \bar{\boldsymbol{\lambda}}_t \big) \tag{9}$$

We can then solve for the equilibrium implied expected return, expressed as a function of current prices:

$$\boldsymbol{\mu}_t = \bar{a}\, \Sigma_t \boldsymbol{x}_{mt} - \boldsymbol{cy}_t, \tag{10}$$

where $\boldsymbol{cy}_t = Z_t \bar{\boldsymbol{\lambda}}_t$ is the *convenience yield*. The first term on the right-hand side is the standard equilibrium expected excess return in an economy where investors do not derive utility from services. The second term, the convenience yield, reflects characteristics such as liquidity, hedging value, or collateral use, whose utility may vary across investors.

Substituting (10) into (7), we obtain the holdings of an individual investor i:

$$\boldsymbol{x}_{it} = \frac{\bar{a}}{a_{it}} \boldsymbol{x}_{mt} \; + \; \frac{1}{a_{it}} \Sigma_t^{-1} Z_t \, (\boldsymbol{\lambda}_{it} - \bar{\boldsymbol{\lambda}} v_t). \tag{11}$$

The first term represents a proportional holding of the market portfolio. In the absence of services, the standard two-fund separation holds, and investors differ only in how much of the market portfolio they hold, with the proportion determined by their risk aversion. The second term is an investor-specific tilt that captures whether an investor values services more or less than the average investor.

C. Predictions

Based on the setup, we state a set of propositions that guide the empirical analysis. Proofs for all propositions are provided in Appendix B. In the propositions, we use the term *policy* to denote an exogenous change to the system—such as one induced by central bank actions—to draw a direct link to the empirical results. The results, however, apply to any exogenous change.

Let $\boldsymbol{z}^k$ be the k-th column of matrix Z_t, and $z^k(n)$ be the n-th element of this vector.

Proposition 1 (Service shock and equilibrium returns)**.** *If a policy increases the service flow k of asset n (raising $z^k(n)$), the convenience yield on that asset unambiguously rises. The effect on its expected excess return $\mu(n)$ is ambiguous in equilibrium, since it depends on how the aggregate market portfolio $\boldsymbol{x}_{mt}$ adjusts in response.*

Proposition 2 (Rebalancing toward valued services)**.** *Suppose all investors have the same risk-aversion coefficient. If the service k of asset n increases, then investors with above-average λ_{it}^k tilt their portfolios toward n, while those with below-average λ_{it}^k tilt away.*

D. Market Segmentation

We now introduce market segmentation. We assume investors can only invest in a pre-specified subset of assets. This can be interpreted as an investment mandate in Koijen and Yogo (2019). Suppose each investor i can only hold assets in a subset represented by the selection matrix S_i. Specifically, let M_i be the number of assets in investor i's universe, S_i is then an $N \times M_i$ matrix that selects the relevant covariance structure, and the weights on the other assets are zero. Investors' problem is given by

$$\max_{x \in \operatorname{span}(S_i)} \; (\mu_t + Z_t \boldsymbol{\lambda}_{it})^\top \boldsymbol{x}_{it} - \frac{a_i}{2}\, \boldsymbol{x}_{it}^\top \Sigma_t \boldsymbol{x}_{it}.$$

The optimal portfolio choice is

$$\boldsymbol{x}_{it} = \frac{1}{a_i}\, (\Sigma_t^i)^{-1} \big(\boldsymbol{\mu}_t + Z_t \boldsymbol{\lambda}_{it}\big), \tag{12}$$

where Σ_t^i is the variance–covariance matrix that incorporates the restriction that allocations are limited to assets within the investment mandate.[38]

The market-clearing condition is

$$\boldsymbol{x}_{mt} = \underbrace{\int_i \tilde{w}_i \frac{1}{a_i} (\Sigma_t^i)^{-1}}_{\overline{\Sigma}_t} \boldsymbol{\mu}_t + \underbrace{\int_i \tilde{w}_i \frac{1}{a_i} (\Sigma_t^i)^{-1}\, Z_t \boldsymbol{\lambda}_{it},}_{\Pi_t} \tag{13}$$

where $\tilde{w}_i$ denotes investor i's wealth share (as defined above).

[38] Formally, $(\Sigma_t^i)^{-1} = S_i\, (S_i^\top \Sigma_t S_i)^{-1} S_i^\top$.

Equilibrium expected returns can be expressed in the same form as in equation 10:

$$\boldsymbol{\mu}_t = (\overline{\Sigma}_t)^{-1}\boldsymbol{x}_{mt} - \boldsymbol{cy}_{\boldsymbol{y}}, \text{ where } \boldsymbol{cy}_t := (\overline{\Sigma}_t)^{-1}\Pi_t, \tag{14}$$

where $\overline{\Sigma}_t$ summarizes the aggregate risk-bearing capacity of investors, capturing how wealth shares and risk tolerances interact with investment mandates, and $\boldsymbol{cy}_t$ represents equilibrium convenience yield, which aggregates demand for services, weighted by both risk tolerance and portfolio restrictions.

In the following sections, we present empirical results guided by the model and its propositions. At the beginning of each section, we restate the propositions under study and explain how the model informs the interpretation of the findings. We proxy the convenience yield in Equation 11 with the CDS-bond basis, which captures the relative yield investors are willing to forego in order to hold a bond. Several factors contribute to the convenience yield, including collateral value, regulatory constraints, and liquidity. Our focus is on how central bank commitments affect the service value of corporate bonds. As emphasized in the literature, these commitments primarily influence bond safety and liquidity, which are the key non-pecuniary services shaped by policy.

E. Predictions (Segmented Market)

Proposition 3 (Service shock under segmentation)**.** *If a policy increases the service flow k of asset n (raising $z^k(n)$), the convenience yield on that asset unambiguously increases. The strength of this increase depends on the composition of the investor segment: the effect is larger when a greater share of investors that are allowed to hold asset n place a higher value on service k.*

II. Appendix: Proofs

A. Proofs

Proof of Proposition 1. Let e_n denote the n-th unit vector. By definition of the convenience yield,

$$\boldsymbol{cy}_t \;=\; Z_t\,\bar{\boldsymbol{\lambda}}_t \qquad \Longrightarrow \qquad cy_t(n) \;=\; \sum_{j=1}^{K} z^j(n)\,\bar{\lambda}_t^j.$$

Hence, for a change in the k-th service of asset n,

$$\frac{\partial\, cy_t(n)}{\partial z^k(n)} \;=\; \bar{\lambda}_t^k.$$

Because service k is valued in the aggregate (i.e., $\bar{\lambda}_t^k > 0$), the convenience yield on asset n rises when $z^k(n)$ increases.

For expected excess returns, equilibrium implies

$$\boldsymbol{\mu}_t \;=\; \bar{a}\, \Sigma_t\, \boldsymbol{x}_{mt} \;-\; \boldsymbol{cy}_t.$$

Differentiating the n-th component with respect to $z^k(n)$ yields

$$\frac{\partial\, \mu_t(n)}{\partial z^k(n)} \;=\; \bar{a}\, e_n^\top \Sigma_t\, \frac{\partial \boldsymbol{x}_{mt}}{\partial z^k(n)} \;-\; \frac{\partial\, cy_t(n)}{\partial z^k(n)} \;=\; \bar{a}\, e_n^\top \Sigma_t\, \frac{\partial \boldsymbol{x}_{mt}}{\partial z^k(n)} \;-\; \bar{\lambda}_t^k.$$

The second term is negative for a positive service shock, while the first term depends on the general-equilibrium rebalancing of the market portfolio $\boldsymbol{x}_{mt}$ induced by price changes. Its sign cannot be determined without additional assumptions on how the market portfolio adjusts. Therefore, the net effect on $\mu_t(n)$ is ambiguous. $\square$

Proof of Proposition 2. Assume identical risk aversion $a_{it} \equiv a$, so $\bar{a} = a$. From (11),

$$\boldsymbol{x}_{it} = \boldsymbol{x}_{mt} + \frac{1}{a}\, \Sigma_t^{-1} Z_t \left(\boldsymbol{\lambda}_{it} - \bar{\boldsymbol{\lambda}}_t\right).$$

