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Thiago Fauvrelle
European Stability Mechanism

Max Riedel
Leibniz Institute for Financial Research SAFE

Mathias Skrutkowski
European Stability Mechanism

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Thiago Fauvrelle[1] European Stability Mechanism
Max Riedel[2] Leibniz Institute for Financial Research SAFE
Mathias Skrutkowski[3] European Stability Mechanism

Abstract

This paper studies whether Eurosystem collateral eligibility played a role in the portfolio choices of euro area asset managers during the "dash-for-cash" episode of 2020. We find that asset managers reduced their allocation to ECB-eligible corporate bonds, selling them in order to finance redemptions, while simultaneously increasing their cash holdings. These findings add nuance to previous studies of liquidity strains and price dislocations in the corporate bond market during the onset of the Covid-19 pandemic, indicating a greater willingness of dealers to increase their inventories of corporate bonds pledgeable with the ECB. Analysing the price impact of these portfolio choices, we also find evidence pointing to price pressure for both ECB-eligible and ineligible corporate bonds. Bonds that were held to a larger extent by investment funds in our sample experienced higher price pressure, although the impact was lower for ECB-eligible bonds. We also discuss broader implications for the related policy debate about how central banks could mitigate similar types of liquidity shocks.

Keywords: Investment funds, dash-for-cash, corporate bonds, Eurosystem collateral eligibility

JEL codes: G11, G23

[1] T.Fauvrelle@esm.europa.eu
[2] Riedel@safe-frankfurt.de
[3] M.Skrutkowski@esm.europa.eu

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Thiago Fauvrelle
Max Riedel
Mathias Skrutkowski*

Abstract

This paper studies to what extent Eurosystem collateral eligibility played a stabilising role during the "dash-for-cash" episode of 2020. We find that funds with a higher share of ECB-eligible corporate bonds experienced lower redemption volumes, in particular those with close affiliation to banks. We also find that asset managers followed a liquidation pecking order, whereby they reduced their allocation to eligible bonds, selling them to finance redemptions. These findings add nuance to previous studies of liquidity strains and selling pressure in the corporate bond market during the onset of the Covid-19 pandemic, indicating a greater willingness of dealers to increase their inventories of corporate bonds pledgeable with the ECB. Analysing the price impact of these portfolio choices, we also find evidence pointing to sustained price pressure for both ECB-eligible and ineligible corporate bonds. While the price impact was generally lower and less sustained for ECB-eligible bonds, the difference was primarily due to lower price pressure on bonds issued by banks. We discuss the broader implications of these findings for monetary policy transmission and financial stability as well as the policy debate on how central banks can better mitigate similar liquidity shocks in the future.

Keywords: Investment funds, portfolio choice, Covid-19 liquidity crisis, corporate bond market, Eurosystem collateral framework

JEL Classification: E58, G01, G1, G11, G12, G23

*Thiago Fauvrelle (T.Fauvrelle@esm.europa.eu) and Mathias Skrutkowski (M.Skrutkowski@esm.europa.eu) are affiliated with the European Stability Mechanism (ESM). Max Riedel (Riedel@safe-frankfurt.de) is affiliated with Leibniz Institute for Financial Research SAFE. The views expressed in this paper are those of the authors and do not necessarily reflect those of the ESM. Special thanks go to Bo Becker, Stephen Cechetti, Mattias Gnewuch, Lars Hörngren, Edmund Moshammer, as well as the participants of the VfS Annual Conference 2025 in Cologne and 15th Annual Financial Market Liquidity Conference in Budapest for their valuable feedback and comments. We gratefully acknowledge research support from the Leibniz Institute for Financial Research SAFE. The usual disclaimer on errors applies.

1 Introduction

Global corporate bond markets witnessed severe price dislocations during the onset of the Covid-19 pandemic. The sudden drop in bond prices coincided with a surge in redemptions from investors in open-end investment funds, giving rise to excess supply in the secondary market, as asset managers tried to finance redemptions by selling the underlying assets, while dealers were reluctant to expand their inventories to accommodate the surge in demand for liquidity (Kargar et al., 2021). In the euro area, redemption volumes of open-end bond funds reached a peak during the month of March 2020, corresponding to nearly 10 percent of assets under management (see Figure 1).

[Figure 1 about here]

In this study, we examine whether Eurosystem collateral eligibility of corporate bonds played a role in redemption decisions of fund investors as well as the portfolio choice decisions of euro area asset managers during this so-called dash-for-cash episode. Our broader aim is to improve our understanding as to what extent the Eurosystem collateral framework played a downstream stabilising role during that period, even for non-bank financial institutions such as investment funds without direct access to the Eurosystem.

We focus our empirical study on the corporate bond market for two reasons. First, funds that invest in corporate bonds are known to be particularly susceptible to runs, since corporate bonds are typically less liquid than sovereign bonds, which aggravates strategic complementarities in redemption decisions (Chen et al., 2010; Goldstein et al., 2017). The second, closely related reason is that the corporate bond market is of key importance for financial stability. Following the Global Financial Crisis of 2008-2009 (GFC), euro area firms have increasingly turned to financing themselves using corporate bonds, and less with bank loans (Cappiello et al., 2021). The dash-for-cash episode raised concerns that, by flooding the secondary market with an excess of supply, a redemption shock can also spill over to the primary market, making it more difficult or costly for firms to issue new bonds. Runs on investment funds can thus contribute to a corporate credit crunch, in a similar way to runs on banks. In addition, fire sales by investment funds more generally hurt the performance of all financial agents holding the same assets (for evidence of systemic spillovers in debt markets, see Falato, Hortacsu, et al., 2021).

Using a panel regression analysis, we study whether redemption decisions by fund investors depended on the share of ECB-eligible corporate bonds held by investment funds in the preceding quarter. We find that funds with a higher share of eligible bonds experienced lower redemption volumes, in line with prior evidence of strategic complementarities in redemptions (Chen et al., 2010; Goldstein et al., 2017; Ma et al., 2022). This effect was stronger for funds with closer ties to banks, in line with studies that show the mitigating impact of bank affiliation (Bagattini et al., 2023). We also study to what extent asset managers changed their allocation towards ECB-eligible corporate bonds in Q1 2020. Our findings show that managers reduced the share of eligible corporate bonds in their portfolios, while simultaneously increasing their cash holdings, in line with previous findings of cash hoarding and funds following a liquidity pecking order when financing redemptions (Ma et al., 2022; Morris et al., 2017). We corroborate these findings by analysing holding-level data and confirming that investment funds reduced their holdings of ECB-eligible corporate bonds in Q1 2020 to a larger extent than they reduced other holdings, thereby showing that the liquidation pecking order also applies to pledgeability of bonds.

Turning to the price impact of these portfolio choices, we find evidence of price pressure for both ECB-eligible and ineligible corporate bonds. Bonds that were sold to a larger extent by the investment fund industry in our sample experienced higher price pressure. Moreover, the price impact was sustained for an extended duration of time, impairing the transmission of monetary policy to the cost of market-based finance for firms, with potentially material consequences for their financing decisions. While the price impact was generally lower and less sustained for ECB-eligible bonds, the difference was primarily due to lower yield spread increases on bonds issued by banks. These results suggest that the liquidity provided by banks and dealers was not sufficient to mitigate price dislocations in the euro area corporate bond market, in particular for bonds issued by non-financial corporations.

Our paper contributes to a growing literature on the impact of fund redemptions on the U.S. and euro area corporate bond market (Claessens & Lewrick, 2021; Falato, Goldstein, et al., 2021). More specifically, in analysing the relationship between Eurosystem collateral eligibility and redemption volumes, it contributes to the literature on strategic complementarities in fund redemptions (Chen et al., 2010; Goldstein et al., 2017) and provides further evidence on the mitigating impact of bank affiliation (Bagattini et al., 2023). Our analysis of portfolio adjustments adds to documented evidence of a liquidation pecking order (Ma et al., 2022), while the price impact analysis adds nuance to earlier findings of a mitigating impact related to ECB-eligibility (Breckenfelder & Hoerova, 2023).

Our findings also have implications for the related policy debate about how central banks could mitigate similar types of liquidity shocks (Buiter et al., 2023). By reducing strategic complementarities in redemption decisions and increasing the willingness of dealers to purchase bonds eligible for refinancing operations, the Eurosystem collateral framework may be seen to have played a stabilising role in the corporate bond market. However, the fact that asset managers reduced their allocation to eligible corporate bonds implies that they had to sell them at distressed prices, contributing to stronger price pressures than if they had been able to obtain margin loans to (at least partially) finance the redemptions. This suggests that banks do not sufficiently act as conduit between the ECB and the investment fund industry during redemption shocks. These findings could add weight to recently made calls for extending central bank liquidity facilities to non-bank financial institution (NBFI) counterparties, including asset managers.

In Appendix A, we elaborate further on this argument by developing a theoretical model, in which asset managers have the choice to fund redemptions either by selling their risky holdings at distressed prices or by obtaining the necessary funds via collateralised borrowing. Our results suggest that collateral pledgeability reduces asset managers' need to divest assets at distressed prices, reducing spillovers to the real economy and other parts of the financial sector.

2 Related Literature

As the economic ramifications of the Covid-19 pandemic started to unfold in March 2020, global financial markets experienced a number of dislocations, driven by a common surge in demand for liquidity. This so-called dash-for-cash episode has been widely studied. Severe price dislocations have been documented in the U.S. treasury market, due to forced selling by hedge funds, which had attempted to exploit small yield differences through leverage (Schrimpf et al., 2020). Initial price movements gave rise to variation margin calls, forcing these investors to unwind their positions, leading to a self-reinforcing "margin spiral" of illiquidity, growing price dislocations, and tighter margin requirements (Brunnermeier & Pedersen, 2008).

Price dislocations were particularly pronounced in the corporate bond market. Here, the impetus was driven by large redemptions from open-end investment funds. Between the months of February and March, the average U.S. investment fund experienced cumulative outflows of nearly 10% of net asset value (Falato, Goldstein, et al., 2021). Funds that invested in more illiquid bonds experienced larger outflows, confirming earlier evidence of strategic complementarities in redemptions (Chen et al., 2010; Goldstein et al., 2017), but followed a liquidation pecking order whereby they sold more liquid assets to finance redemptions (Ma et al., 2022). The impact of these flows was compounded by a reluctance of primary dealers to absorb inventory and expand their balance sheets. There was a concomitant shift in trading from risky-principal to agency trades, while the willingness of customers to pay for immediacy rose dramatically (Kargar et al., 2021). Trading volumes shifted to liquid securities, with soaring transaction costs and inverted trade-size pricing, while inventories of non-primary dealers shrank (O'Hara & Zhou, 2021). The price dislocations that resulted from this dynamic caused investment-grade corporate bonds to trade at significant discounts to credit default swaps (Haddad et al., 2021).

Similar patterns have been documented in the euro area, with peak daily redemptions reaching 10 percent of net asset value for individual funds (Claessens & Lewrick, 2021). Figure 2 shows the impact on credit spreads for an index of euro area corporate bonds. Using data for Irish investment funds, Dunne et al. (2024) found that funds applying price-based liquidity management tools (such as redemption fees and anti-dilution levies) experienced smaller outflows; bonds held to a larger extent by such funds in turn experienced smaller yield changes. Using euro area data on repo transactions,efound that banks reduced repo financing to funds during the same period, increasing the need for selling bonds to finance redemptions, although the tightening was smaller for bonds eligible as Eurosystem collateral. However, funds with closer ties to banks experienced lower outflows, as banks compensated redemptions by third party investors in the fund through purchasing fund units (Bagattini et al., 2023).

[Figure 2 about here]

The imbalances in the secondary market also spilled over to the primary market, with a sharp decline in issuance volumes raising concerns about spillovers to the real economy, through hampering the ability of non-financial corporations to raise the credit needed to bridge the anticipated demand shock. In response to these disruptions, the ECB announced that it would purchase up to EUR 750 billion worth of bonds under its Pandemic Emergency Purchase Programme, and the Federal Reserve introduced new facilities allowing it to outright purchase investment-grade bonds issued by U.S. firms. These measures were designed to bolster liquidity and reduce the costs and risks of intermediating corporate debt, and had a near-immediate effect upon their announcement, leading to a sharp decline in demand for liquidity and a concomitant normalisation of primary issuance volumes. A discussion about the policy implications of these events has followed, with proposals ranging from those arguing that central banks should act as a market maker of last resort (MMLR), to those more modest in scope, proposing that they should instead enhance existing refinancing facilities, with respect to what collateral and which counterparties to accept in these operations.

O'Hara and Zhou (2021) argue that the actions of the Federal Reserve during the Covid-19 crisis already constitute a *de facto* testament to central banks' new MMLR role, claiming that such a new direction is warranted by how the nature of crises has changed. The notion of a MMLR was first articulated by Buiter and Siebert (2007). The authors suggested that central banks should stand ready to tackle dysfunction in securities markets relevant to monetary or financial stability by making two-way prices to buy and sell those securities. Critics of this notion argue that buying assets may be warranted under a loose monetary policy stance, but would not be called for in a high-inflation environment. The promise of future outright purchases may also create moral hazard, giving investors incentives to take more risk, knowing that the central bank will act as a backstop, taking on both credit and liquidity risk in case of market dysfunction. Furthermore, purchases can have detrimental effects on market liquidity in the longer run, by creating uncertainty around the central bank's exit date, i.e., whether ownership of the bonds will be rolled, held until maturity, or sold as and when market conditions improve (Tucker, 2014).