Define investor i's *tilt* relative to the market portfolio:

$$\boldsymbol{\tau}_{it} := \boldsymbol{x}_{it} - \boldsymbol{x}_{mt} = \frac{1}{a}\, \Sigma_t^{-1} Z_t \left(\boldsymbol{\lambda}_{it} - \bar{\boldsymbol{\lambda}}_t\right).$$

Let e_n be the n-th unit vector. A marginal increase in the k-th service of asset n changes only the (n,k) entry of Z_t, so

$$\frac{\partial\, \boldsymbol{\tau}_{it}}{\partial z^k(n)} = \frac{1}{a}\, \Sigma_t^{-1} \left(e_n e_k^\top\right) \left(\boldsymbol{\lambda}_{it} - \bar{\boldsymbol{\lambda}}_t\right) = \frac{1}{a} \left(\Sigma_t^{-1} e_n\right) \left(\lambda_{it}^k - \bar{\lambda}_t^k\right).$$

Taking the n-th component,

$$\frac{\partial\, \tau_{it}(n)}{\partial z^k(n)} = \frac{1}{a}\, e_n^\top \Sigma_t^{-1} e_n \left(\lambda_{it}^k - \bar{\lambda}_t^k\right) = \frac{1}{a}\, [\Sigma_t^{-1}]_{nn} \left(\lambda_{it}^k - \bar{\lambda}_t^k\right).$$

Because Σ_t is positive definite, $[\Sigma_t^{-1}]_{nn} > 0$ and $a > 0$. Hence the sign of the change in investor i's position in asset n equals the sign of $\lambda_{it}^k - \bar{\lambda}_t^k$: if $\lambda_{it}^k > \bar{\lambda}_t^k$, the tilt in n increases (tilt toward n); if $\lambda_{it}^k < \bar{\lambda}_t^k$, it decreases (tilt away from n). This proves the proposition. $\square$

Proof of Proposition 3. From (13), define

$$\overline{\Sigma}_t \;:=\; \int_i \tilde{w}_i\, \frac{1}{a_i} (\Sigma_t^i)^{-1}, \qquad \Pi_t \;:=\; \int_i \tilde{w}_i\, \frac{1}{a_i} (\Sigma_t^i)^{-1} Z_t \boldsymbol{\lambda}_{it}.$$

Equilibrium expected returns are given by (14):

$$\boldsymbol{\mu}_t \;=\; (\overline{\Sigma}_t)^{-1} \boldsymbol{x}_{mt} - \boldsymbol{cy}_t, \qquad \boldsymbol{cy}_t \;:=\; (\overline{\Sigma}_t)^{-1} \Pi_t.$$

Note that $\overline{\Sigma}_t$ depends on (Σ_t^i) and not on Z_t, so it is *constant* with respect to a service shock.

Consider a marginal increase in the k-th service of asset n, i.e. in the (n, k) entry of Z_t. Since only that entry of Z_t changes, we have

$$\frac{\partial \Pi_t}{\partial z^k(n)} = \int_i \tilde{w}_i\, \frac{1}{a_i}\, (\Sigma_t^i)^{-1} \left(e_n e_k^\top\right) \boldsymbol{\lambda}_{it} = \int_i \tilde{w}_i\, \frac{1}{a_i}\, (\Sigma_t^i)^{-1} e_n\, \lambda_{it}^k.$$

Because $\overline{\Sigma}_t$ is fixed with respect to $z^k(n)$,

$$\frac{\partial \boldsymbol{cy}_t}{\partial z^k(n)} = (\overline{\Sigma}_t)^{-1}\, \frac{\partial \Pi_t}{\partial z^k(n)} = \sum_i \tilde{w}_i\, \frac{1}{a_i}\, (\overline{\Sigma}_t)^{-1} (\Sigma_t^i)^{-1} e_n\, \lambda_{it}^k.$$

Taking the n-th component and writing $[\cdot]_n$ for the n-th entry,

$$\frac{\partial\, cy_t(n)}{\partial z^k(n)} = \sum_i \tilde{w}_i\, \frac{1}{a_i}\, e_n^\top (\overline{\Sigma}_t)^{-1} (\Sigma_t^i)^{-1} e_n\, \lambda_{it}^k \;=\; \sum_i \omega_i^n\, \lambda_{it}^k,$$

where

$$\omega_i^n \;:=\; \tilde{w}_i\, \frac{1}{a_i}\, e_n^\top (\overline{\Sigma}_t)^{-1} (\Sigma_t^i)^{-1} e_n \;\geq 0.$$

Indeed, for investors who *cannot* hold asset n, $(\Sigma_t^i)^{-1}e_n = \mathbf{0}$ so $\omega_i^n = 0$; for those who can, write

$$\omega_i^n/(\tilde{w}_i/a_i) = \left((\Sigma_t^i)^{-1/2}e_n\right)^\top \left((\Sigma_t^i)^{-1/2}(\overline{\Sigma}_t)^{-1}(\Sigma_t^i)^{-1/2}\right)\left((\Sigma_t^i)^{-1/2}e_n\right) \geq 0,$$

since $(\overline{\Sigma}_t)^{-1}$ is positive definite.

Hence

$$\frac{\partial\, cy_t(n)}{\partial z^k(n)} \;=\; \sum_{i\in\mathcal{S}_n} \omega_i^n\, \lambda_{it}^k \;\geq\; 0,$$

with strict inequality whenever at least one investor in the segment that is allowed to hold asset n has $\lambda_{it}^k > 0$ and $\omega_i^n > 0$. Therefore, the convenience yield on asset n increases when $z^k(n)$ rises.

Moreover, the strength of this increase is

$$\text{(marginal effect)} \;=\; \sum_{i\in\mathcal{S}_n} \omega_i^n\, \lambda_{it}^k,$$

a wealth- and risk-tolerance–weighted aggregation over precisely those investors who *can* hold n. It is monotone in each λ_{it}^k and in the segment weights $\tilde{w}_i/a_i$. Therefore, the effect is larger when a greater share of the investors authorized to hold asset n place a higher value on service k of asset n. □

Proof of Proposition 3. From (14),

$$\boldsymbol{cy}_t = (\overline{\Sigma}_t)^{-1}\Pi_t, \qquad \Pi_t = \int \tilde{w}_i \tfrac{1}{a_i}(\Sigma_t^i)^{-1} Z_t \boldsymbol{\lambda}_{it}\, di,$$

where $\lambda_{it}^{(k)}$ denotes the k-th component of the vector $\boldsymbol{\lambda}_{it}$.

Since $\overline{\Sigma}_t$ does not depend on Z_t, only Π_t responds to a service shock. For a marginal increase in $z^k(n)$,

$$\frac{\partial cy_t(n)}{\partial z^k(n)} = \int \tilde{w}_i \tfrac{1}{a_i}\, e_n^\top (\overline{\Sigma}_t)^{-1}(\Sigma_t^i)^{-1} e_n\, \lambda_{it}^{(k)}\, di.$$

Define the weight

$$\omega_i^n := \tilde{w}_i \tfrac{1}{a_i}\, e_n^\top (\overline{\Sigma}_t)^{-1}(\Sigma_t^i)^{-1} e_n.$$

Because both $(\overline{\Sigma}_t)^{-1}$ and $(\Sigma_t^i)^{-1}$ are positive definite, the quadratic form $e_n^\top(\overline{\Sigma}_t)^{-1}(\Sigma_t^i)^{-1}e_n$

is nonnegative, hence $\omega_i^n \geq 0$, with equality if i cannot hold n.

Therefore,

$$\frac{\partial cy_t(n)}{\partial z^k(n)} = \int_{\mathcal{S}_n} \omega_i^n \, \lambda_{it}^{(k)} \, di \; \geq 0,$$

strictly positive whenever some investor in $\mathcal{S}_n$ values service k. The magnitude of the effect is larger when a greater share of the investors that can hold asset n place a higher value on service k. □

B. Additional Propositions

Proposition 4 (Supply shock and inverse demand)**.** *A reduction in the supply of asset n increases its price and lowers its expected return. The effect is stronger when investors are more inelastic. More elastic investors reduce their holdings more strongly in response.*

Proof of Proposition 4. From (10), equilibrium expected returns are

$$\boldsymbol{\mu}_t = \bar{a} \, \Sigma_t \boldsymbol{x}_{mt} - \boldsymbol{c}\boldsymbol{y}_t,$$

where $\boldsymbol{x}_{mt}$ is the market portfolio, fixed by asset supplies.