By contrast, when the central bank provides liquidity through repurchase agreements (repos) or loans against collateral, prices are still determined by market forces. Providing liquidity through an enhanced standing facility would thus not affect the monetary policy stance to the same extent as through an MMLR. In addition, the term and pricing of the loans are known *ex ante*, although they can be rolled if needed. Prior to the pandemic, there were already commentators arguing for the role of central bank balance sheets as a macroprudential tool to mitigate liquidity shocks, and the importance of increasing *ex ante* transparency around the terms and conditions for its refinancing operations (Fisher, 2018). The core idea goes back to the notion that central banks are natural candidates for acting as a lender of last resort (LOLR), commonly attributed to the 19th century economist Walter Bagehot. Tucker (2014) has summarised his core dictum as follows: to avert panic, central banks "should lend freely to solvent but illiquid firms against good collateral at a high rate of interest".

Critics of an enhanced refinancing facility argue that it can still give rise to moral hazard, through giving incentives to invest in less liquid assets, knowing that they can be refinanced with the central bank in a crisis. However, as argued by Fisher (2018), these incentives can be reduced if the central bank makes it clear that it will only provide refinancing against high quality collateral, along with being transparent about the terms and conditions (i.e., haircuts and lending rates). The role of central bank collateral frameworks has also received renewed attention following the string of U.S. bank failures in March 2023; the concept of collateral prepositioning is increasingly being discussed as a means to mitigate risks related to uninsured deposits (McLaughlin, 2024).

A key question that has been raised in the aforementioned policy discussion is whether central banks should provide liquidity on demand to counterparties other than banks. Proponents of this idea argue that NBFIs have come to play a more prominent role in the financial system, after the reforms implemented following the GFC, accounting for nearly half of global financial assets according to a recent estimate (FSB, 2022). Moreover, fluctuations in liquidity demand increasingly stem from corresponding parts of the financial sector these days, driven, inter alia, by fund redemptions and margin requirements on derivatives transactions (Bailey, 2021; Hall, 2021). A recent case has been made for hedge funds to become eligible counterparties in the Federal Reserve's discount window, on account of their systemic role in the U.S. Treasury market and vulnerabilities related to the so-called basis trade (Kashyap et al., 2025). Critics argue that banks can act as an intermediary between the central bank and the NBFI sector, so there is no need to extend a direct facility, and that doing so would unduly increase moral hazard (Tucker, 2014). But the evidence from the dash-for-cash episode indicates that banks do not sufficiently fill the role of intermediary during episodes of severe market strain.

There may be several reasons why banks choose not to fully satisfy demand for liquidity during times of crisis. Firstly, banks may be worried about their own ability to meet regulatory liquidity requirements during episodes of market strain, choosing to hoard liquidity for themselves, rather than act as a conduit between central banks and the NBFI sector. Secondly, repo transactions are a low-margin business, and capital requirements for market risk have increased, meaning that banks may have lower incentives to engage in securities lending or repos than before. This can create frictions, forcing NBFIs to sell assets at distressed prices, which might have been avoided had they been able to borrow funds using the assets as collateral (Fontaine et al., 2021).

In a recent report by the Advisory Scientific Committee of the European Systemic Risk Board, Buiter et al. (2023) make the case that central banks in advanced economies should consider formalising the terms and conditions according to which they would intervene in securities markets in the future. A number of key design features are discussed for an enhanced LOLR, as well as a MMLR facility. For the LOLR facility, they argue that the list of counterparties should be restricted to regulated and supervised entities, in order to ensure their solvency. Beyond this limitation, the "facility could be open to brokers, dealers, asset managers, MMFs, pension funds, insurance companies, finance companies and certain types of investment companies, including hedge funds" (Buiter et al., 2023). The goal of both facilities would be to ensure that financial markets function normally. When choosing between the two, "the natural choice would be to lend and, to the extent possible, allow private agents to determine securities prices and allocate capital resources" (ibid). In other words, an enhanced LOLR would be preferable whenever possible.

Our paper contributes to this discussion, as well as to the empirical literature on strains in the corporate bond market during the dash-for-cash episode. Since the Eurosystem already included corporate bonds in its list of eligible collateral—unlike the Federal Reserve—the episode provides a case study as to what extent the framework contributes to stabilising the market during large redemption waves. Previous studies have shown that redemption flows were lower from U.S. investment funds that invest in more liquid assets—pointing to an incentive structure similar to the notion of strategic complementarities in the classic literature on bank runs (Diamond & Dybvig, 1983)—while asset managers followed a liquidity pecking order to finance redemptions (Ma et al., 2022). This paper is the first to study the role that Eurosystem collateral eligibility played in redemption decisions by fund investors and portfolio adjustments by asset managers.

3 Institutional background and derived hypotheses

3.1 The Eurosystem collateral framework

The ECB provides liquidity through overnight funding or through its main refinancing operations. Overnight funding is made available to eligible banks in the Eurosystem against a broad list of collateral published on its website on a daily basis, together with the applicable haircuts. Crucially, the list of eligible collateral has included a broad universe of investment-grade corporate bonds from the start. The loans provided in its main refinancing operations are made against the same collateral, have a fixed term of one week and are priced below the rate on its marginal lending facility, but above the rate on its deposit facility. The ECB has also operated under a fixed rate-full allotment regime since 2008, meaning that it provides unlimited reserves to eligible counterparties on demand, sometimes referred to as an *ample reserves regime*. Moreover, since there is virtually no repo market for corporate bonds in the euro area, there is no stigma attached to entering into refinancing transactions with the ECB, using corporate bonds as collateral (Bindseil et al., 2017). As noted by Cecchetti and Schoenholtz (2022), the transparency of the Eurosystem collateral framework reduces moral hazard, compared to the case where the ECB would, say, commit to provide refinancing on a more discretionary basis: when it declares there is a crisis, and against whatever collateral the eligible counterparties might have.

Prior studies have shown that corporate bonds that become eligible as collateral in the Eurosystem trade at lower yields, a so-called eligibility premium that arises because of the near cash-like feature the bonds acquire on account of being pledgeable with the ECB. Eligibility also increases activity in the securities lending market, but reduces trading activity and hence the liquidity of newly issued bonds, as banks likely increase their inventories, hoarding these assets on account of their usefulness for refinancing purposes

(Pelizzon et al., 2024). A key question for the fund-flow analysis is whether these features also serve to mitigate strategic complementarities in redemption decisions, i.e. whether the incentive for fund investors to redeem during episodes of market strain is reduced for funds that hold a higher share of ECB-eligible bonds, expecting that the asset manager will either be able to borrow against them as collateral or liquidate them with little price impact, reducing the first-mover advantage. Prior studies have also shown that funds affiliated with banks experienced lower outflows during the dash-for-cash. In addition to examining whether Eurosystem eligibility served to mitigate outflows, we also investigate to what extent bank-affiliation played a mitigating role.

3.2 Liquidity provision to asset managers

We use the term *pledgeability* to denote an asset manager's ability to obtain funding against ECB-eligible corporate bonds pledged as collateral with the lender, as a means to finance redemptions. Due to the fact that asset managers are not eligible as counterparties in the Eurosystem, the source of funding would in practice be a bank or a dealer, acting as a conduit between the ECB and the asset manager. There are a number of different ways such funding could be arranged in practice, each with different implications in terms of ownership and right to dispose of the asset being pledged as collateral. These in turn have different implications for the hypotheses we will be testing in the empirical study. The main alternatives are i) obtain a loan; enter into ii) a repo agreement; or iii) a securities lending agreement. These are briefly discussed below.

Margin loans or lines of credit

Under this option, the asset manager would obtain a loan from a lender, pledging the risky asset as collateral. The collateral would typically be deposited in a custodian account and the asset manager would retain legal ownership of the asset. Following the implementation of Directive 2002/47/EC on financial collateral arrangements, EU lenders have been given the right to reuse collateral on certain conditions, making such loans more attractive to the lender. In concrete terms, it means that a bank could pledge securities obtained as collateral for a margin loan to an asset manager as collateral for ECB refinancing. We would expect asset managers who are fully able to fund redemptions using this means to retain an unchanged allocation to bonds eligible as Eurosystem collateral, since they would retain legal ownership of the assets pledged as collateral for the loans and would not have to sell any risky assets to finance redemptions. To the extent that asset managers would also have to sell risky assets to finance the redemptions, we would expect them to sell bonds not eligible as Eurosystem collateral, because lenders would be likely to prefer collateral pledgeable with the ECB.

Repo agreements

Under this option, the asset manager would i) sell the risky asset to a dealer and ii) simultaneously agree to buy it back at a fixed price in the future. The repurchase price would be based on the sales price plus an accrued interest rate (the repo rate). In this case, the legal ownership of the risky asset would change hands, meaning that the dealer can dispose of it freely and use as collateral to obtain secured funding itself. We would expect an asset manager able to fully fund redemptions using this means to have a lower allocation to bonds eligible as Eurosystem collateral following the transaction. This is because the dealer is likely to have a preference for entering into a repo on a bond pledgeable with the ECB, knowing that it comes with a guaranteed source of funding. It should be noted that there is virtually no private repo market for corporate bonds in the euro area, meaning that this option would not be available for asset managers in the case of this asset type.

Securities lending

The securities lending market allows dealers to obtain access to assets without purchasing them outright, by borrowing them in exchange for another asset or (less commonly in Europe) cash as collateral. In order to use this approach as a means to finance redemptions, an asset manager could lend a risky asset to a dealer, in exchange for cash as collateral. The asset manager would retain the legal ownership of the asset but the dealer would obtain the right to dispose of it, meaning that it could be used to obtain secured funding. We would expect asset managers to have an unchanged or increased allocation to bonds eligible as Eurosystem collateral following this transaction, since they would retain legal ownership of the loaned assets. In case they would also need to sell other assets to finance redemptions, it is likely that they would be selling bonds not eligible as Eurosystem collateral, knowing that dealers would have a preference for borrowing assets pledgeable with the ECB.

To summarise the above discussion, we would expect asset managers who were able to finance redemptions by either loans or securities lending agreements to have an unchanged or higher allocation to corporate bonds pledgeable with the ECB, following said transactions. Since there is no private repo market for corporate bonds in the euro area, these would be the two main alternatives to finance redemptions, other than selling the bonds outright. This leads us to derive a set of testable hypotheses for the empirical analysis of fund-level portfolio adjustments, where we use the change in allocation to ECB-eligible corporate bonds as an indirect test of whether asset managers were able to finance redemptions by loans or securities lending agreements. The reason for this empirical strategy is the lack of available data for margin loans and lines of credit to directly investigate the extent to which these financing options were available, as this tends to be proprietary bank information. In doing so, we distinguish between bonds issued by non-financial corporations and those issued by banks, to pinpoint systemic spillovers to the real economy stemming from investment fund portfolio choices.

3.3 Derived hypotheses

Fund-flow analysis

Hypothesis 1: Investment funds with a higher allocation to ECB-eligible bonds experienced lower outflows during the dash-for-cash, due to lower strategic complementarities in redemption decisions, as fund investors expected the asset manager to either be able to borrow against them as collateral or liquidate them with less price impact. The effect was stronger for funds affiliated with banks.

Hypothesis 2: Investment funds with a higher allocation to ECB-eligible bonds did not experience lower outflows during the dash-for-cash, irrespective of bank affiliation. The pledgeability feature did not lower strategic complementarities in redemption decisions, as investment funds are not eligible counterparties in the Eurosystem.

Fund-level analysis

Hypothesis 3: Asset managers were able to obtain loans from banks or enter securities lending agreements with dealers at terms and conditions that made it a more favourable alternative to finance redemptions, compared to selling assets at distressed prices. Their allocation to corporate bonds pledgeable with the ECB increased as a consequence of this, on account of higher demand for these assets as collateral for bank loans, or from dealers wishing to borrow them.

Hypothesis 4: Asset managers were not able to finance redemptions by obtaining loans from banks or through securities lending agreements with dealers at sufficiently favourable terms and conditions, at least not to a significant extent. They were instead forced to sell assets at distressed prices. In doing so, they followed a liquidity pecking order (Ma et al., 2022), which caused their allocation to corporate bonds pledgeable with the ECB to decrease, due to higher demand for these assets from banks and dealers.

Price impact analysis

Hypothesis 5: The portfolio adjustments made by asset managers to finance redemptions contributed to an increase in yield spreads of corporate bonds, but the impact was lower for ECB-eligible bonds, as banks acted as a conduit between the fund sector and the ECB, resulting in lower frictions.

Hypothesis 6: The portfolio adjustments made by asset managers to finance redemptions contributed to an increase in yield spreads on corporate bonds, but the impact was not significantly lower for ECB-eligible bonds, at least not for the subcategory of those issued by non-financial corporations. This is because asset managers followed a liquidation pecking order, choosing to sell a higher share of ECB-eligible bonds to finance redemptions, resulting in significant price pressure in this segment that was not offset by higher demand for ECB-eligible bonds on account of their use as collateral in Eurosystem operations.

4 Data and Methodology

4.1 Data sources

The main data sources used in our study are the European Central Bank's (ECB) list of eligible marketable assets, Refinitiv Lipper, Refinitiv Workspace, and Dealogic. The ECB's list is a comprehensive account of financial instruments that are eligible to be used as collateral in the Eurosystem's operations. The list is maintained and updated at a daily frequency by the ECB and is used as a reference for financial institutions that participate in Eurosystem's operations, such as lending and monetary policy operations. Refinitiv Lipper is a commercial financial database that provides comprehensive information on investment funds. Among other information, it includes data on funds' characteristics, performance, and granular holding-level data on funds' portfolios. Refinitiv Workspace is a commercial financial database that provides static data as well as historical information on transaction volumes, prices, and bid-ask spreads of financial assets. Dealogic is a commercial database that provides static bond characteristics such as the principal amount or initial credit ratings.

4.2 Data processing and descriptive statistics

We compile the daily lists of Eurosystem-eligible marketable assets into a quarterly panel covering the period Q1 2015 to Q2 2020. In each quarter, an asset is considered ECB-eligible if it appears on the list at least once in a quarter.

We utilise the Lipper database to construct three datasets. First, we calculate the aggregate exposure of all investment funds in the database to individual corporate bonds. This results in a quarterly bond-level panel that captures the time-varying share of a bond's principal amount held by the investment fund industry. Next, we apply a series of filters to construct fund-level and holding-level datasets. Our analysis focuses on euro area-domiciled, corporate bond-holding investment funds that reported at least ten different holdings in Q4 2019. Within these funds, at least one corporate bond is required to be ECB-eligible, which results in a universe of more than 2,000 candidate funds. The fund holding information is collected for the end-of-quarter reporting dates between Q1 2015 and Q2 2020. We categorise the holdings into cash, corporate bonds, sovereign bonds, term notes, derivatives, repurchase agreements, and other using both Lipper's asset type variable and supplementary sources of information.[1] Within the corporate bond category, we differentiate between bank bonds and non-bank corporate bonds.

[1] Asset categorisation is not a trivial exercise as, depending on the source of information, the same asset can be assigned into different categories. We employ different approaches to categorise the assets, which are described in more detail in Appendix B.1. As a general rule, assets are referred to as cash if Lipper's asset type is one of the following: "Cash", "Cash Equivalent", "Currency". Assets are referred to as corporate bonds if asset type is: "Corporate Medium Term Notes", "CORP", "Global Bonds", or "Corporate Intermediate and Long Term Debt", "Bank Debt". Assets are referred to as sovereign debt (in a broad sense) if asset type is: "Treasury STRIPS", "Supranational", "Treasury Bills", "Sovereign Bond", "MUNI", "Government other", "Agency Medium Term Notes", "Agencies".

There are several reasons for doing so. First, many prior studies of the dash-for-cash have not made this differentiation (Breckenfelder & Hoerova, 2023; O'Hara & Zhou, 2021). Our paper thus contributes to the empirical literature by examining whether the impact of the redemption wave was stronger for bonds issued by banks or non-financial corporations. Second, we are primarily interested in examining the impact on bonds issued by the latter category, since the potential spillover to the primary market for these issuers was cited as a key reason for the policy measures taken by central banks to mitigate the liquidity strain in the corporate bond market. Since then, it has been highlighted as a key transmission channel for systemic risk. While banks that run into financing problems may also contribute to systemic risk, the policy implications are fundamentally different, as there is a comprehensive safety net in place to deal with liquidity problems in banks.

We furthermore restrict the fund sample by requiring the average quarterly share of corporate (sovereign) bonds to be above (below) 25% over the considered sample period, which reduces our final sample to 766 individual funds. We supplement the holding-level data with quarterly ECB-eligibility information using the above-mentioned list of eligible marketable assets and construct a dummy variable *ECB-eligible* that equals one if an asset is Eurosystem-eligible in a given quarter, and zero otherwise. The proportion of eligible and ineligible corporate bonds in each fund's portfolio is then calculated in terms of aggregated par value for each quarter within the sample period; we refer to this variable as *ECB-eligible corporate bond share* (in short, *Eligible CBS*). The reason for using par value as opposed to market value, is that we are interested in portfolio changes due to discretionary allocation choices. Hence, we want to avoid contaminating the results with changes caused by diverging relative price fluctuations in the groups. Finally, we define a *COVID* dummy variable taking the value of one for Q1 2020, and zero otherwise. In the following, we refer to the aggregated dataset with fund-quarter observations as the fund-level panel, while the disaggregated dataset with fund-holding-quarter observations is termed the holding-level dataset.

For the price analysis, we obtain for all corporate bonds held by the sample of our funds in Q1 2020 the daily information on the yield to maturity and the bid-ask spreads from Refinitiv Workspace for the period 31.12.2019 to 31.03.2020. We define the yield spread as the difference between the bond's end-of-day yield to maturity and the maturity-matched risk-free rate, derived from the German Bund yield curve.[2] The bonds are supplemented with daily ECB-eligibility information.

The descriptive statistics are reported in Table 1. Panel A presents the investment fund industry's aggregate exposure to corporate bonds during the period Q1 2015 to Q2 2020, differentiating between bonds that were at least once ECB-eligible during the sample period ($Ever\ EA = 1$) and those that were never eligible assets. On average, the size of a bond is about EUR 714 million, with investment funds collectively holding in their portfolios about EUR 23 million or 4% of a bond's outstanding principal amount. The exposure is slightly larger for eligible bonds with a principal amount of EUR 795.4 million and absolute holdings of about EUR 30 million. Panel B presents the statistics at the fund level. The average fund has a market value of EUR 731.5 million and holds about 287 individual assets. Cash represents about 2% of total holdings, while corporate and sovereign bonds comprise 80% and 6% of the portfolio's market value, respectively. About 25% of corporate holdings are ECB-eligible. During the sample period, we observe on average net fund inflows of about 3%. The holding level sample, Panel C, is comprised of 52,750 individual corporate bonds. The funds' mean par value corporate bond exposure is about EUR 2.15 million (EUR 1.87 million for eligible and EUR 2.16 million for ineligible bonds). The quarter-on-quarter relative change in the par value exposure is -10%. In terms of bond currency (not reported in the table), the

[2]The risk-free rate is based on the Nelson-Siegel-Svensson yield curve, with the parameters estimated from Bund yields and taken from the Deutsche Bundesbank's website. We compute the yield spread following Dick-Nielsen et al. (2012) and Friewald et al. (2012).

sample consists of 53.6% USD-, 33.5% EUR-, 5% GBP-, 1.7% CHF-, 1.5% CAD-, and 1.1% SEK-denominated bonds. About 46% (26.8%) of EUR (GBP)-denominated bonds are ECB-eligible. Panel D reports the summary statistics for the 5,648 corporate bonds that are used in the price-level analysis. The yield spreads (0.92% vs 2.67%) and bid-ask spreads (6 basis points (bp) vs 8 bp) of eligible bonds are considerably lower than for ineligible ones. About 35% of the bonds are ECB-eligible, of which 58% are eligible bank bonds. Furthermore, the investment fund industry held in Q4 2019 on average 5% of the bonds' outstanding principal amount (not reported in the table). This exposure dropped by 1 percentage point (pp) in Q1 2020, which indicates a strong divestment behaviour due to the COVID-induced market turmoil.

[Table 1 about here]

4.3 Methodology

4.3.1 Investment fund industry exposure analysis

We begin our analyses by examining the investment fund industry's exposure to corporate bonds over time. In particular, we focus on the industry's response to the market turmoil triggered by the COVID outbreak and investigate the potential role of ECB eligibility during this period. We employ the following baseline regression equation:

$$y_{j,t} = \alpha + \beta_1 COVID_t * \textit{ECB-eligible}_{j,t} + \beta_2 COVID_t + \textit{Controls} + \gamma_j + \delta_h + \epsilon_{j,t}, \qquad (1)$$

where the variable of interest, $y_{j,t}$, is defined as the ratio between the aggregate par value of bond j held across all investment funds in quarter t and the bond's principal amount. As an alternative definition, we use the quarter-on-quarter change of the ratio. $COVID_t$ is a dummy variable that equals one in Q1 2020, and is zero otherwise. $\textit{ECB-eligible}_{j,t}$ is a dummy variable indicating whether bond j is pledgeable with the Eurosystem at time t. *Controls* include (i) the natural logarithm of bond j's time-to-maturity at the end of quarter t and (ii) four quarter indicators. The former variable accounts for maturity-related asset allocation decisions, while the latter absorb seasonal patterns. We further add bond fixed effects, γ_j, and half year fixed effects, δ_h, to account for individual bond characteristics and time variation in the overall market sentiment, respectively. $\epsilon_{j,t}$ is the error term. In addition to the baseline specification, we test whether the change in industry exposure was different for ECB-eligible bank bonds by interacting the relevant covariates with a *Bank bond* indicator.

4.3.2 Fund flows analysis

We study the investment fund flows using the following baseline regression equation:

$$y_{it} = \alpha + \beta COVID_t + \textit{Fund controls}_{it} + \textit{Trend}_t + \gamma_i + \delta_{ih} + \epsilon_{it}, \tag{2}$$

where the dependent variable, y_{it}, is the relative net fund flows of fund i in quarter t, defined as a ratio between absolute net fund in- and outflows in t and fund size in $t-1$. *Fund controls*$_{it}$ account for fund-specific time-varying characteristics. These include the lagged fund size and lagged sum of cash holdings, terms notes, and sovereign bonds as percentage share of fund size. The former variable controls for any size-specific redemption effects, while the latter takes into account fund investors' differentiated redemption responses depending on a fund's cash and cash-equivalent holdings. The time trend variable, *Trend*$_t$, accounts for aggregate time-specific trends in the market. The fund fixed effects, γ_i, absorb any unobserved fund-specific characteristics such as management style or investment strategy. The fund×half year fixed effects, δ_{ih}, account for any variables that are specific to a particular fund, and that vary at a low, bi-annual frequency.

4.3.3 Fund-level analysis

We study the investment funds' allocation decisions during redemption waves using the following regression equation:

$$y_{i,t} = \alpha + \beta COVID_t + \textit{Fund controls}_{i,t} + \textit{Trend}_t + \gamma_i + \delta_{i,h} + \epsilon_{it}, \tag{3}$$

where $y_{i,t}$ is defined as the proportion of ECB-eligible corporate bonds relative to the total face value of all corporate bonds held in the portfolio by fund i in quarter t. $\textit{Fund controls}_{i,t}$ account for fund-specific time-varying characteristics. These include the lagged dependent variable, lagged fund size, and lagged sovereign bond share. The former variable accounts for autocorrelation, fund size absorbs any size-specific portfolio allocation effects, and the lagged sovereign share controls for asset managers' preference to sell the more liquid assets first. The time trend variable, $\textit{Trend}_t$, accounts for aggregate time-specific trends in the investment fund industry. The fund fixed effects, γ_i, absorb any unobserved fund-specific characteristics such as management style or investment strategy. The fund$\times$half year fixed effects, $\delta_{i,h}$, account for any variables that are specific to a particular fund, and that vary at a low, bi-annual frequency.

4.3.4 Holding-level analysis

To examine the investment funds' allocation decisions at the holding level, we employ the following baseline model specification:

$$y_{i,j,t} = \alpha + \beta COVID_t * \textit{ECB-eligible}_{j,t} + \textit{Bond controls}_{i,j,t} + \zeta_{i,t} + \theta_{j,h} + \epsilon_{i,j,t}, \tag{4}$$

where the variable of interest, $y_{i,j,t}$, is either (i) the relative quarter-on-quarter change in the par value of holding j in fund i in quarter t, or (ii) the logarithm of the corporate bond par value. $\textit{Bond controls}_{i,j,t}$ are: (i) the lagged logarithm of the holding j's par value held by fund i in quarter t and (ii) a dummy variable that equals one if the bond matured in t. The former covariate controls for autocorrelation, while the latter accounts for the mechanical reduction in the bond holding due to the bond having matured. Fund×quarter fixed effects, ζ_{it}, absorb any unobserved time-varying fund-specific characteristics, such as fund's popularity among investors. The bond×half year fixed effects, $\theta_{j,h}$, account for unobserved low-frequency time-varying bond-specific characteristics, such as credit rating changes. In addition to the baseline specification, we test whether the change in holdings was different for ECB-eligible bank bonds by interacting the relevant covariates with a *Bank bond* indicator.

4.3.5 Price analyses: impact and duration

To examine the impact of investment fund redemption waves on secondary market bond prices, we use the following regression equation:

$$\begin{aligned} y_{j,t} = \alpha &+ \beta_1 COVID_t * \textit{(Industry's QoQ exposure change)}_j * \textit{ECB-eligible}_j \\ &+ \beta_2 COVID_t * \textit{(Industry's QoQ exposure change)}_j + \beta_3 COVID_t * \textit{ECB-eligible}_j \\ &+ \gamma_j + \delta_{f(j),t} + \zeta_{m(j),t} + \eta_{r(j),t} + \epsilon_{j,t} \end{aligned} \quad (5)$$

where the variable of interest, $y_{j,t}$, is either (i) the yield spread of bond j on day t, or (ii) the bid-ask spread. $COVID_t$ is a dummy variable equal to one in March 2020, and zero otherwise. $\textit{ECB-eligible}_j$ indicates whether bond j was pledgeable with the Eurosystem at least once in Q4 2019. $\textit{Industry's QoQ exposure change}_j$ measures the quarter-on-quarter change in the investment fund industry's relative exposure to bond j between Q4 2019 and Q1 2020. Bond fixed effects, γ_j, absorb all time-invariant bond-specific characteristics such as country of risk. Similar to Ma et al. (2022), we further include issuer-time ($\delta_{f(j),t}$), maturity-time ($\zeta_{m(j),t}$), and initial-rating-time ($\eta_{r(j),t}$) fixed effects to achieve a granular within-bond-type analysis. The bond issuer is defined at the ultimate parent level and the time to maturity is grouped into yearly buckets. In addition to the baseline specification, we test whether the price impact on ECB-eligible bonds was different for bonds issued by banks by interacting the relevant covariates with a *Bank bond* indicator.

The final analysis focuses on the duration of the COVID-induced price impact. To measure the speed of the price reversal after the market turmoil, we use the following baseline model:

$$\begin{aligned} y_j = \alpha + \beta_1 \textit{ECB-eligible}_j * (\textit{Industry's QoQ exposure change})_j + \beta_2 \textit{ECB-eligible}_j \\ + \beta_3 (\textit{Industry's QoQ exposure change})_j + \textit{Controls}_j + \epsilon_j, \end{aligned} \tag{6}$$

where y_j measures the weeks until bond j's weekly average yield spread returns back to its pre-market-turmoil level, which we define as the average yield spread in the first week of March 2020. To account for bond-specific characteristics that could influence the speed of the price reversal, the vector of $\textit{Controls}_j$ includes the natural logarithm of bond j's principal amount, the weekly average yield spread and time-to-maturity measured in the first week of March 2020, the issuer's industry sector, bond currency, and a dummy variable indicating whether the bond is callable.