Consider a marginal reduction in the supply of asset n, i.e. a decrease in $x_{mt}(n)$. Because $\bar{a} > 0$ and $\Sigma_t \succ 0$, we have

$$\frac{\partial \mu_t(n)}{\partial x_{mt}(n)} = \bar{a} \, \Sigma_{nn} > 0.$$

Thus lowering $x_{mt}(n)$ reduces $\mu_t(n)$, i.e. it raises the price of asset n.

The magnitude of the effect is proportional to $\bar{a}$, the wealth-weighted average risk tolerance: if investors are more inelastic (smaller risk tolerance $1/a_{it}$), then $\bar{a}$ is larger and the response of expected returns to supply is stronger.

Finally, from (11), individual holdings adjust according to

$$x_{it}(n) = \tfrac{\bar{a}}{a_{it}} \, x_{mt}(n) + \cdots ,$$

so investors with higher elasticity ($1/a_{it}$ larger) reduce their holdings more strongly when supply falls. □

Proposition 5 (Supply shock under segmentation)**.** *If the supply of asset n increases while services remain fixed, the expected return on n rises. The magnitude of this effect depends on how elastic the group of investors who can hold asset n is. If only a few or very risk-averse (inelastic) investors are allowed to hold it, the price impact is large.*

Proof of Proposition 5. From (14), equilibrium expected returns satisfy

$$\boldsymbol{\mu}_t = (\overline{\Sigma}_t)^{-1}\boldsymbol{x}_{mt} - \boldsymbol{c}\boldsymbol{y}_t,$$

with $\overline{\Sigma}_t = \int \tilde{w}_i \frac{1}{a_i}(\Sigma_t^i)^{-1}\, di$ and $\boldsymbol{c}\boldsymbol{y}_t = (\overline{\Sigma}_t)^{-1}\Pi_t$.

Since $\boldsymbol{c}\boldsymbol{y}_t$ does not depend on supplies $\boldsymbol{x}_{mt}$, a change in supply affects expected returns through the first term. Differentiating with respect to $x_{mt}(n)$,

$$\frac{\partial \boldsymbol{\mu}_t}{\partial x_{mt}(n)} = (\overline{\Sigma}_t)^{-1}e_n, \qquad \frac{\partial \mu_t(n)}{\partial x_{mt}(n)} = e_n^\top (\overline{\Sigma}_t)^{-1}e_n \;>\; 0.$$

Thus, when the supply of asset n increases, $\mu_t(n)$ rises and its price falls. The slope of this inverse demand curve is $e_n^\top(\overline{\Sigma}_t)^{-1}e_n$, which depends on the aggregate risk-bearing capacity of those investors who can hold n. If only a few investors are in the segment for n, or if they have high risk aversion (low elasticity), then $\overline{\Sigma}_t$ places less weight on them and $(\overline{\Sigma}_t)^{-1}$ amplifies the effect. Hence the price impact is larger when the relevant segment is small or inelastic. □

III. Appendix: Effects on Prices

A. High-Frequency Identification, CSDB Sample

Figure C.1 shows the evolution of average credit spreads around the announcement of the CSPP and PEPP, separately for eligible and ineligible corporate bonds.

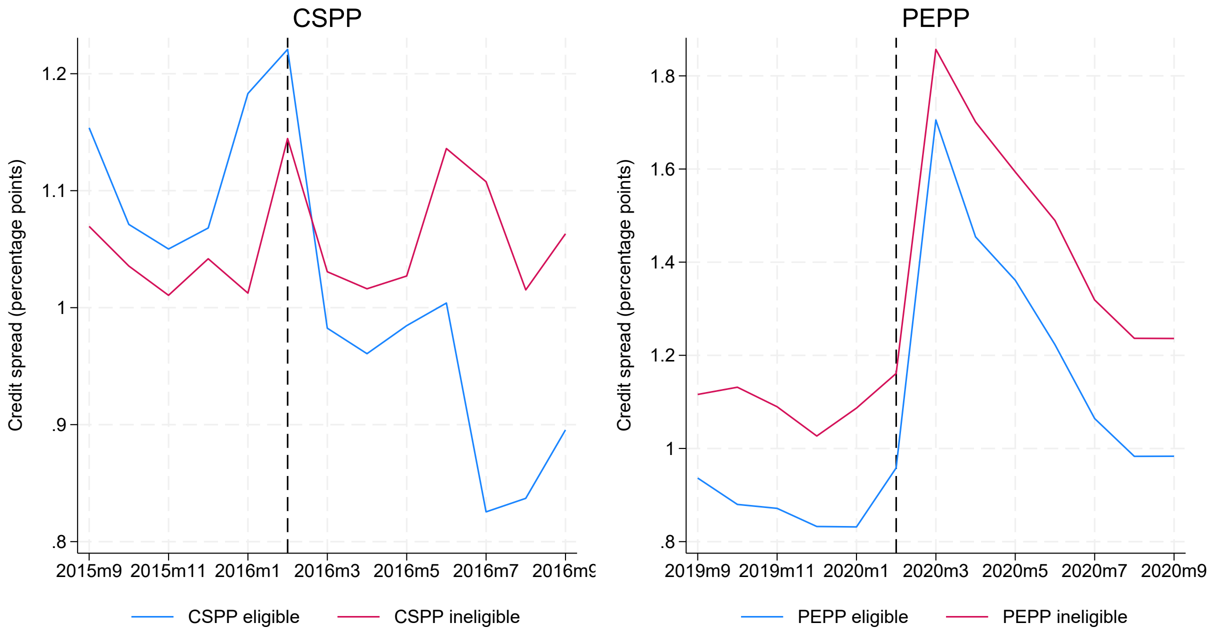


Figure C.1. **Average credit spreads around CSPP and PEPP announcement dates.** This plot illustrates the average credit spreads of QE-eligible (blue) and QE-ineligible (pink) corporate bonds around the announcement dates of the CSPP (March 2016) and PEPP (March 2020).

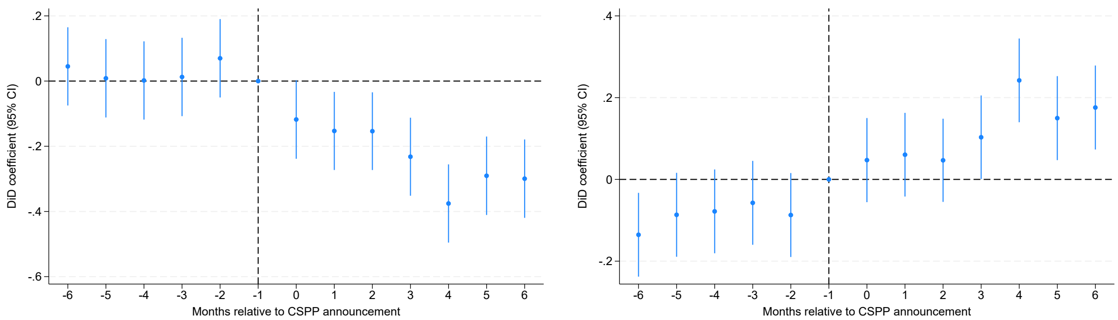
The time period included in this plot is the same as in the baseline specification — six months before and six months after the announcement of the purchase program. From the time series plots, it becomes obvious that after the announcement of the CSPP the decrease in spreads was significantly larger for eligible bonds relative to ineligible bonds. Similarly, around the announcement of the PEPP the spike in spreads was larger for ineligible bonds relative to the eligible ones. In the results that follow, we identify the impact of the two programs in a more robust way, as we control for bond and firm characteristics.