5 Results

Investment fund industry exposure

We begin by examining the share held by the investment fund industry of the total outstanding amount of corporate bonds over time, focusing on the industry response during the March 2020 market turmoil. The results are presented in Table 2.

[Table 2 about here]

Model 1 focuses on the COVID outbreak period and tells us that there was a 20 basis point (bp) lower share held by the investment fund industry in Q1 2020 as opposed to other periods. Given that on average the industry has an exposure of 3.685% to corporate bonds in our sample, this drop corresponds to a sizeable average exposure reduction of 5.75%. The results on the quarter-on-quarter exposure change confirm this finding. In Model 5, we observe that the industry reduced its exposure from Q4 2019 to Q1 2020 by about 1.1 percentage points (pp). In Model 2, we test whether there was a difference in the drop observed for ECB-eligible corporate bonds compared to the overall drop. Indeed, we find that the reduction in the share held of ECB-eligible corporate bonds was 40 bp higher than the reduction for non-eligible bonds. In other words, the industry response to the COVID outbreak and the resulting redemption wave was to reduce its exposure to ECB-eligible corporate bonds to a larger extent than to non-eligible bonds. In Model 3, we test whether our findings could be driven by the sell-off of bank-issued corporate bonds. We find that the industry reduced its exposure to bank bonds on average by 30 bp, while the coefficient for the overall drop during the COVID outbreak becomes insignificant. This suggests that the overall exposure reduction observed in Model 1 could be attributed to both bank bonds and ECB-eligible corporate bonds. Model 4 confirms this finding: The interaction terms between the COVID dummy and both the ECB-eligibility dummy and the bank bond dummy are negative and significant. However, Model 8 suggests that the industry might have also focused on reducing its exposure to ECB-eligible bank bonds. We will further explore this in the next sections.

Overall, our analysis indicates a significant and widespread reduction in corporate bond holdings across the investment fund industry during the COVID outbreak, and that the reduction was particularly pronounced for ECB-eligible bonds and bank-issued bonds.

Fund-flow findings

Following the analysis of the investment fund industry exposure, we run panel regressions to determine the impact of pledgeability on fund flows during the redemption wave in Q1 2020. The results are presented in Table 3.

[Table 3 about here]

The first model only includes the dummy for the COVID outbreak, and shows that there were significant fund outflows in Q1 2020. In the second model, we test whether fund flows over time are related to the share of ECB-eligible corporate bonds held in the previous quarter but find no statistically significant evidence of this. However, interaction term *COVID * Eligible CBS* in Model 3 is significant and positive at 0.221. This tells us that fund outflows during the COVID outbreak were lower, the higher the share of eligible corporate bonds held by the fund in the preceding quarter. These results align broadly with prior findings by Ma et al. (2022), who show that outflows from US investment funds during the dash-for-cash were lower for funds with a higher share of liquid bonds. We thus find evidence that the pledgeability feature of ECB-eligible bonds serves to temper strategic complementarities in fund redemptions, leading us to reject Hypothesis 2 for the fund-flow analysis.

Studies have also shown that bank affiliation played a mitigating role in terms of the redemption volumes faced by euro area investment funds during the dash-for-cash (Bagattini et al., 2023). In Model 4, we therefore control for whether the fund is affiliated with a bank. *Bank-affiliated* is a dummy variable that equals one if the fund belongs to an investment company that (i) is a direct subsidiary of a bank, (ii) has a bank as the main shareholder, or (iii) is part of holding company that also holds a bank.[3] In contrast with

[3]For instance, BNP Paribas Asset Management belongs to the first category since it is a subsidiary of BNP Paribas, Amundi Asset Management belongs to the second category since its main shareholder is Crédit Agricole, and Columbia Management Investment Advisers belongs to the third category since

prior findings, we find that funds affiliated with a bank overall experienced slightly larger (but insignificant) outflows during the COVID outbreak. However, when interacting this variable with the ECB-eligible corporate bond share, we find that bank-affiliated funds experienced lower outflows during the COVID outbreak, the higher the share of ECB-eligible corporate bonds held in the preceding quarter. In other words, our findings suggest that the mitigating role of bank affiliation documented in prior studies depends on the share of ECB-eligible bonds held by the fund in question.

Fund-level findings

Following the analysis of fund flows, we run panel regressions to determine whether asset managers in our sample increased or decreased their allocation to bonds eligible as Eurosystem collateral during the redemption wave in Q1 2020. The results are presented in Table 4.

[Table 4 about here]

The first model focuses only on two periods, Q4 2019 and Q1 2020. We can observe that during the COVID outbreak investment funds' share of ECB-eligible corporate bonds dropped by 1 pp. In the second model, we extend the time period to cover the full sample, controlling for fund fixed effects and the presence of a linear time trend. The inclusion of the time trend is motivated by the fact that there is a general decline of ECB-eligible corporate bond holdings in investment funds' portfolio holdings over time, as shown by Figure 3.

[Figure 3 about here]

it is owned by Ameriprise Financial, which also owns Ameriprise Bank. One might argue that the third category is a very loose definition of bank-affiliation. For robustness purposes, we re-ran the analyses by defining bank-affiliation using only the first two categories. However, the results do not differ quantitatively or qualitatively and are available upon request.

We also control for fund size, the allocation to ECB-eligible corporate bonds in the previous quarter, as well as the lagged share of sovereign bonds in the total investment portfolio. The rationale for the latter is that a higher share of sovereign bonds in the prior quarter may affect asset managers' propensity to change the allocation to ECB-eligible corporate bonds. The results tell us that the *COVID* dummy remains statistically significant, with a coefficient of -0.014.

To better understand the driving forces behind our findings, we run Models 3 and 4. In Model 3, we test whether asset managers' propensity to reduce the allocation to ECB-eligible corporate bonds is affected by the share of sovereign bonds at their disposal. Considering that sovereign bonds are typically more liquid than corporate bonds, it would be natural to follow a liquidation pecking order to finance redemptions, whereby sovereign bonds are sold prior to corporate bonds, in line with the findings of Ma et al. (2022). We define the variable *Outflows* $>$ *Sov. share* as a dummy that equals one if fund outflows in a given quarter are larger than the share of sovereign bonds held by the fund in the previous quarter, and zero otherwise. The variable acts as a proxy for the fund's (in)ability to cover the outflows by selling its (more liquid) sovereign bond holdings. The variable has a significant and negative coefficient of -0.004, suggesting that funds experiencing outflows exceeding their sovereign bond holdings in general tend to reduce their allocation to ECB-eligible corporate bonds. However, the interaction term *COVID**(*Outflows* $>$ *Sov. share*) in Model 3 is both small in terms of magnitude and insignificant, suggesting that the scale of this behaviour did not differ during the dash-for-cash.

To test whether bank affiliation also affected the allocation to ECB-eligible corporate bonds, we introduce the variable *Bank-affiliated* in Model 4. We would expect funds with a bank affiliation to keep their ECB-eligible assets in their portfolios as they could be pledged with the bank against a short-term loan that could finance the outflows. Our results, however, do not show any significant relationship between bank-affiliation and the allocation decision.

Our findings suggest that investment funds reduce their relative share of ECB-eligible corporate bonds during redemption waves irrespective of the share of more liquid holdings or bank-affiliation. Potentially, we underestimate the immediate impact of redemptions on asset managers' allocation decisions since our panel is at quarterly frequency, while the market turmoil reached its peak in mid-March 2020 and then began to stabilise. Therefore, the end-of-March 2020 holdings partially reflect a market normalisation. In Appendix C, we study whether a similar allocation decision takes place in times of idiosyncratic redemption shocks. For this purpose, we focus on individual funds experiencing large redemption flows. We define a large fund redemption as an outflow that exceeds 20% of the previous quarter fund size (measured at market prices). Fund-specific large redemption shocks are spread throughout the whole sample period and affect almost all funds at some point in time. The results of this analysis are presented in Table C1 and the findings suggest that the relative reduction of ECB-eligible corporate bonds in the portfolio also takes place at individual fund level; whenever a fund experiences high redemptions, it tilts its holdings towards ECB-ineligible corporate bonds.

Holding-level findings

One limitation with the above fund-level analysis is that the reduced allocation to ECB-eligible corporate bonds that we observe in Q1 2020 is not by itself evidence that asset managers were selling these bonds. A lower allocation could, in theory, also be caused by buying more ECB-ineligible bonds, although this is not likely to have been the case, given that we know that the funds experienced a redemption shock and had to sell assets to finance it. Nevertheless, in order to verify the extent to which asset managers actually sold ECB-eligible corporate bonds, we now turn to the individual holdings.

In the following analyses, we use two different dependent variables. The first one is defined as the quarter-on-quarter change in the par value of a bond held by a fund. This variable helps us to measure the relative change of a fund's exposure to an individual holding. The second variable is defined as the logarithm of a bond's par value. We use this variable for robustness purposes and to estimate the absolute EUR-value change in the fund's exposure to an individual asset. The results using the first dependent variable are presented in Table 5, while the results using the second one are reported in Table 6. In both cases, we restrict the sample to holdings of corporate bonds only and ignore funds' exposures to sovereign bonds and other asset categories.

[Table 5 about here]

[Table 6 about here]

The results in Table 5 and 6 are broadly consistent with the analysis at the fund level presented in Table 4. Model 1 in Table 5 suggests that during our sample period, funds are likely to increase their holdings of ECB-eligible bonds by 8.7 percentage points less compared to ineligible bonds. This is confirmed by the negative regression coefficient in Table 6, Model 1. The coefficient of -1.154 indicates that, all other factors being equal, a fund is likely to have approximately 68% less exposure to an eligible bond compared to one that is not. Model 2 in both tables indicates that there was a significant reduction in the par value of ECB-eligible corporate bonds in Q1 2020, as measured by the interaction term *COVID*ECB-eligible*. This is evidence that asset managers sold these bonds to finance the redemption shock, and not only reduced their allocation to them.

Similar to the fund-level analysis, we also examine a number of additional interaction terms. In Model 3, we test whether our findings are driven by bank bonds. The positive coefficient of *Bank bond*ECB-eligible* reveals that asset managers in general tend to purchase and hold more ECB-eligible bank bonds as opposed to ECB-eligible bonds issued by non-financial corporations. However, during the Covid-19 outbreak, both bond categories were equally likely to be sold, as indicated by the insignificant triple interaction term. As before, bank affiliation does not seem to affect the results. Similar to the fund-level analysis, we find a significant negative relationship between the interaction of outflows exceeding the share of sovereign bonds held with ECB eligibility and both dependent variables. This indicates that investment funds suffering outflows that exceed their sovereign bond holdings sell ECB-eligible corporate bonds in order to finance the redemptions, regardless of whether the redemption shock was systemic or idiosyncratic. In the Appendix, Tables C2 and C3 provide tentative support for the above findings also on a broader scale. In this analysis, we replace the COVID dummy with a proxy for large idiosyncratic fund outflows, *Outflows* $\geq$ *20%*, and restrict the sample period to range from Q1 2015 to Q4 2019 to exclude the systemic impact of the dash-for-cash episode. The interaction term *(Outflows* $\geq$ *20%)*ECB-eligible* is significant in Models 2 and 3 in both tables, suggesting that large outflows are associated with similar asset allocation decisions as during a systemic event. However, the effect becomes insignificant when we differentiate between funds by whether their outflows exceed the share of sovereign bonds held.

To corroborate our interpretation of these findings as evidence of a liquidation pecking order, we perform a liquidation-outflow-sensitivity analysis as a robustness exercise. The methodology follows Ma et al. (2022) and is described in detail in Appendix D. Our findings are presented in Figure 6 and Table 7. Figure 6 plots the estimated liquidation-outflow sensitivities for different initial credit rating buckets. Consistent with Ma et al. (2022), Panel A shows that bonds with higher initial credit ratings exhibit a greater liquidation-to-outflow sensitivity. Focusing on the subsample of investment-grade corporate bonds, Panel B of the same figure reveals that higher-rated ECB-eligible bonds have the strongest sensitivity, suggesting that the liquidation pecking order applies also to the pledgeability of bond.

[Figure 6 about here]

[Table 7 about here]

The regression results in Table 7 further confirm this pattern by taking into account the liquidation rank of the bonds held. In Model 1, we find that bonds with a higher liquidation rank are more sensitive to fund outflows, consistent with Ma et al. (2022). In Model 2, we differentiate between ECB-eligible and ECB-ineligible bonds within the same liquidation rank. The positive and significant coefficient on the triple interaction term supports the existence of a liquidation pecking order driven by ECB eligibility. Since our primary focus in on corporate bonds, we re-run this analysis for this subsample in Models 3 and 4. The results are both qualitatively and quantitatively similar to those obtained for the full bond sample.

Taken together, our findings suggest that asset managers reduced their allocation to corporate bonds eligible as Eurosystem collateral during the dash-for-cash episode at the onset of the Covid-19 pandemic, selling them in order to finance the redemptions. The results hold up to a number of robustness checks, pointing to a rejection of Hypothesis 3 in Section 3, in favour of Hypothesis 4. Overall the findings suggest that the documented liquidity pecking order holds also during non-crisis periods, i.e. asset managers generally follow a pecking order whereby they sell ECB-eligible corporate bonds to finance redemptions in response to large outflows, including those that do not coincide with a systemic liquidity crisis. However, there is some uncertainty as to whether or not this is driven by outflows exceeding the share of sovereign bonds held.

Price-level findings

In addition to the analysis of changes in fund allocation and holdings, we attempt to study the price impact of these portfolio choices. For this purpose, we focus on corporate bonds held by the investment funds in our sample between Q4 2019 and Q1 2020. The results are presented in Table 8.

[Tables 8 about here]

Model 1 in Table 8 tells us that there was a general drop in bond prices in March 2020. The coefficient for the *COVID* dummy indicates that the yield spread increased on average by 70 bp. Turning to Model 2, we observe that the increase was larger for ECB-ineligible corporate bonds (78.8 bp) and lower for ECB-eligible corporate bonds, with an increase of 55 bp. In Model 3, we introduce an interaction term between the COVID dummy and the quarter-on-quarter difference in the share of a bond's principal amount held by the investment fund industry. The coefficient of *COVID*(Industry's QoQ exposure change)* is significant and negative at 2.798, telling us that bonds sold to a larger extent by the investment fund industry experienced higher price pressure and spread increases during the dash-for-cash episode. A 1 pp reduction in the industry's quarter-on-quarter exposure to a bond is associated with a 2.8 bp increase in the yield spread. In Model 4, we interact this term with the ECB-eligibility dummy. The results indicate that fund-driven price pressures were higher for ineligible bonds (coefficient of -4.217), but there was still a material and significant negative relationship between the change in the share of the principal amount of ECB-eligible bonds held by the investment fund industry and their yield spread increase in March 2020. In Model 5, we further differentiate between corporate bonds issued by banks and those issued by non-financial corporations. Crucially, the coefficient of *COVID*(Ind. QoQ exp. chng.)*ECB-eligible*Bank bond* is significant, suggesting that ECB-eligible bank bonds that were sold to a larger extent by the investment fund industry experienced lower price pressure, compared to bonds issued by non-financial corporations, while the coefficient of *COVID*(Ind. QoQ exp. chng.)*ECB-eligible* is insignificant. This suggests that the lower price pressure observed for ECB-eligible bonds in Model 4 is driven by lower price pressure on the subcategory of such bonds issued by banks. However, for bank bonds in general, the price pressure is not significantly different compared to bonds issued by non-financial corporations. Also, the negative and significant coefficient of *COVID*ECB-eligible*Bank bond* indicates that ECB-eligible bonds issued by banks experienced a lower overall price drop compared to those issued by non-financial corporations, irrespective of the price pressure stemming from the fund industry.

It is important to note that the analytical approach followed thus far does not allow us to make any conclusive claims about causality. In order to corroborate our interpretations of the above findings as evidence of price pressure induced by asset manager portfolio adjustments in response to outflows, we run a number of additional analyses as robustness checks.

For this purpose, we construct four proxies of mutual-fund-induced price pressure on the bond market: i) flow-implied trade (Jiang et al., 2021), ii) price pressure (Coval & Stafford, 2007; Jiang et al., 2021), iii) imputed outflow (Ma et al., 2022), and iv) liquidation-adjusted outflow (Ma et al., 2022). The definitions of the variables are provided in Appendix D.2. The results are presented in Tables 9 and 10, indicating that all four variables have a significant impact on the yield spread during the dash-for-cash episode, although with varying degree with respect to ECB eligibility.

Starting with the flow-implied trade analysis in Table 9, the negative coefficient for the interaction term *COVID*Flow-implied trade* in Model 1 confirms that fund outflows during the Covid outbreak gave rise to bond sales that caused significant spread increases. However, the coefficient for the *COVID*Flow-implied trade*ECB-eligible* term in Model 2 is insignificant, suggesting that the price impact of mutual fund trades was not different for ECB-eligible bonds, while the positive and significant coefficient of the *COVID*Flow-implied trade*ECB-eligible*Bank bond* interaction term in Model 3 reveals that the price impact was lower for ECB-eligible bank bonds. Turning to the results using the price pressure proxy, the coefficient for the *COVID*Price pressure* variable is significant, confirming the general finding that outflow-driven bond sales by asset managers during the Covid outbreak caused an increase in yield spreads. However, the results for the interaction term with ECB eligibility are significant, suggesting that there is a differentiated price response between eligible and ineligible bonds if only extreme fund inflows and outflows are considered.

Turning to the imputed outflow and liquidation-adjusted outflow analysis in Table 10, both the *COVID*Imputed outflow* and *COVID*LAO* coefficients are significant and positive, confirming that fund outflows caused significant price pressure through the resulting bond sales. However, the insignificant triple interaction terms in Models 2 and 5 suggest that the price impact was not different for ECB-eligible bonds. The differentiation between bank and non-bank eligible corporate bonds in Models 3 and 6 reveals that the price impact was lower for bank bonds. Overall, the results confirm our earlier findings along with the interpretation that asset manager portfolio adjustments in response to fund outflows led to price pressure in the bond market. The results also indicate that the observed pressure was generally not significantly lower for ECB-eligible corporate bonds, only for the subcategory of those issued by banks. This leads us to reject hypothesis 5, in favour of hypothesis 6.

[Table 9 about here]

[Table 10 about here]

In Table 11, we turn to bid-ask spreads as a proxy for market liquidity. Model 1 documents an increase in bid-ask spreads during the dash-for-cash episode, while Model 2 suggests a slightly smaller positive net effect for ECB-eligible bonds. ECB-eligible corporate bonds had lower bid-ask spreads overall during the studied period. Model 3 tells us that a 1 pp quarter-on-quarter reduction in industry's exposure to a bond is associated with a 15.7 bp bid-ask spread increase during the dash-for-cash, while Model 4 indicates that ECB-eligible bonds did not suffer significantly differently from industry-wide divestments compared to their ineligible counterparts. Model 5 shows that bank bonds tend to have lower bid-ask spreads in general. However, there seems to be no significant difference between ECB-eligible and ineligible bank bonds. While the price pressure stemming from the fund industry has a significant and negative impact on bid-ask spreads across all corporate bonds, it does not seem to affect bank bond liquidity significantly, supporting the above yield spread findings.

[Table 11 about here]

Taken together, these results indicate that the investment fund industry contributed to significant price pressure on corporate bonds during the dash-for-cash in the euro area. However, it should be noted that our analysis does not allow us to verify whether they exerted stronger price pressure relative to other market participants. For instance, our data do not allow us to determine to what extent euro area banks also contributed to price pressure through selling bonds on the secondary market.

Duration of the price impact

To further examine the economic significance of the price impact presented in the previous section, we analyse the extent to which it was sustained over time. The results are presented in Table 12.

[Table 12 about here]

In Model 1, we test whether the duration of the price impact was different for ECB-eligible corporate bonds. The constant in the model tells us that overall, it took about 38 weeks for the average weekly yield spread of the bonds in our sample to revert to its pre-COVID baseline level. The coefficient of the dummy for ECB eligibility is significant with a value of −4.025, implying that the duration of the price impact was about 4 weeks shorter for ECB-eligible bonds. In Model 2, we test whether the duration was different for the subcategory of ECB-eligible corporate bonds issued by banks. The coefficient for ECB-eligibility remains significant (though less so) but with a smaller magnitude of −1.237, while the coefficient of *ECB-eligible*Bank bond* is significant at −4.341. In other words, the shorter duration of the price impact for ECB-eligible bonds was driven to a large extent by bank-issued bonds.

In Model 3, we test whether the duration of the price impact was affected by the magnitude of the investment fund industry's exposure to the bond in the preceding quarter. The coefficient for the variable *Industry's relative exposure in Q4 2019* is positive and significant, implying that the price impact was more sustained, the larger the fund industry's share of the total outstanding amount of a bond held in the previous quarter.

In Model 4, we test whether the industry's divestments quarter-on-quarter affected the duration of the price impact. The underlying logic of this model is that when the investment fund industry reduces it share of the total outstanding amount of a bond, it creates more supply on the secondary market. The larger the divestment, the longer time it takes for this excess supply to be absorbed and for the price impact to be reversed. The coefficient for the change in the overall share held by the investment fund industry between Q4 2019 and Q1 2020 is insignificant. However, the coefficient of the interaction term *ECB-eligible*(Ind. QoQ exp. chng)* is negative and significant at −35.226. This means that the larger the reduction of the investment industry's share in ECB-eligible bonds, the longer was the duration of the price impact.

Model 5 is an extension of Model 2 to determine whether the effect of fund divestments on the duration of the price impact was different for ECB-eligible bank bonds. As in Model 2, we find that the duration of the price impact was overall shorter for ECB-eligible bonds issued by banks, compared to those issued by non-financial corporations. However, unlike in Model 4, the *ECB-eligible*(Ind. QoQ exp. chng.)* variable is not significant, while we can observe a weakly significant positive coefficient for the variable *(Ind. QoQ exp. chng.)*Bank bond*. This means that the price impact on bonds issued by banks was shorter, the higher the divestments of the fund industry in Q1 2020 were. While counterintuitive at first glance, this could be interpreted such that the price pressure on bank bonds for which funds were able to find a buyer was shorter in duration, due to higher demand for these from dealers. Whether the bank bond is ECB-eligible or not does not seem to play a significant role in this case.

Overall, the results in this section indicate that the duration of the observed price impact on corporate bonds was substantial, with potentially important economic consequences for firms' financing decisions during the period. The duration was shorter for ECB-eligible bonds, but much more so for the subcategory of such bonds issued by banks than those issued by non-financial corporations. In other words, the consequences for ECB-eligible bond issuers operating in the real economy were more significant than for the financial sector, with more persistent and adverse price drops for bonds that were sold more heavily by the investment fund industry.

Discussion of findings

Our findings indicate that ECB-eligibility played a mitigating role during the dash-for-cash. Funds that held a higher share of ECB-eligible corporate bonds in the previous quarter experienced lower outflows during the COVID outbreak. However, the fund- and holding-level analyses also suggest that banks and dealers were unwilling to provide financing against ECB-eligible bonds as collateral, at least not at sufficiently good terms to make this a favourable alternative compared to selling bonds at distressed prices.

One way to interpret our fund- and holding-level results is that asset managers of euro area investment funds follow a liquidation pecking order during periods of large redemptions, whereby corporate bonds eligible as Eurosystem collateral are sold prior to other corporate bonds. As discussed in Section 3, this is likely because they are more attractive to dealers, as they can in turn pledge the bonds as collateral in exchange for loans from the ECB, providing them with a guaranteed source of funding. Nevertheless, the sale of these bonds still generated significant price pressure. Moreover, the price impact was sustained for an extended duration of time, impairing the transmission of monetary policy to the cost of market-based finance for firms, with potentially material consequences for their financing decisions. While the price impact was generally lower and less sustained for ECB-eligible bonds, the difference was primarily due to lower price pressure and spread increases on bonds issued by banks.

To further verify what role pledgeability played, we examine ECB data on collateral usage. Figure 4 shows that usage of corporate bonds as Eurosystem collateral increased sharply between Q1 and Q2 2020. While one might have expected the increase to show up already in Q1, this may be impacted by the interval between the time that a dealer acquired a bond and entered into a refinancing agreement with the ECB. It may be noted that the peak in bond fund redemptions occurred around the middle of March (see Figure 1), meaning it is quite plausible that the time lags in question caused the reported collateral usage to spill over into Q2. The increased usage of the ECB's main refinancing facility for corporate bonds suggests that the pledgeability feature of these bonds became more valuable for dealers during the dash-for-cash episode, providing further support for our interpretation that pledgeability was a key factor in increasing their willingness to acquire them.

The data on collateral usage is also relevant to the question of the relative price pressure exerted by asset managers compared to that potentially exerted by other market participants. Due to lack of access to supervisory data on securities holdings for banks, we are not able to verify the extent to which banks and dealers contributed to price pressure, relative to that exerted by asset managers. However, the increased collateral usage may been seen as tentative evidence that banks and dealers exerted lower price pressure relative to asset managers, as they were able to draw on the ECB main refinancing facility as a source of liquidity.

[Figure 4 about here]

At the same time, the funds in the sample increased their cash holdings substantially in Q1 2020, more than doubling them (see Figure 5). This means that, while the funds followed a pecking order in terms of the bonds they chose to divest, they simultaneously increased their cash holdings, meaning that they sold more bonds than strictly necessary for financing redemptions. These results confirm prior studies finding evidence of pro-cyclical cash hoarding by asset managers, during periods of large redemption volumes (Morris et al., 2017).

[Figure 5 about here]

The above findings contribute to previous studies of price dislocations in the corporate bond market during the onset of the Covid-19 pandemic, and have relevant implications for the policy discussion about the role of central banks in mitigating similar types of liquidity shocks. To start with, the fact that asset managers followed a pecking order in terms of the corporate bonds they chose to divest improves our understanding of asset managers' portfolio choices during periods of stress. This adds nuance to existing evidence of distress in the corporate bond market during the pandemic (Falato, Goldstein, et al., 2021; Haddad et al., 2021; Kargar et al., 2021; O'Hara & Zhou, 2021), suggesting that dealers were more prone to increase their inventories of bonds eligible as Eurosystem collateral, likely because of higher demand for these on account of their pledgeability with the ECB and consequent near cash-like features. By increasing the willingness of dealers to expand their inventories of eligible assets during episodes of market strain, the Eurosystem collateral framework might thus be seen to fill a stabilising role.

The fact that asset managers simultaneously increased their cash holdings, at the same time adds nuance to the findings of Pelizzon et al. (2024), who show that corporate bonds that become eligible as Eurosystem collateral acquire near cash-like features due to their pledgeability with the ECB. Our results suggest that while they may acquire cash-like features for banks in the Eurosystem, this is not the case for asset managers—who are not eligible as counterparties in the ECB's main refinancing operations. These findings align with those of Corell et al. (2025) who find that the convenience yield of corporate bonds varies across investor groups, depending on the service flows they provide for the respective investors. In our theoretical model, the utility of asset managers increases with the extent to which they can pledge assets as collateral in exchange for funding to finance redemptions, and decreases with the extent to which they have to divest assets at distressed prices to do so. The fact that asset managers sold proportionally more bonds eligible as Eurosystem collateral thus suggests that they were unable to pledge corporate bonds in exchange for funding from banks or dealers, considering that it would otherwise have been more valuable to hold on to assets with such high degree of fungibility, given their higher likelihood of being accepted as collateral.