B. Parallel Trend

Next, to assess the validity of the parallel trends assumption and provide evidence of the dynamic impact of both ECB packages for different time periods, we set up a Granger causality test, as suggested in Angrist and Pischke (2009). The goal is to check whether causes happen before consequences and not the opposite. To do this, we split the *Post* dummy into monthly dummies and run the following specification:

$$y_t(n) = \sum_{\tau} \theta_{0,\tau} \times \mathbb{1}_{\tau=t} \times Eligible_t(n) + \alpha_{R\times M} + \alpha_t + \epsilon_t(n) \tag{15}$$

(a) CSPP: September 2015 – September 2016



(b) PEPP: September 2019 – September 2020

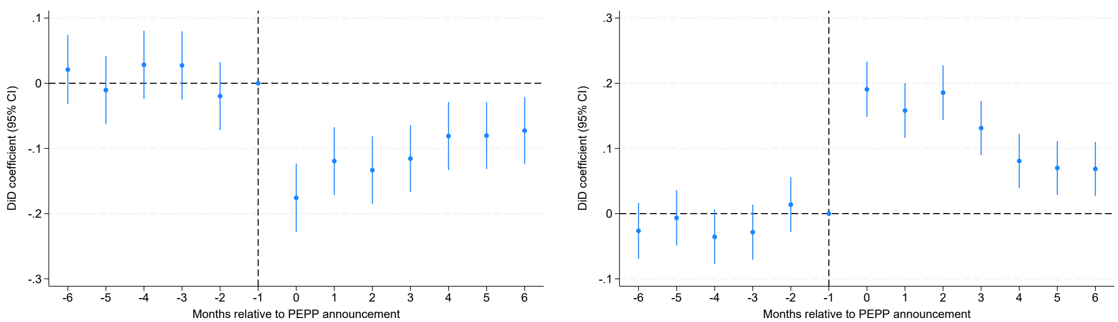


Figure C.2. **DiD coefficients around the CSPP announcement.** This figure contains the monthly point estimates in equation (15) where the dependent variables are credit spreads (left-hand panel) and the CDS-bond basis (right-hand panel).

We chose the month before the program announcement as reference date. Figure C.2 shows the dynamic DiD coefficient estimates with 95% confidence intervals for the two events (CSPP and PEPP) for the credit spread (left-hand side) and for the CDS-Bond basis (right-hand side).

The impact of the two programs on the credit spread is clear. We observe that all coefficients are not statistically significant and close to zero until the month before the program announcement, whereas they become negative and statistically significant in the months that follow. The fact that we do not observe significant differences in the pre-period is strong evidence that the parallel trends assumption holds.

Finally, note that the mechanism we propose works through a change in the service flows that a bond provides, not through a change in the relative supply of different assets. Therefore, an important question that naturally arises is whether the actual purchases of the ECB have an effect on top of the eligibility effect. In Figure C.3, we present the average CDS-bond basis of CSPP-eligible bonds (blue) and that of bonds *actually* purchased by the ECB (pink). The two lines are almost identical for the entire period of interest, which

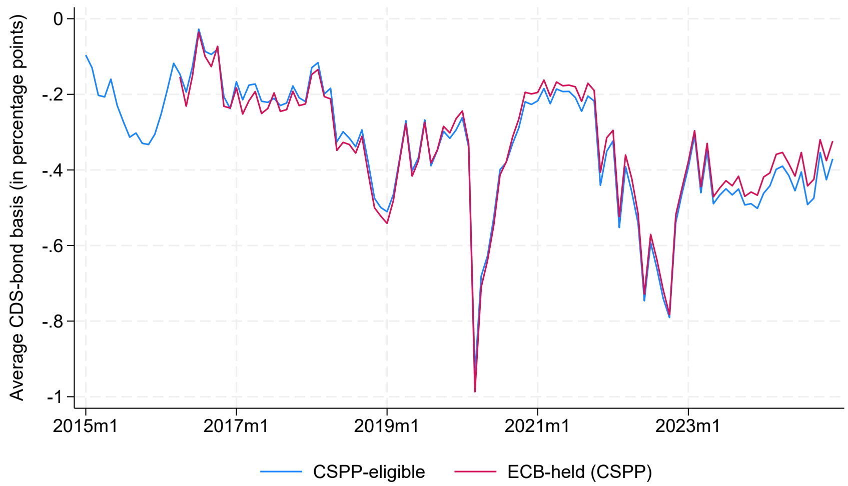


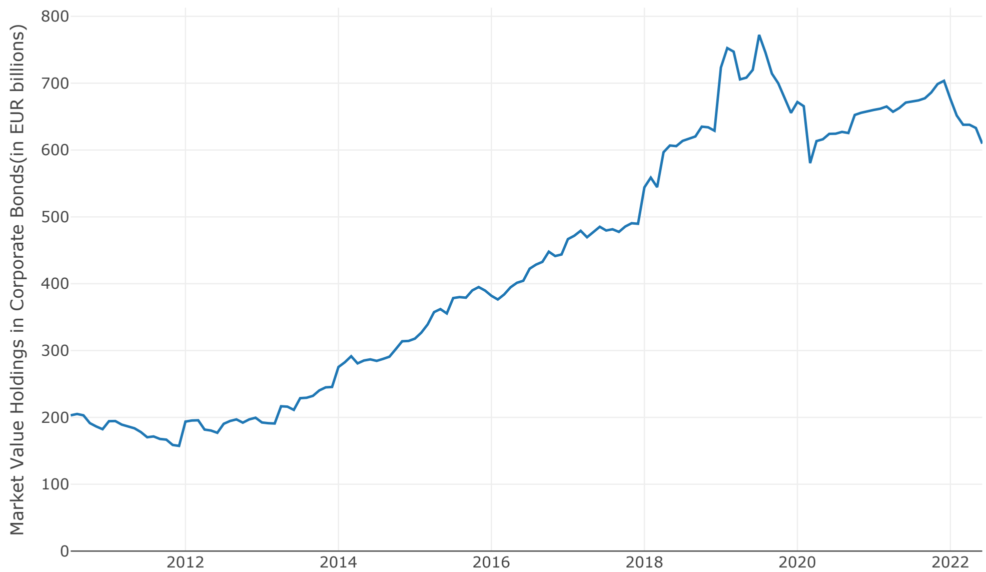
Figure C.3. **Average CDS-bond basis for ECB-held bonds compared to the universe of CSPP-eligible bonds.** This figure plots the average CDS-bond basis separately for CSPP-eligible bonds (blue) and the bonds *actually purchased* by the ECB (pink).

confirms that there is no additional effect caused by the actual ECB purchase.

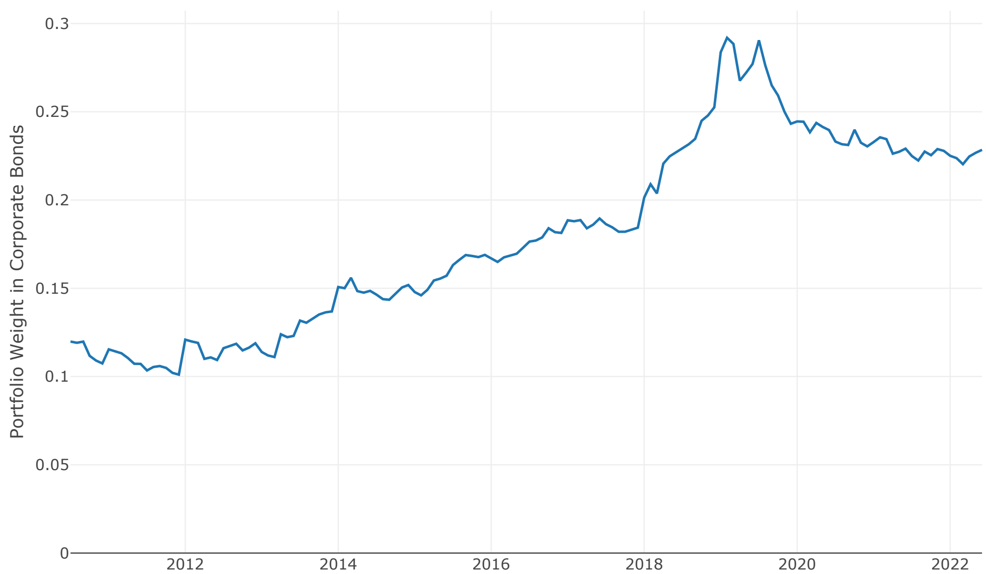
IV. Fund-Level Analysis

A. Data

We retrieve monthly euro area mutual fund holdings, asset under management (AUM), and flows from Morningstar. We include only open-end funds and exclude closed-end, variable annuity funds, and index funds from our analysis. To ensure data quality, we exclude holdings for which the amount held by the fund exceeds their total outstanding amount and truncate the share of total outstanding at the 99th percentile. We merge the holdings table with ECB corporate bond table (CSDB) and exclude observations for which the market value is zero or the ratio of the market value of holdings to the total market value amount exceeds one. The sample is further refined based on fund characteristics. Funds must have at least 1 million market value holdings in corporate bonds each month. We also drop funds where the portfolio weight in corporate bond positions is greater than one. To ensure consistent reporting behavior, for monthly holdings data, we only keep funds that report in all 3 months of each quarter and include only those with holdings data available for at least 6 months across the event window. For the quarterly table, we only include funds that report holdings for at least 2 quarters within the event window.

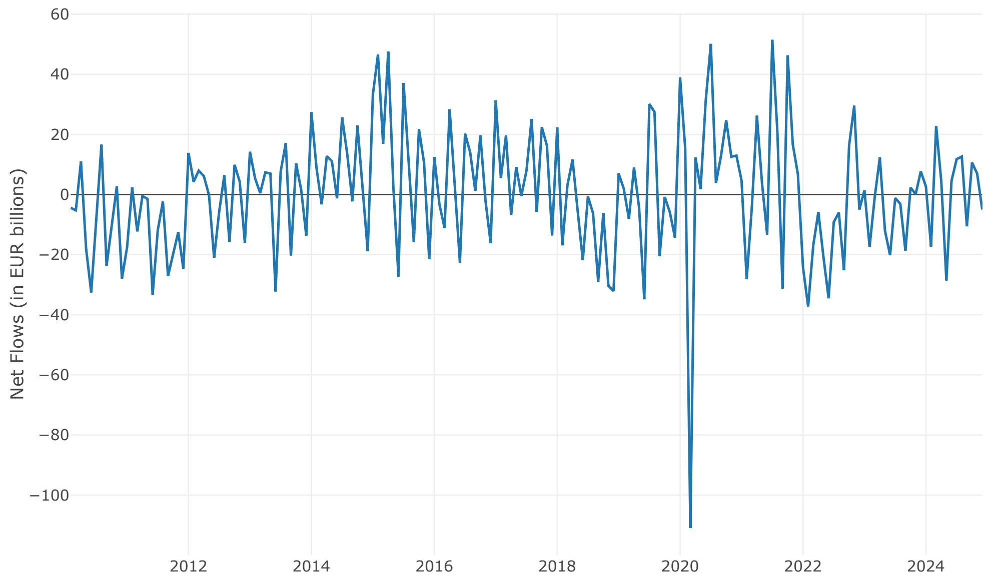


(a) Market Value Holdings in Corporate Bonds

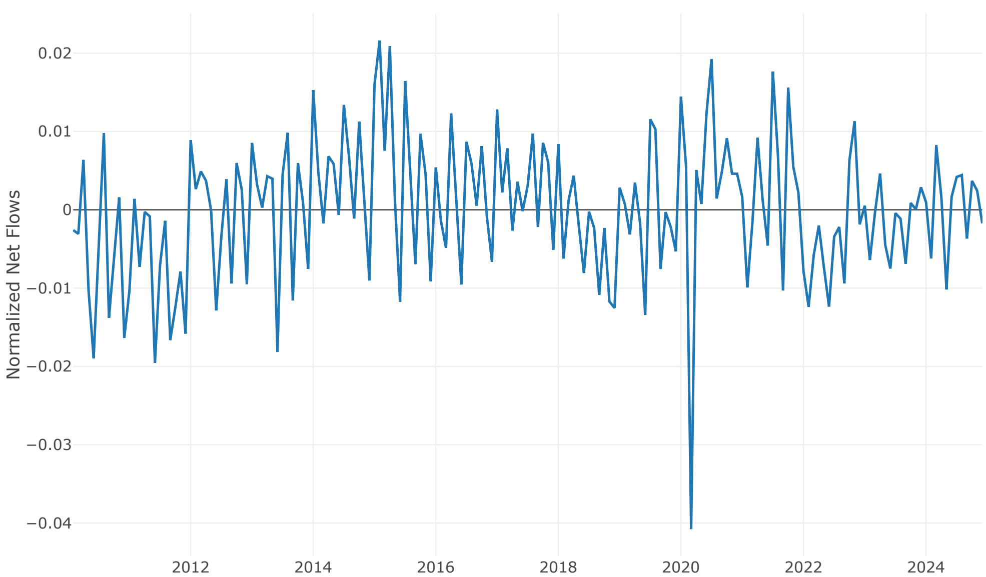


(b) portfolio Weight in Corporate Bonds

Figure D.1. **Time Series of Mutual Fund Portfolio Weight in Corporate Bonds.** Panel (a) plots the mutual funds' total market value holdings in corporate bonds overtime. Panel (b) plots the time series of the ratio of mutual funds' total market value holdings in corporate bonds to total AUM. The sample is monthly from July 2010 to June 2022.



(a) Net Flows



(b) Normalized Net Flows

Figure D.2. **Time Series of Mutual Fund Flows.** Panel (a) shows the sum of euro mutual fund net flows over time. Panel (b) shows the time series of total fund net flows normalized by the total fund AUM in the previous period. The sample is monthly from February 2010 to December 2024.

Table D1. **Descriptive statistics for mutual funds holdings.** This tables shows the descriptive statistics for key variables in regression(4). x is the portfolio weight of fund i in bond n, defined as the ratio of the market value of fund i's holdings in that bond to the fund's total market value holdings across all corporate bonds. The key independent variable *CapitalFlightiness* is computed from equation (3). *HighCapF* is a dummy indicator reflecting whether the fund's *CapitalFlightiness* falls within the top 75th percentile. βs are the loadings on the first two principal components obtained from a principal component analysis (PCA) of bond returns at the bond category level. The sample is monthly. We winsorize x, *CapitalFlightiness*, and βs at 1% and 99% to remove outliers.

(a) CSPP: September 2015 – September 2016

	N	Pctl(25)	Median	Pctl(75)	Mean	St. Dev.
Portfolio weight (%)	694,376	0.575	1.446	3.490	3.443	5.855
CapitalFlightiness	694,376	0.022	0.039	0.060	0.045	0.031
HighCapF	694,376	0	0	1	0.256	0.436
Elig	694,376	0	0	1	0.481	0.500
Post	694,376	0	1	1	0.556	0.497
β_1	291,886	−0.070	−0.052	−0.026	−0.040	0.048
β_2	291,886	−0.024	0.009	0.033	−0.004	0.068

(b) PEPP: September 2019 – September 2020

	N	Pctl(25)	Median	Pctl(75)	Mean	St. Dev.
Portfolio weight (%)	1,281,421	0.353	0.983	2.354	2.240	3.767
CapitalFlightiness	1,281,421	0.014	0.031	0.054	0.040	0.036
HighCapF	1,281,421	0	0	1	0.276	0.447
Elig	1,281,421	0	1	1	0.541	0.498
Post	1,281,421	0	1	1	0.571	0.495
β_1	518,250	−0.066	−0.036	0.051	−0.012	0.060
β_2	518,250	−0.023	0.002	0.021	−0.001	0.069

Table D2. **Descriptive statistics for mutual funds portfolio weights.** This table displays the descriptive statistics for key variables in regression (5). The fund AUM is the average fund AUM over the two years preceding the QE announcements (CSPP and PEPP) and is presented in millions. Portfolio weights are represented in percentage points. $x_{i,other}$ includes fund positions in derivatives, real estats, private equity, commodities, etc. $Log(AUM)_{i,pre}$ and $x_{i,pre}^{corpbond}$ refer to the fund's assets under management and corporate bond share at the onset of the events (September 2015 for CSPP and September 2019 for PEPP). *HighCapF* is a dummy indicator reflecting whether the fund's *CapitalFlightiness* falls within the top 75th percentile. Data is monthly. We trim the distribution of Δx_{im} by keeping observations within the interval [-100, 100], and winsorize at the 1st and 99th percentiles to remove outliers.