The magnitude and duration of the price impact moreover implies that the liquidity provided by banks and dealers was not sufficient to mitigate price dislocations in the euro area corporate bond market, in particular for bonds issued by non-financial corporations, with potentially material consequences for firms' financing decisions. While Pelizzon et al. (2024) argue that the Eurosystem collateral framework helps to improve the functioning of the euro area corporate bond market, compensating for its low secondary market liquidity, our findings suggest that its capacity to do so is weaker following episodes with large redemptions from open-end funds.

Turning to the policy implications, the results could add weight to the argument that central banks considering to set up an enhanced LOLR facility should consider the benefits of extending it to asset managers.[4] If asset managers had been able to take out loans directly from the ECB against corporate bonds eligible as Eurosystem collateral, they would have needed to divest fewer bonds at distressed prices, reducing the price pressure as well as the systemic impact of the redemption wave on other parts of the financial system. Extending refinancing facilities to asset managers would thus strengthen the function of central bank balance sheets as a macroprudential tool during periods of surging demand for liquidity.

While the theoretical model we present in Appendix A implies a continuous increase in asset manager utility, the more redemptions can be financed with loans against collateral, there are important real-world limitations to this case that should be considered. As an overall constraint, the UCITS directive (2009/65/EC) stipulates that UCITS funds may borrow up to 10 percent of the net asset value of the fund on a temporary basis. In addition, asset managers may have internal or supervisory limits on the amount of leverage they can assume, in addition to limitations in the form of the haircuts the ECB imposes. In case the volume of redemptions financed with loans becomes so large that these limits are close to being reached, it may trigger increasing first-mover incentives to redeem fund shares prior to the point where the fund has to start divesting assets. In case the asset manager has reasons to believe an initial redemption shock to be permanent, it would thus be more prudent to use central bank refinancing as a short-term solution to finance redemptions, i.e. as a means to buy the time to spread bond divestments out over a longer period, thus reducing the price impact—as opposed to rolling the loans until the point when the assets backing them mature (as implied by the theoretical model).

[4] In fact, the Federal Reserve Act of 1913, Section 13(3), provides for this possibility under unusual and exigent circumstances (Labonte, 2020).

As such, extending central bank liquidity facilities to asset managers should not be considered in isolation, but as part of a broader range of regulatory and supervisory policy reforms to address the structural problems associated with liquidity mismatches in open-end investment funds. These include measures such as swing-pricing, redemption gates and generally matching redemption terms to the liquidity of the assets invested in by the fund.

While the transparent nature of the Eurosystem collateral framework should serve to reduce moral hazard, unintended consequences of extending central bank liquidity facilities to asset managers cannot be ruled out. For instance, Jasova et al. (2024) find that discrepancies between private market and central bank haircut policies give banks incentives to invest in bonds with the highest gap between private market and central bank haircuts, especially those issued by domestic and systemically important banks. These incentives were moreover found to generate higher bank interconnectedness. Similar incentives to exploit discrepancies between private market and central bank refinancing terms may be created for asset managers, if they were to be made eligible counterparties in the Eurosystem, potentially increasing interconnectedness. In addition, Branzoli et al. (2024) show that funds that held a higher share of bonds eligible for central banks' asset purchase programs took on more credit and liquidity risk during the pandemic.

Notwithstanding these caveats, to the extent that it may help to reduce the selling pressure during periods of large outflows, we believe that extending central bank refinancing to asset managers can be considered as a component of a broader solution, as it would improve financial stability through the greater flexibility it confers on investment funds to finance redemptions.

6 Conclusion

In this paper, we study to what extent the Eurosystem collateral framework played a stabilising role during the dash-for-cash episode. We find that funds who held a higher share of ECB-eligible bonds in the preceding quarter experienced lower outflows during the COVID outbreak. We also find that asset managers reduced their allocation to corporate bonds pledgeable with the ECB, selling them in order to finance redemptions, while simultaneously increasing their cash holdings. Furthermore, we find evidence of significant and sustained price pressure associated with these portfolio choices. The magnitude and duration of the price impact moreover implies costlier access to capital markets, impairing the transmission of monetary policy to the cost of market-based finance for firms, with potentially material consequences for their financing decisions. While the price impact was generally lower and less sustained for ECB-eligible bonds, the difference was primarily due to lower price pressure and spread increases on bonds issued by banks.

These findings improve our understanding of asset manager portfolio choices during redemption shocks, suggesting that euro area asset managers follow a liquidation pecking order when selling bonds to finance redemptions, whereby corporate bonds pledgeable with the ECB are divested prior to non-pledgeable bonds. On the one hand, the Eurosystem collateral framework may thus be seen to have played a stabilising role in the corporate bond market during the dash-for-cash, in reducing fund outflows and increasing the willingness of dealers to expand their inventories of corporate bonds. On the other hand, it also implies that banks/dealers were unwilling to either extend credit or enter into securities lending agreements with investment funds against cash collateral. Asset managers were hence forced to sell the bonds at distressed prices instead, contributing to further price pressure. These findings could add weight to the case for central bank liquidity facilities to be extended to asset managers. If asset managers had been able to take out loans directly from the central bank against corporate bonds eligible as Eurosystem collateral, they would have needed to divest fewer bonds at distressed prices, reducing the overall price pressure. This would have reduced the systemic impact of the redemption shock on the real economy and other parts of the financial system. However, such a measure should not be considered in isolation, but as part of a broader range of regulatory and supervisory policy reforms to address the structural problems associated with liquidity mismatch in open-end investment funds; including measures like swing-pricing, redemption gates and generally matching redemption terms to the liquidity of the assets invested in by the fund.

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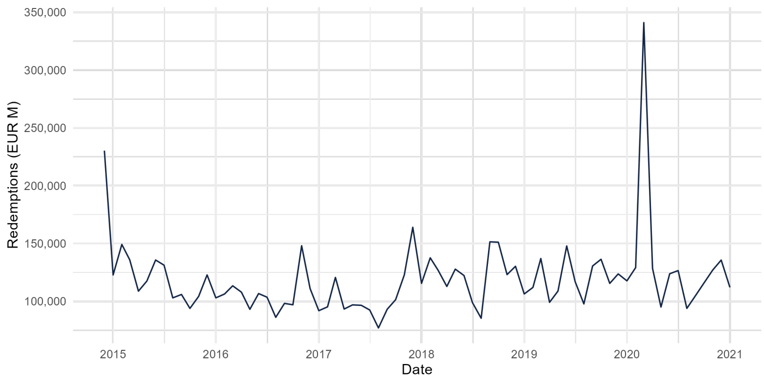
Figures

Figure 1: Monthly redemptions of euro area bond funds

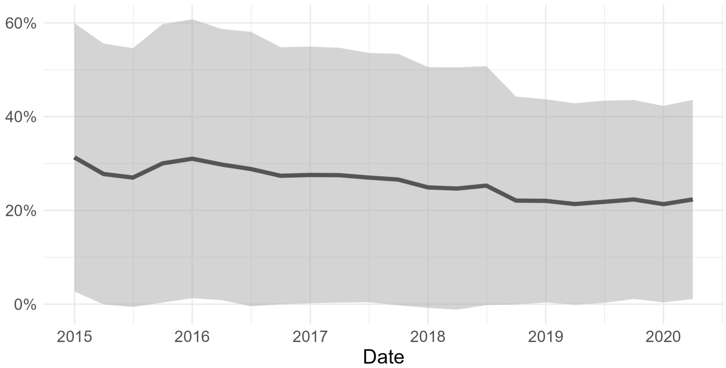


The figure depicts the aggregate monthly redemptions of euro area bond funds. The sample period spans Q1 2015 - Q4 2020. The data come from the European Central Bank.

Figure 2: Evolution of Z-spread of iBoxx EUR Corporates

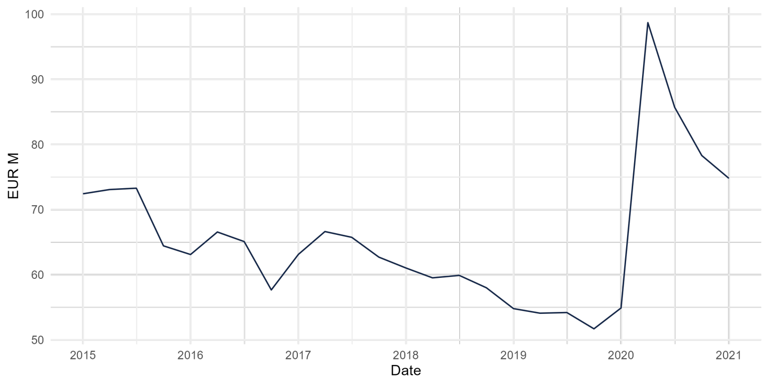
The figure depicts the monthly Z-spread of iBoxx EUR Corporates index. The sample period spans Q1 2015 - Q4 2020. The data come from Refinitiv Eikon.

Figure 3: Evolution of the ECB-eligible asset share in investment fund portfolios



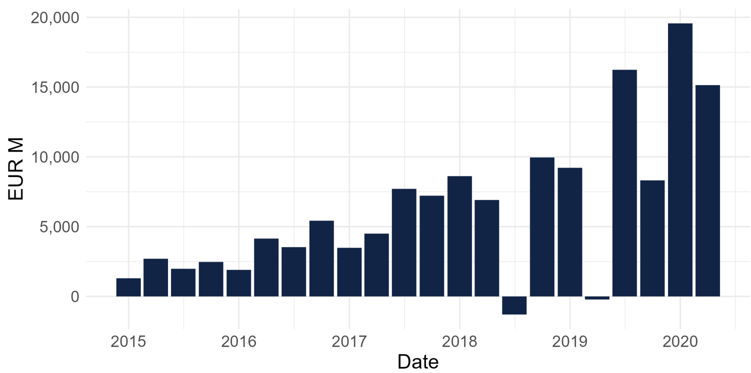
The figure illustrates the mean (represented by the black line) along with the standard deviation (depicted by the grey shaded area) of the proportion of ECB-eligible corporate bonds in euro area corporate bond investment funds. The sample period spans Q1 2015 - Q4 2020. The data come from Refinitiv Lipper.

Figure 4: Eurosystem collateral usage of corporate bonds



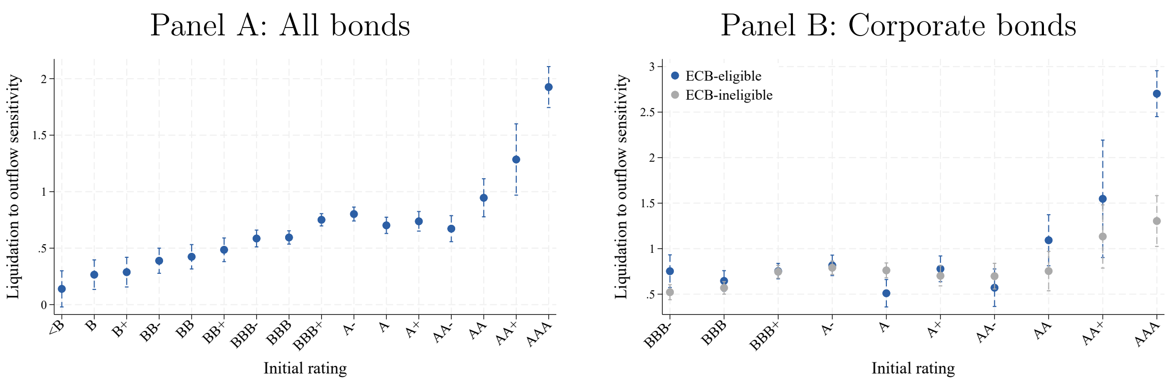
The figure depicts the aggregate usage of corporate bonds as collateral with the Eurosystem. The sample period spans Q1 2015 - Q4 2020. The data come from the European Central Bank.

Figure 5: Evolution of cash holdings



The figure depicts the aggregate evolution of cash holdings of funds in scope. The data includes holdings classified as "Cash", "Cash Equivalent", "Cash Options" or "Currency". The sample period spans Q1 2015 - Q2 2020. The data come from Refinitiv Lipper.

Figure 6: Liquidation-outflow sensitivity



The figure plots the liquidation-outflow sensitivities for bonds with different initial ratings. Panel A depicts the sensitivities for all bonds held by mutual funds at the end of Q4 2019. Panel B focuses on investment grade corporate bonds, differentiating between ECB-eligible and -ineligible bonds. Similar to Ma et al. (2022), the plotted sensitivities, $\beta_{g(j)}$, are estimated using the following regression equation: $Liquidation_{i,j} = \beta_{g(j)}\,Outflows_i + Fund\ controls_i + \gamma_j + \epsilon_{i,j}$. $Liquidation_{i,j}$ is defined as the bond-fund-level percentage change in par value amount between Q4 2019 and Q1 2020. $Outflows_i$ denotes the percentage change in fund-level assets under management from Q4 2019 to Q1 2020. $Fund\ controls_i$ include the natural logarithm of the fund's size in Q4 2019, the fund return between Q3 and Q4 2019, the percentage share of cash holdings in Q4 2019, and the fund's regional investment focus. γ_j represents the bond fixed effects. The liquidation groups, $g(j)$, are based on the bonds' initial credit ratings. The capped bars depict the 95% confidence intervals. The data come from Refinitiv Lipper and Dealogic.