(a) CSPP: September 2015 – September 2016

	Key variables in regression (5)				
	Pctl(25)	Median	Pctl(75)	Mean	St. Dev.
$\Delta x_{i,elig}$	−0.784	0.000	1.184	0.154	2.982
$\Delta x_{i,inelig}$	−3.811	−0.613	1.919	−1.165	5.785
$\Delta x_{i,cash}$	−4.126	−0.391	2.166	−1.043	8.476
$\Delta x_{i,sov}$	−4.341	−0.187	1.732	−1.469	7.341
$\Delta x_{i,equity}$	0.000	0.000	0.000	0.040	2.610
$\Delta x_{i,other}$	−1.809	2.470	7.676	3.490	10.637
CapitalFlightiness	0.017	0.035	0.059	0.043	0.035
HighCapF	0	0	0	0.244	0.430
AUM	37.290	118.008	352.025	365.920	796.744
	$x_{i,m}$ **in pre-period CSPP (September 2015)**				
$x_{i,elig}$	0.406	2.887	7.348	5.451	7.015
$x_{i,inelig}$	8.017	16.490	29.872	20.722	16.458
$x_{i,cash}$	2.575	6.896	16.049	13.151	17.287
$x_{i,sov}$	4.908	16.925	41.948	25.851	25.144
$x_{i,equity}$	0.000	0.000	7.153	6.147	12.476
$x_{i,other}$	12.590	27.422	44.699	28.678	25.439
	$x_{i,m}$ **in post-period CSPP (September 2016)**				
$x_{i,elig}$	0.568	3.180	7.617	5.615	7.028
$x_{i,inelig}$	7.784	15.443	27.663	19.583	15.492
$x_{i,cash}$	2.191	5.439	15.197	12.192	16.924
$x_{i,sov}$	4.075	15.240	38.845	24.340	24.784
$x_{i,equity}$	0.000	0.000	7.417	6.170	12.486
$x_{i,other}$	12.590	27.422	44.699	28.678	25.439

(b) PEPP: September 2019 – September 2020

	Key variables in regression (5)				
	Pctl(25)	Median	Pctl(75)	Mean	St. Dev.
$\Delta x_{i,elig}$	−0.274	0.663	2.814	1.312	3.423
$\Delta x_{i,inelig}$	−1.529	0.302	2.677	0.577	4.682
$\Delta x_{i,cash}$	−2.716	−0.065	2.213	−0.838	8.366
$\Delta x_{i,sov}$	−3.154	−0.001	1.832	−0.550	7.548
$\Delta x_{i,equity}$	−0.104	0.000	0.000	−0.318	2.685
$\Delta x_{i,other}$	−4.680	−0.439	3.655	−0.092	10.296
CapitalFlightiness	0.011	0.026	0.049	0.035	0.031
HighCapF	0	0	0	0.237	0.425
AUM	49.762	136.010	387.869	436.510	1,161.619
	$x_{i,m}$ **in pre-period PEPP (September 2019)**				
$x_{i,elig}$	1.493	4.448	10.474	7.146	7.817
$x_{i,inelig}$	6.231	14.079	26.306	17.883	15.172
$x_{i,cash}$	2.081	5.026	11.338	9.413	12.336
$x_{i,sov}$	3.247	13.809	34.818	22.397	23.719
x_{equity}	0.000	0.000	9.479	7.144	12.680
$x_{i,other}$	18.699	34.396	54.516	36.016	25.094
	$x_{i,m}$ **in post-period PEPP (September 2020)**				
$x_{i,elig}$	2.307	5.828	12.609	8.431	8.279
$x_{i,inelig}$	7.006	14.158	26.868	18.460	15.733
$x_{i,cash}$	2.303	5.017	10.446	8.593	11.286
$x_{i,sov}$	2.917	13.775	33.730	21.825	23.628
x_{equity}	0.000	0.000	8.779	6.841	12.695
$x_{i,other}$	19.032	34.684	53.773	35.849	24.991

Table E1. **Intermediary Effects, Difference-in-Differences Approach** The table reports the estimates of Equation 6. The triple interaction coefficients θ_{MF} and θ_{ICPF} capture the additional effects of the policies for bonds that, ex-ante, had a higher share held by mutual funds or by insurance corporations and pension funds, respectively.

(a) CSPP: June 2015 – December 2016

	MF			ICPF			MF & ICPF		
	(1) Credit Spread	(2) CDS	(3) Basis	(4) Credit Spread	(5) CDS	(6) Basis	(7) Credit Spread	(8) CDS	(9) Basis
Post × Eligible × MF Share	-0.271**	0.077	0.347**				-0.372**	0.098	0.470**
	(0.112)	(0.087)	(0.131)				(0.147)	(0.093)	(0.178)
Post × Eligible × ICPF Share				0.096	-0.021	-0.117	-0.050	0.001	0.051
				(0.076)	(0.044)	(0.092)	(0.082)	(0.056)	(0.101)
Post × Eligible	-0.058	-0.096**	-0.039	-0.163**	-0.067	0.096	-0.007	-0.094	-0.087
	(0.044)	(0.042)	(0.054)	(0.066)	(0.039)	(0.080)	(0.075)	(0.056)	(0.094)
ISIN FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
Rating x Maturity x Time FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
R^2	0.92	0.91	0.79	0.89	0.91	0.75	0.90	0.91	0.75
Observations	18,185	18,185	18,185	21,991	21,991	21,991	25,129	25,129	25,129

(b) PEPP: June 2019 – December 2020

	MF			ICPF			MF & ICPF
	(1) Credit Spread	(2) CDS	(3) Basis	(4) Credit Spread	(5) CDS	(6) Basis	
Post × Eligible × MF Share	-0.123	-0.097	0.026				
	(0.137)	(0.091)	(0.142)				
Post × Eligible × ICPF Share				0.104	0.133	0.029	
				(0.096)	(0.083)	(0.073)	
Post × Eligible	-0.005	0.047	0.052	-0.040	-0.031	0.009	
	(0.050)	(0.045)	(0.061)	(0.075)	(0.047)	(0.068)	
ISIN FE	✓	✓	✓	✓	✓	✓	
Rating x Maturity x Time FE	✓	✓	✓	✓	✓	✓	
R^2	0.90	0.87	0.81	0.89	0.88	0.81	
Observations	24,087	24,087	24,087	28,150	28,150	28,150	

V. Appendix: Intermediary Effects

A. Announcement Effects

After establishing the effects using the difference-in-differences approach, we now turn to a higher-frequency analysis and focus on the announcement effects of the policy. Following standard practice in the literature, we study market reactions around the announcement date and then include intermediary holdings to assess heterogeneity. For this part of the analysis, we restrict the sample to the iBoxx dataset, which provides daily data. Specifically, we compute the change in $y(n)$ from the three-day average before the announcement to d days after the event. When using iBoxx data, we also include euro-denominated investment-grade bonds issued by firms outside the euro area. This broader sample gives us a larger set of non-eligible bonds and improves identification. We estimate:

$$\begin{aligned}\Delta y(n) = \theta_1\ \mathit{Treat}_t(n) + \theta_{MF}\ \mathit{Treat}_t(n) \times \mathit{MF}(n) + \gamma_{MF}\ \mathit{MF}(n) \\ + \theta_{ICPF}\ \mathit{Treat}_t(n) \times \mathit{ICPF}(n) + \gamma_{ICPF}\ \mathit{ICPF}(n) + \text{Fixed Effects} + u_d(n)\end{aligned} \tag{16}$$

We can estimate a θ for each time lag. We use a 2-weeks period to make sure our results are not driven by difference in liquidity across bonds and at the same time use a window tight enough. The main coefficients of interest are θ_{MF} and θ_{ICPF}.

Panel (a) of Table E2 reports the results for the CSPP announcement. The estimates support the difference-in-differences approach. In columns (1) and (2), we find that the interaction with mutual fund ownership yields coefficients of -0.21 and -0.17 for bond yields and credit spreads, respectively. This implies that a 10 percentage point increase in mutual fund share results in an additional 1.7 basis point reduction in bond yields following the announcement.

Consistent with earlier findings, most of the effect is driven by the convenience yield. The coefficient on the CDS-bond basis in column (3) is 0.18, indicating that the decline in yields is primarily attributable to an increase in convenience yield rather than a change in default risk. The results align closely with those in the previous section, despite relying on a different identification strategy and dataset, further reinforcing the robustness of our findings.

We extend the analysis to the PEPP announcement in Panel (b) of Table E2. The outcome variable is measured as the change between the average over the three days before March 24—one week after the announcement—and the two weeks that follow. The PEPP was announced outside a scheduled Governing Council meeting, and the timing was unexpected by markets. As shown in Figure 2b, market reactions unfolded within a few days.