Tables

Table 1: Descriptive statistics

Variable	Ever EA	Mean	SD	p1	p99	Obs
Panel A: Investment fund industry exposure to corporate bonds						
Industry's relative exposure	1	0.04	0.07	0.00	0.28	23,722
	0	0.04	0.06	0.00	0.29	60,283
Industry's relative exposure (QoQ change)	1	0.00	0.03	-0.07	0.07	22,077
	0	0.00	0.02	-0.06	0.07	55,221
Industry's absolute exposure (million EUR)	1	30.29	40.89	0.22	198.71	23,722
	0	20.49	38.55	0.07	182.15	60,283
Principal amount (million EUR)	1	795.42	431.54	76.00	2,000.00	23,722
	0	682.25	492.91	50.00	2,285.89	60,283
Panel B: Investment fund characteristics						
Cash share		0.02	0.07	-0.15	0.20	10,694
Corporate bond share		0.80	0.18	0.21	1.00	10,694
Eligible CBS		0.25	0.25	0.00	0.95	10,694
Fund flows		0.03	0.18	-0.38	0.83	8,787
Market value fund (million EUR)		731.50	2,341.66	6.42	6,602.94	10,694
No. asset holdings		287	497	23	2,539	10,694
Sovereign bond share		0.06	0.09	0.00	0.36	10,694
Panel C: Corporate bond holdings						
Market value (million EUR)	1	2.17	4.96	0.01	23.36	693,580
	0	2.49	6.21	0.00	26.39	1,886,102
Par value (million EUR)	1	1.87	4.42	0.00	21.15	763,912
	0	2.16	5.19	0.00	25.05	2,098,598
Par value (QoQ change)	1	-0.10	0.41	-1.00	1.11	606,773
	0	-0.10	0.45	-1.00	1.33	1,640,545
Panel D: Corporate bond prices and characteristics						
Bank bond	1	0.58	0.49	0.00	1.00	130,985
	0	0.49	0.50	0.00	1.00	241,328
Bid-ask yield (%)	1	0.06	0.06	0.02	0.33	126,947
	0	0.08	0.09	0.02	0.54	233,735
Principal amount (million EUR)	1	735.83	364.85	62.94	1,750.00	130,985
	0	588.31	403.01	46.69	1,775.57	241,328
Time-to-maturity (years)	1	4.69	5.05	0.17	19.87	130,193
	0	5.11	8.02	0.19	27.46	240,310
Yield spread (%)	1	0.92	0.79	0.25	3.63	126,185
	0	2.67	1.68	0.23	9.51	232,142

The table presents summary statistics related to the investment fund industry (Panel A), investment fund characteristics (Panel B), investment fund corporate bond holdings (Panel C), and corporate bond prices and characteristics (Panel D). Panels A, B and C (D) report descriptives for the period from Q1 2015 to Q2 2020 (31.12.2019 to 31.03.2020). The bond-level statistics differentiate between bonds are either at least once ECB-eligible during the sample period (*Ever EA* = 1) or never. *Industry's relative exposure* is the ratio between the aggregate par value amount of a bond held across all investment funds in the Refinitiv Lipper database and the bond's total principal amount. *Industry's relative exposure (QoQ change)* is the quarter-on-quarter change in *Industry's relative exposure. Industry's absolute exposure (million EUR)* is the the aggregate par value of a bond held across all investment funds in the Refinitiv Lipper database in a given quarter. *Principal amount (million EUR)* is the amount paid at maturity of the bond. *Cash share* (Corporate bond share) is the relative proportion of cash (corporate) holdings to total fund holdings (measured at market value). *Eligible CBS* measures the relative proportion of ECB-eligible corporate bonds to total corporate bond holdings of a fund (measured at par value). *Fund flows* measures a fund's aggregate in- and outflows in the current quarter relative to the fund size (measured at market value) in the previous quarter. *Sovereign bond share* is the relative proportion of sovereign holdings to total fund holdings (measured at market value). *No. asset holdings* is number of individual assets held by a fund at time t. *Market value fund (million EUR)* (*Par value (million EUR)*) reports the net total market value (par value) of a fund's holdings. *Par value (QoQ change)* is the relative quarter-on-quarter change in corporate bond holdings. *Bid-ask spread* is the difference between the bond's daily bid and ask yield. *ECB-eligibility dummy* equals one if the bond is ECB-eligible. *Time-to-maturity* is the number of years to repayment of principal. *Yield spread* is the difference between the bond's yield to maturity and the maturity-matched risk-free rate, derived from the German Bund yield curve. The data come from Refinitiv Lipper and Refinitiv Workspace.

Table 2: Investment fund industry share in corporate bonds during the COVID outbreak

	Industry's relative exposure				Industry's relative exposure (QoQ change)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
COVID * ECB-eligible * Bank bond				0.002				-0.004**
				[0.002]				[0.002]
COVID * Bank bond			-0.003***	-0.003***			-0.001	0.001
			[0.001]	[0.001]			[0.001]	[0.001]
COVID * ECB-eligible		-0.004***		-0.004***		-0.004***		-0.001
		[0.001]		[0.001]		[0.001]		[0.001]
COVID	-0.002***	-0.001***	-0.001	0.000	-0.011***	-0.010***	-0.011***	-0.010***
	[0.000]	[0.000]	[0.000]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Observations	145,514	145,514	145,514	145,514	130,794	130,794	130,794	130,794
R-squared	0.853	0.853	0.853	0.853	0.071	0.072	0.071	0.072
No. clusters	13,723	13,723	13,723	13,723	12,726	12,726	12,726	12,726
Bond FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Half year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

The table presents the results of quarterly panel regressions on the effect of the COVID outbreak on the investment fund industry's aggregate exposure to corporate bonds. The dependent variable is the ratio between the aggregate par value of a bond held across all investment funds at the end of a given quarter and the bond's total principal amount outstanding. *COVID* is a dummy that equals one in Q1 2020, and is zero otherwise. *Bank bond* is a dummy that equals one if the bond is issued by a bank, and is zero otherwise. *ECB-eligible* is a dummy that equals one if the bond is listed in the Eurosystem's list of eligible marketable assets, and is zero otherwise. Bond and half year fixed effects are included where indicated. Additional control variables are log(time-to-maturity) and four seasonal quarter indicators. The sample period spans Q1 2015 to Q2 2020. The data come from Refinitiv Lipper. Standard errors are clustered at the bond level and are reported in squared brackets. Statistical significance is denoted by ***, **, and * at the 1%, 5%, and 10% levels, respectively.

Table 3: Mutual fund flows during the COVID outbreak

	Fund flows				
	(1)	(2)	(3)	(4)	(5)
COVID * Eligible CBS * Bank-affiliated					0.123*
					[0.073]
COVID * Bank-affiliated				-0.012	-0.043*
				[0.018]	[0.024]
Eligible CBS * Bank-affiliated					-0.088
					[0.215]
COVID * Eligible CBS			0.221***		0.148***
			[0.036]		[0.057]
Eligible CBS		0.086	0.040	0.086	0.101
		[0.099]	[0.100]	[0.099]	[0.172]
COVID	-0.118***	-0.141***	-0.191***	-0.134***	-0.166***
	[0.009]	[0.011]	[0.014]	[0.015]	[0.021]
Observations	1,328	7,634	7,634	7,634	7,634
R-squared	0.639	0.730	0.733	0.730	0.733
No. clusters	664	731	731	731	731
Fund FE	Yes	No	No	No	No
Fund×half year FE	No	Yes	Yes	Yes	Yes
Controls	No	Yes	Yes	Yes	Yes

The table presents the results of quarterly panel regressions on the effect of the COVID outbreak in Q1 2020 on investment funds' flows. The dependent variable *Fund flows* is defined as the ratio between net in- and outflows at time t and fund size at $t-1$. *COVID* is a dummy that equals one in Q1 2020, and is zero otherwise. *Eligible CBS* is the lagged share of ECB-eligible corporate bonds as percentage of total corporate bond holdings. *Bank-affiliated* is a dummy that equals one if the fund is affiliated with a bank, and is zero otherwise. Fund and fund×half year fixed effects are included where indicated. Additional control variables are (i) lagged fund size (the total market value of the fund's portfolio holdings at the end of the previous quarter), (ii) lagged sum of cash holdings, term notes, and sovereign bonds as percentage share of fund size, and (iii) a linear time trend. Model 1 is restricted to two periods: Q4 2019 and Q1 2020. The remaining models cover the sample period Q1 2015 to Q2 2020. The data come from Refinitiv Lipper. Standard errors are clustered at fund level and are reported in squared brackets. Statistical significance is denoted by ***, **, and * at the 1%, 5%, and 10% levels, respectively.

Table 4: ECB-eligible corporate bond allocation during the COVID outbreak

	ECB-eligible corporate bond share			
	(1)	(2)	(3)	(4)
COVID * Bank-affiliated				0.002
				[0.003]
COVID * (Outflows > Sov. share)			0.004	
			[0.004]	
Outflows > Sov. share			-0.004**	
			[0.002]	
COVID	-0.010***	-0.014***	-0.014***	-0.016***
	[0.002]	[0.002]	[0.003]	[0.003]
Observations	1,532	7,750	7,750	7,750
R-squared	0.984	0.987	0.987	0.987
No. clusters	766	745	745	745
Fund FE	Yes	No	No	No
Fund×half year FE	No	Yes	Yes	Yes
Controls	No	Yes	Yes	Yes

The table presents the results of quarterly panel regressions on the effect of the COVID outbreak in Q1 2020 on investment funds' asset allocation decisions. The dependent variable is the share of ECB-eligible corporate bonds as percentage of total corporate bond holdings. *COVID* is a dummy that equals one in Q1 2020, and is zero otherwise. *Outflows > Sov. share* is a dummy that equals one if the fund's outflows are larger than the fund's sovereign holdings (as % of fund size) in the previous quarter, and is zero otherwise. *Bank-affiliated* is a dummy that equals one if the fund is affiliated with a bank, and is zero otherwise. Fund and fund×half year fixed effects are included where indicated. Additional control variables are (i) the lagged ECB-eligible corporate bond share, (ii) lagged fund size (the total market value of the fund's portfolio holdings at the end of the previous quarter), (iii) lagged sovereign bond share (as % of fund size), and (iv) a linear time trend. Model 1 is restricted to two periods: Q4 2019 and Q1 2020. The remaining models cover the sample period Q1 2015 to Q2 2020. The data come from Refinitiv Lipper. Standard errors are clustered at fund level and are reported in squared brackets. Statistical significance is denoted by ***, **, and * at the 1%, 5%, and 10% levels, respectively.

Table 5: ECB-eligible corporate bond holding changes during the COVID outbreak

	Par value (QoQ % change)				
	(1)	(2)	(3)	(4)	(5)
COVID * Bank-affiliated * ECB-eligible					0.020
					[0.015]
Bank-affiliated * ECB-eligible					-0.004
					[0.005]
COVID * (Outflows > Sov. share) * ECB-eligible				-0.008	
				[0.020]	
(Outflows > Sov. share) * ECB-eligible				-0.007**	
				[0.003]	
COVID * Bank bond * ECB-eligible			-0.014		
			[0.031]		
Bank bond * ECB-eligible			0.124**		
			[0.062]		
COVID * Bank bond			-0.016*		
			[0.008]		
COVID * ECB-eligible		-0.037***	-0.034***	-0.028**	-0.047***
		[0.010]	[0.008]	[0.011]	[0.016]
ECB-eligible	-0.087***	-0.082***	-0.094***	-0.080***	-0.079***
	[0.021]	[0.021]	[0.022]	[0.021]	[0.021]
Observations	2,168,181	2,168,181	2,168,181	2,168,181	2,168,181
R-squared	0.329	0.329	0.329	0.329	0.329
No. clusters	741	741	741	741	741
Fund×year×quarter FE	Yes	Yes	Yes	Yes	Yes
Bond×half year FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes

The table presents the results of quarterly panel regressions on the effect of the COVID outbreak in Q1 2020 on investment funds' asset purchases. The dependent variable is the relative quarter-on-quarter change in corporate bond holdings. *COVID* is a dummy that equals one in Q1 2020, and is zero otherwise. *Bank bond* is a dummy that equals one if the bond is issued by a bank, and is zero otherwise. *ECB-eligible* is a time-varying dummy that equals one if the bond is listed in the Eurosystem's list of eligible marketable assets at least once in a given quarter, and is zero otherwise. *Outflows > Sov. share* is a dummy that equals one if the fund's outflows are larger than the fund's sovereign holdings (as % of fund size) in the previous quarter, and is zero otherwise. *Bank-affiliated* is a dummy that equals one if the fund is affiliated with a bank, and is zero otherwise. Fund×year×quarter and bond×half year fixed effects are included where indicated. Additional control variables are (i) lagged log(par value) and (ii) a dummy that equals one if the bond matured in quarter t. The sample period spans Q1 2015 to Q2 2020. The data come from Refinitiv Lipper. Standard errors are clustered at fund level and are reported in squared brackets. Statistical significance is denoted by ***, **, and * at the 1%, 5%, and 10% levels, respectively.