This setting allows us to examine how the effects of the policy vary with investor composition. We find a sizable response. The coefficient on mutual fund holdings, θ_{MF}, is approximately -1.1, implying a 10 basis point decline in yields for a 10 percentage point increase in mutual fund ownership. As in the CSPP case, the effect is entirely driven by the convenience yield: the coefficient in column (4) is also 1.1, confirming that the yield compression reflects changes in liquidity or safety premia rather than credit risk.

The PEPP results confirm the pattern observed under the CSPP. However, the interpretation may differ due to the nature of the shock. As noted by Coppola (2021), mutual funds are prone to fire sales during recessions, which can amplify the rise in bond yields. It is therefore expected that the ECB's intervention had a stronger effect on bonds held by mutual funds, as these bonds experienced more severe dislocations prior to the announcement.

At the same time, the evidence is consistent with the prediction of our model, which emphasizes that such policies are particularly beneficial to mutual funds. In a counterfactual scenario without the intervention, mutual funds would have likely faced steeper losses. The ECB effectively acted as a countercyclical buyer, supplying liquidity precisely when mutual funds needed it most.

Table E2. **The effect of corporate QE on sectoral corporate bond holdings.** This table displays the results of estimating equation (2) separately for five holdings sectors: Banks, mutual funds, insurance companies & pension funds, others (incl. households and non-financial corporations), and rest of the world (i.e., non-euro area holdings estimated as the residual).

(a) CSPP

	(1) Credit Spread	(2) CDS	(3) Basis
Eligible × MF Share	-23.98**	-3.190	20.79***
	(10.06)	(9.418)	(4.537)
Eligible × ICPF Share	-11.33	-6.040	5.287
	(12.74)	(12.32)	(4.089)
Eligible	4.801	-0.558	-5.359*
	(7.108)	(6.345)	(2.548)
MF Share	-16.85*	8.293	25.15***
	(8.397)	(10.29)	(5.086)
ICPF Share	-4.336	3.907	8.243**
	(6.269)	(6.604)	(2.944)
Rating x Maturity FE	✓	✓	✓
R^2	0.34	0.29	0.16
Observations	818	818	818

(b) PEPP

	(1) Credit Spread	(2) CDS	(3) Basis
Eligible × MF Share	-1.079**	0.063	1.142**
	(0.416)	(0.188)	(0.344)
Eligible × ICPF Share	-0.337	0.443***	0.781**
	(0.301)	(0.046)	(0.297)
Eligible	0.724***	-0.101*	-0.825***
	(0.191)	(0.051)	(0.170)
MF Share	0.769*	-0.139	-0.909**
	(0.362)	(0.168)	(0.264)
ICPF Share	0.498**	-0.278**	-0.776***
	(0.195)	(0.087)	(0.159)
Rating x Maturity FE	✓	✓	✓
R^2	0.17	0.05	0.12
Observations	1,216	1,216	1,216

VI. Appendix: Additional Tables and Figures

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Table F1. **Portfolio shares rebalancing around the two corporate QE programs.** This table displays the change in portfolio corporate bond holdings (in EUR billion) between the beginning and end of each event period (2015q1 – 2016q4 for CSPP; 2019q1 – 2020q4 for PEPP), separately for QE-eligible and -ineligible bonds, for the following investor sectors: Banks, mutual funds, insurance companies & pension funds, others (incl. households and non-financial corporations), and rest of the world (i.e., non-euro area holdings estimated as the residual). Net issuance is calculated as the sum of all sectors' rebalancing. The third column contains each sector's total holdings (ineligible and eligible) at the beginning of the event period. The final column shows the total change in holdings (ineligible and eligible) over the event period as a share of initial holdings.

(a) CSPP

	2015q4 – 2016q2			2015q4 – 2016q4			2015q4
	Eligible	Ineligible	Sovereign	Eligible	Ineligible	Sovereign	Holdings
Banks	-0.11	0.42	-0.31	-1.06	2.24	-1.18	1215
ICPF	0.51	-0.14	-0.37	0.70	-0.02	-0.69	1535
MF	2.63	0.75	-3.38	2.74	1.52	-4.26	950
Other	0.10	-0.36	0.26	0.33	-1.09	0.77	566
ECB	0.62	0.00	-0.62	4.09	0.01	-4.10	682
RoW	0.24	1.28	-1.52	-1.32	2.41	-1.09	2195
Net issuance	-3.99	-1.96	5.95	-5.49	-5.07	10.55	.

(b) PEPP

	2019q4 – 2020q2			2019q4 – 2020q2			2019q4
	Eligible	Ineligible	Sovereign	Eligible	Ineligible	Sovereign	Holdings
Banks	0.36	0.16	-0.52	0.73	2.00	-2.73	1185
ICPF	1.13	0.32	-1.46	1.62	0.68	-2.30	1839
MF	2.97	-0.74	-2.24	4.26	-0.33	-3.93	1039
Other	-1.65	-3.70	5.35	-0.79	-4.18	4.98	490
ECB	1.51	0.22	-1.73	2.41	0.07	-2.48	1658
RoW	1.06	-1.01	-0.05	1.73	0.22	-1.95	2457
Net issuance	-5.38	4.74	0.64	-9.95	1.54	8.41	.

Table F2. **The effect of corporate QE on portfolio share, Long Sample** This table displays the results of estimating equation (2) separately for five holdings sectors: Banks, mutual funds, insurance companies & pension funds, others (incl. households and non-financial corporations), and rest of the world (i.e., non-euro area holdings estimated as the residual).

(a) CSPP: 2015q2 – 2016q4

	(1) Banks	(2) MF	(3) ICPF	(4) Other	(5) RoW
Post=1 × CSPP eligible=1	-0.485***	0.167**	0.054	-0.530***	-0.549***
	(0.12)	(0.06)	(0.06)	(0.07)	(0.13)
CSPP eligible=1	-1.572**	-0.778*	0.449	-0.916**	1.933***
	(0.47)	(0.34)	(0.37)	(0.28)	(0.46)
Holder country x Time FE	✓	✓	✓	✓	✓
Rating x Maturity x Time FE	✓	✓	✓	✓	✓
R^2	0.25	0.19	0.22	0.16	0.04
Observations	63,147	98,474	102,267	101,926	28,262

(b) PEPP: 2019q4 – 2020q4

	(1) Banks	(2) MF	(3) ICPF	(4) Other	(5) RoW
Post=1 × PEPP eligible=1	-0.469***	0.051*	-0.275***	0.193***	0.011
	(0.11)	(0.02)	(0.04)	(0.03)	(0.14)
PEPP eligible=1	-0.279	-1.270***	-0.050	-0.980***	2.073***
	(0.44)	(0.21)	(0.24)	(0.22)	(0.43)
Holder country x Time FE	✓	✓	✓	✓	✓
Rating x Maturity x Time FE	✓	✓	✓	✓	✓
R^2	0.32	0.18	0.20	0.14	0.08
Observations	74,639	145,801	157,882	111,175	29,617

Figure F.1. **Mutual Funds Holdings and Basis Response** The figure depicts the relationship between the increase in CDS-Bond basis (y-axis) around ECB announcements and the corresponding mutual fund holdings (x-axis). Bonds are ranked according to the magnitude of their spread reactions and sorted into 50 groups with comparable responses. For each group, we compute the average mutual fund share. Panel (a) presents the results for the CSPP announcement, while Panel (b) reports the results for the PEPP announcement.

(a) CSPP (b) PEPP

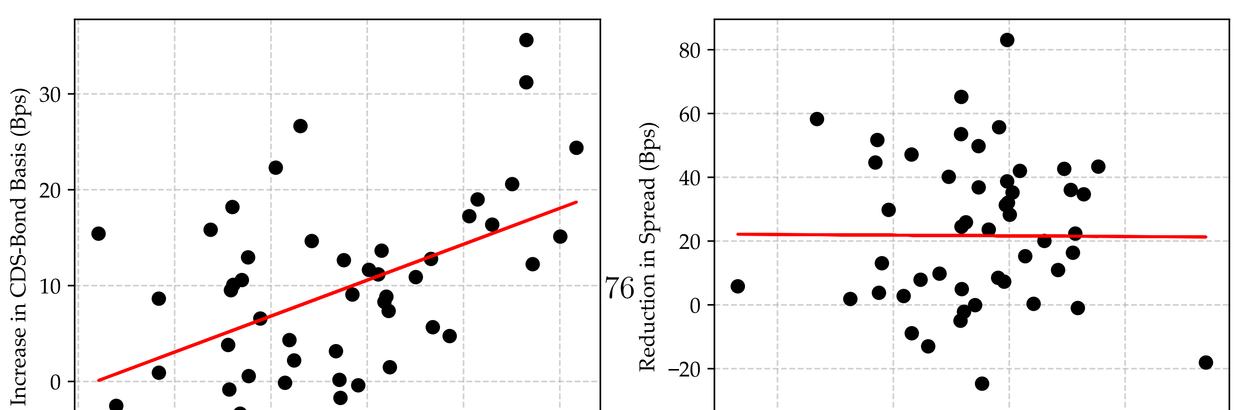

Table F3. **The effect of corporate QT on portfolio share.** This table reports the results from estimating equation (2) for the QT period. We use athe sample window 2021Q1–2023Q4. The regression is estimated separately for five investor sectors: banks, mutual funds, insurance companies and pension funds, other domestic investors (including households and non-financial corporations), and the rest of the world (non-euro area investors, computed as the residual).

QT: 2021q1 - 2023q4 (Post Dummy: 2021q4)

	(1) Banks	(2) MF	(3) ICPF	(4) Other	(5) RoW
Post 2021q4 × Eligible	-0.078	-0.089**	-0.240***	0.174***	0.001
	(0.05)	(0.03)	(0.02)	(0.03)	(0.06)
Eligible	-0.524	-1.274***	-0.272	-0.523**	1.764***
	(0.36)	(0.19)	(0.20)	(0.18)	(0.37)
Holder country x Time FE	✓	✓	✓	✓	✓
Rating x Maturity FE	✓	✓	✓	✓	✓
R^2	0.31	0.17	0.21	0.12	0.11
Observations	153,127	302,466	315,957	234,022	65,140

Figure F.2. **ECB Share of Outstanding Amount** igure F.2 plots the shares of the outstanding amount of eligible bonds held by the ECB. The share was 0% at the beginning of 2016, prior to the start of the CSPP and peaked to 27% in 2023.

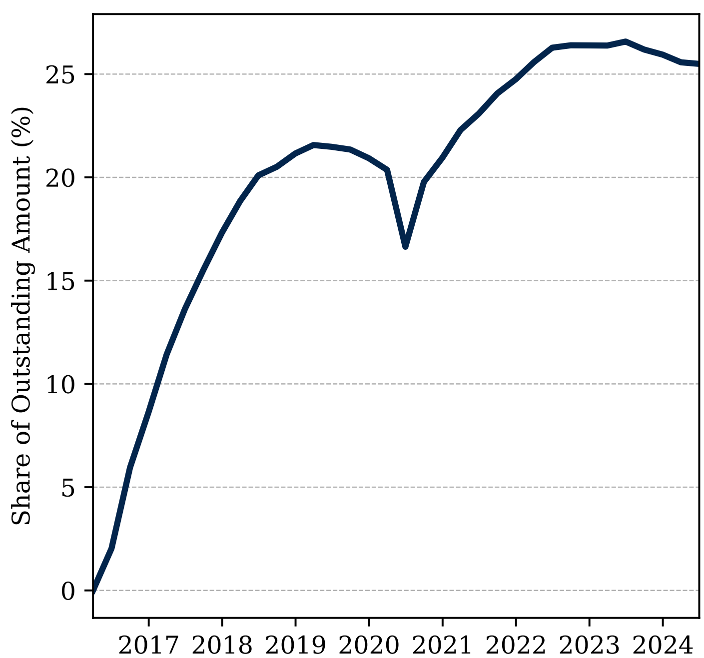

Table F4. **The effect of corporate QT on portfolio share.** This table reports the results from estimating equation (2) for the QT period. We use athe sample window 2021Q1–2023Q4. The regression is estimated separately for five investor sectors: banks, mutual funds, insurance companies and pension funds, other domestic investors (including households and non-financial corporations), and the rest of the world (non-euro area investors, computed as the residual).

QT: 2021q1 - 2023q4 (Post Dummy: 2022q1)

	(1) Banks	(2) MF	(3) ICPF	(4) Other	(5) RoW
Post 2022q1 × Eligible	-0.053	-0.084***	-0.223***	0.210***	0.037
	(0.03)	(0.02)	(0.02)	(0.06)	(0.05)
Eligible	-0.547	-1.284***	-0.303	-0.535**	1.739***
	(0.37)	(0.20)	(0.20)	(0.18)	(0.38)
Holder country x Time FE	✓	✓	✓	✓	✓
Rating x Maturity FE	✓	✓	✓	✓	✓
R^2	0.31	0.17	0.21	0.12	0.11
Observations	153,127	302,466	315,957	234,022	65,140

Table F5. **The effect of corporate QT on portfolio share.** This table reports the results from estimating equation (2) for the QT period. We use athe sample window 2021Q1–2023Q4. The regression is estimated separately for five investor sectors: banks, mutual funds, insurance companies and pension funds, other domestic investors (including households and non-financial corporations), and the rest of the world (non-euro area investors, computed as the residual).

QT: 2021q1 - 2023q4 (Post Dummy: 2022q2)

	(1) Banks	(2) MF	(3) ICPF	(4) Other	(5) RoW
Post Q2 2022 × Eligible	-0.084***	-0.066***	-0.213***	0.244***	0.053
	(0.02)	(0.02)	(0.01)	(0.06)	(0.05)
Eligible	-0.532	-1.301***	-0.326	-0.542**	1.732***
	(0.37)	(0.20)	(0.20)	(0.18)	(0.39)
Holder country x Time FE	✓	✓	✓	✓	✓
Rating x Maturity FE	✓	✓	✓	✓	✓
R^2	0.31	0.17	0.21	0.12	0.11
Observations	153,127	302,466	315,957	234,022	65,140

Table F6. **The effect of corporate QT on portfolio share.** This table reports the results from estimating equation (2) for the QT period. We use athe sample window 2021Q1–2023Q4. The regression is estimated separately for five investor sectors: banks, mutual funds, insurance companies and pension funds, other domestic investors (including households and non-financial corporations), and the rest of the world (non-euro area investors, computed as the residual).

QT: 2021q1 - 2023q4 (Post Dummy: 2022q3)

	(1) Banks	(2) MF	(3) ICPF	(4) Other	(5) RoW
Post Q3 2022 × Eligible	-0.078***	-0.074***	-0.186***	0.234***	0.060
	(0.02)	(0.01)	(0.01)	(0.05)	(0.04)
Eligible	-0.543	-1.302***	-0.358	-0.517**	1.732***
	(0.38)	(0.20)	(0.20)	(0.19)	(0.39)
Holder country x Time FE	✓	✓	✓	✓	✓
Rating x Maturity FE	✓	✓	✓	✓	✓
R^2	0.31	0.17	0.21	0.12	0.11
Observations	153,127	302,466	315,957	234,022	65,140

Table F7. **The effect of corporate QT on portfolio share.** This table reports the results from estimating equation (2) for the QT period. We use athe sample window 2021Q1–2023Q4. The regression is estimated separately for five investor sectors: banks, mutual funds, insurance companies and pension funds, other domestic investors (including households and non-financial corporations), and the rest of the world (non-euro area investors, computed as the residual).

QT: 2021q1 - 2023q4 (Post Dummy: 2022q4)

	(1) Banks	(2) MF	(3) ICPF	(4) Other	(5) RoW
Post Q4 2022 × Eligible	-0.101***	-0.087***	-0.168***	0.243***	0.086*
	(0.02)	(0.01)	(0.01)	(0.03)	(0.04)
Eligible	-0.539	-1.303***	-0.381*	-0.503**	1.725***
	(0.38)	(0.20)	(0.20)	(0.19)	(0.39)
Holder country x Time FE	✓	✓	✓	✓	✓
Rating x Maturity FE	✓	✓	✓	✓	✓
R^2	0.31	0.17	0.21	0.12	0.11
Observations	153,127	302,466	315,957	234,022	65,140