Table 6: ECB-eligible corporate bond holdings during the COVID outbreak

	Log par value				
	(1)	(2)	(3)	(4)	(5)
COVID * Bank-affiliated * ECB-eligible					0.199
					[0.131]
Bank-affiliated * ECB-eligible					-0.066
					[0.051]
COVID * (Outflows > Sov. share) * ECB-eligible				-0.193	
				[0.175]	
(Outflows > Sov. share) * ECB-eligible				-0.123***	
				[0.038]	
COVID * Bank bond * ECB-eligible			-0.099		
			[0.303]		
Bank bond * ECB-eligible			1.192*		
			[0.625]		
COVID * Bank bond			-0.166**		
			[0.083]		
COVID * ECB-eligible		-0.390***	-0.378***	-0.201*	-0.493***
		[0.086]	[0.085]	[0.109]	[0.126]
ECB-eligible	-1.154***	-1.100***	-1.211***	-1.056***	-1.056***
	[0.264]	[0.265]	[0.285]	[0.265]	[0.270]
Observations	2,215,958	2,215,958	2,215,958	2,215,958	2,215,958
R-squared	0.410	0.410	0.410	0.410	0.410
No. clusters	741	741	741	741	741
Fund×year×quarter FE	Yes	Yes	Yes	Yes	Yes
Bond×half year FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes

The table presents the results of quarterly panel regressions on the effect of the COVID outbreak in Q1 2020 on investment funds' asset holdings. The dependent variable is the logarithm of the corporate bond par value (in EUR) held by the fund. *COVID* is a dummy that equals one in Q1 2020, and is zero otherwise. *Bank bond* is a dummy that equals one if the bond is issued by a bank, and is zero otherwise. *ECB-eligible* is a time-varying dummy that equals one if the bond is listed in the Eurosystem's list of eligible marketable assets at least once in a given quarter, and is zero otherwise. *Outflows > Sov. share* is a dummy that equals one if the fund's outflows are larger than the fund's sovereign holdings (as % of fund size) in the previous quarter, and is zero otherwise. *Bank-affiliated* is a dummy that equals one if the fund is affiliated with a bank, and is zero otherwise. *Log par value (t-1)* is the logarithm of the fund's portfolio holdings' par value at the end of the previous quarter. *Bond matured* is a dummy that equals one if the bond matures in quarter t. Fund×year×quarter and bond×half year fixed effects are included where indicated. Additional control variables are (i) lagged log(par value) and (ii) a dummy that equals one if the bond matured in quarter t. The sample period spans Q1 2015 to Q2 2020. The data come from Refinitiv Lipper. Standard errors are clustered at fund level and are reported in squared brackets. Statistical significance is denoted by ***, **, and * at the 1%, 5%, and 10% levels, respectively.

Table 7: Pecking order and liquidation-outflow sensitivity

	Liquidation			
	(1)	(2)	(3)	(4)
Outflows * Liquidation rank * ECB-eligible		0.195**		0.210**
		[0.097]		[0.098]
Outflows * ECB-eligible		0.091*		0.070
		[0.055]		[0.056]
Liquidation rank * ECB-eligible		0.214***		0.220***
		[0.016]		[0.016]
Outflows * Liquidation rank	0.221***	0.065	0.215***	0.054
	[0.036]	[0.040]	[0.036]	[0.041]
Outflows	0.512***	0.533***	0.512***	0.538***
	[0.022]	[0.025]	[0.023]	[0.025]
Observations	152,069	152,069	147,647	147,647
R-squared	0.330	0.332	0.322	0.324
Bond FE	Yes	Yes	Yes	Yes
Fund controls	Yes	Yes	Yes	Yes
Bond sample	All	All	Corporates	Corporates

The table presents the results of cross-sectional regressions of bond-fund-level liquidations on fund-level outflows, interacted with bond-fund level liquidation rank and ECB-eligibility dummy variable. For each bond that is held by a fund at the end of Q4 2019, the dependent variable *Liquidation* is defined as the percentage change in par value amount between Q4 2019 and Q1 2020. *Outflows* denote the percentage change in fund-level assets under management from Q4 2019 to Q1 2020. Similar to Ma et al. (2022), *Liquidation rank* is measured by the relative liquidation rank of each bond in a fund's portfolio (see Appendix D.1). *ECB-eligible* is a dummy that equals one if the bond is listed in the Eurosystem's list of eligible marketable assets at least once in Q4 2019, and is zero otherwise. Fund controls include the natural logarithm of the fund's size in Q4 2019, the fund return between Q3 and Q4 2019, the percentage share of cash holdings in Q4 2019, and the fund's regional investment focus. Bond fixed effects are included in all regression specifications. Models (1) and (2) use all bonds held by the funds in Q4 2019, while models (3) and (4) focus on corporate bonds only. The data come from Refinitiv Lipper and Dealogic. Robust standard are reported in squared brackets. Statistical significance is denoted by ***, **, and * at the 1%, 5%, and 10% levels, respectively.

Table 8: Price response of corporate bonds during the COVID outbreak

	Yield spread				
	(1)	(2)	(3)	(4)	(5)
COVID * (Ind. QoQ exp. chng) * ECB-eligible * Bank bond					2.621*
					[1.548]
COVID * (Ind. QoQ exp. chng) * Bank bond					-2.143
					[1.366]
COVID * ECB-eligible * Bank bond					-0.297***
					[0.053]
COVID * Bank bond					0.075
					[0.063]
COVID * (Ind. QoQ exp. chng) * ECB-eligible				2.873***	1.220
				[0.773]	[1.102]
COVID * (Industry's QoQ exposure change)			-2.798***	-4.217***	-2.928***
			[0.423]	[0.680]	[0.961]
COVID * ECB-eligible		-0.231***		-0.083***	0.112***
		[0.018]		[0.029]	[0.041]
COVID	0.700***	0.781***			
	[0.010]	[0.015]			
Constant	1.815***	1.815***	1.889***	1.899***	1.882***
	[0.004]	[0.004]	[0.001]	[0.004]	[0.014]
Observations	358,327	358,327	312,189	312,189	312,189
R-squared	0.863	0.864	0.945	0.945	0.945
No. clusters	5,607	5,607	4,883	4,883	4,883
Bond FE	Yes	Yes	Yes	Yes	Yes
Issuer×day FE	No	No	Yes	Yes	Yes
Maturity×day FE	No	No	Yes	Yes	Yes
Rating×day FE	No	No	Yes	Yes	Yes

The table presents the results of daily panel regressions on the effect of the COVID outbreak in March 2020 on corporate bond secondary market prices. The dependent variable is the yield spread (in %). *Bank bond* is a dummy that equals one if the bond is issued by a bank, and is zero otherwise. *COVID* is a dummy that equals one in March 2020, and is zero otherwise. *Industry's QoQ exposure change* is the change in the investment fund industry's relative exposure to a bond between Q4 2019 and Q1 2020. The industry's relative exposure is defined as the ratio between the aggregate principal amount of a bond held across all investment funds and the bond's total principal amount. *ECB-eligible* is a dummy that equals one if the bond is listed in the Eurosystem's list of eligible marketable assets at least once in Q4 2019 and zero otherwise. Bond fixed effects, ultimate parent issuer×day fixed effects, initial rating×day fixed effects, and maturity bucket×day fixed effects are included where indicated. The sample period spans 31. December 2019 to 31. March 2020. The data come from Refinitiv Lipper, Refinitiv Workspace, and Dealogic. Standard errors are clustered at the bond level and are reported in squared brackets. Statistical significance is denoted by ***, **, and * at the 1%, 5%, and 10% levels, respectively.

Table 9: Price response due to mutual fund trades

	Yield spread					
	(1)	(2)	(3)	(4)	(5)	(6)
COVID * Price pressure * ECB-eligible * Bank bond						0.098
						[0.108]
COVID * Price pressure * Bank bond						-0.085
						[0.077]
COVID * Price pressure * ECB-eligible					0.113**	0.051
					[0.048]	[0.072]
COVID * Price pressure				-0.116***	-0.147***	-0.090
				[0.028]	[0.037]	[0.064]
COVID * Flow-implied trade * ECB-eligible * Bank bond			0.263***			
			[0.081]			
COVID * Flow-implied trade * Bank bond			-0.149***			
			[0.051]			
COVID * Bank bond			0.020			0.053
			[0.063]			[0.062]
COVID * Flow-implied trade * ECB-eligible		0.062	-0.085			
		[0.041]	[0.065]			
COVID * Flow-implied trade	-0.109***	-0.127***	-0.030			
	[0.021]	[0.025]	[0.042]			
COVID * ECB-eligible		-0.086***	-0.077***		-0.094***	-0.092***
		[0.029]	[0.028]		[0.028]	[0.028]
Observations	306,906	306,906	306,906	306,941	306,941	306,941
R-squared	0.944	0.944	0.944	0.944	0.944	0.944
No. clusters	4,800	4,800	4,800	4,801	4,801	4,801
Bond FE	Yes	Yes	Yes	Yes	Yes	Yes
Issuer×day FE	Yes	Yes	Yes	Yes	Yes	Yes
Rating×day FE	Yes	Yes	Yes	Yes	Yes	Yes
Maturity×day FE	Yes	Yes	Yes	Yes	Yes	Yes

The table presents the results of daily panel regressions of corporate bond yield spreads on mutual-fund-induced price pressure proxies. *Flow-implied trade* and *Price pressure* are defined as in Jiang et al. (2021). The former measures how flows into and out of mutual funds between Q4 2019 and Q1 2020 translate into bond trading by these funds. The latter measures trading pressure based on realized trades conditional on large fund flows. Both price pressure proxies are defined in Appendix D.2. *ECB-eligible* is a dummy that equals one if the bond is listed in the Eurosystem's list of eligible marketable assets at least once in Q4 2019 and zero otherwise. *COVID* is a dummy that equals one in March 2020, and is zero otherwise. *Bank bond* is a dummy that equals one if the bond is issued by a bank, and is zero otherwise. In all regression specifications are included bond fixed effects, ultimate parent issuer×day fixed effects, initial rating×day fixed effects, and maturity bucket×day fixed effects. The sample period spans 31. December 2019 to 31. March 2020. The data come from Refinitiv Lipper, Refinitiv Workspace, and Dealogic. Standard errors are clustered at the bond level and are reported in squared brackets. Statistical significance is denoted by ***, **, and * at the 1%, 5%, and 10% levels, respectively.

Table 10: Price response due to mutual fund redemptions

	Yield spread					
	(1)	(2)	(3)	(4)	(5)	(6)
COVID * ECB-eligible * LAO * Bank bond						-0.032***
						[0.006]
COVID * LAO * Bank bond						0.016***
						[0.005]
COVID * LAO * ECB-eligible					-0.003	0.016***
					[0.003]	[0.006]
COVID * LAO				0.010***	0.010***	-0.000
				[0.002]	[0.002]	[0.004]
COVID * ECB-eligible * Imputed outflow * Bank bond			-0.023***			
			[0.004]			
COVID * Imputed outflow * Bank bond			0.011***			
			[0.003]			
COVID * Imputed outflow * ECB-eligible		-0.004	0.009**			
		[0.002]	[0.004]			
COVID * Imputed outflow	0.006***	0.007***	0.000			
	[0.001]	[0.002]	[0.003]			
COVID * Bank bond			-0.008			-0.007
			[0.065]			[0.065]
COVID * ECB-eligible		-0.069**	-0.058*		-0.082***	-0.074**
		[0.031]	[0.031]		[0.031]	[0.031]
Observations	311,869	311,869	311,869	311,869	311,869	311,869
R-squared	0.945	0.945	0.945	0.945	0.945	0.945
No. clusters	4,878	4,878	4,878	4,878	4,878	4,878
Bond FE	Yes	Yes	Yes	Yes	Yes	Yes
Issuer×day FE	Yes	Yes	Yes	Yes	Yes	Yes
Rating×day FE	Yes	Yes	Yes	Yes	Yes	Yes
Maturity×day FE	Yes	Yes	Yes	Yes	Yes	Yes

The table presents the results of daily panel regressions of corporate bond yield spreads on mutual-fund-induced price pressure proxies. Following the definitions in Ma et al. (2022), *Imputed outflow* is the weighted average of outflows at funds that held the respective bond at the end of Q4 2019. The liquidation-adjusted outflow, *LAO*, takes also into account the empirical pecking within funds' portfolios. Both price pressure proxies are defined in Appendix D.2. *ECB-eligible* is a dummy that equals one if the bond is listed in the Eurosystem's list of eligible marketable assets at least once in Q4 2019 and zero otherwise. *COVID* is a dummy that equals one in March 2020, and is zero otherwise. *Bank bond* is a dummy that equals one if the bond is issued by a bank, and is zero otherwise. In all regression specifications are included bond fixed effects, ultimate parent issuer×day fixed effects, initial rating×day fixed effects, and maturity bucket×day fixed effects. The sample period spans 31. December 2019 to 31. March 2020. The data come from Refinitiv Lipper, Refinitiv Workspace, and Dealogic. Standard errors are clustered at the bond level and are reported in squared brackets. Statistical significance is denoted by ***, **, and * at the 1%, 5%, and 10% levels, respectively.

Table 11: Liquidity response of corporate bonds during the COVID outbreak

	Bid-ask spread				
	(1)	(2)	(3)	(4)	(5)
COVID * (Ind. QoQ exp. chng) * ECB-eligible * Bank bond					0.073
					[0.072]
COVID * (Ind. QoQ exp. chng) * Bank bond					-0.045
					[0.054]
COVID * ECB-eligible * Bank bond					-0.003**
					[0.001]
COVID * Bank bond					-0.004***
					[0.002]
COVID * (Ind. QoQ exp. chng) * ECB-eligible				-0.060*	-0.102*
				[0.034]	[0.062]
COVID * (Industry's QoQ exposure change)			-0.013	0.009	0.033
			[0.018]	[0.027]	[0.044]
COVID * ECB-eligible		-0.006***		-0.004***	-0.002
		[0.001]		[0.001]	[0.001]
COVID	0.016***	0.018***			
	[0.000]	[0.000]			
Constant	0.064***	0.064***	0.062***	0.063***	0.063***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Observations	355,266	355,266	309,758	309,758	309,758
R-squared	0.931	0.931	0.973	0.973	0.973
No. clusters	5,571	5,571	4,858	4,858	4,858
Bond FE	Yes	Yes	Yes	Yes	Yes
Issuer×day FE	No	No	Yes	Yes	Yes
Maturity×day FE	No	No	Yes	Yes	Yes
Rating×day FE	No	No	Yes	Yes	Yes

The table presents the results of daily panel regressions on the effect of the COVID outbreak in March 2020 on corporate bond secondary market liquidity. The dependent variable is the spread between the bid and the ask yield-to-maturity. *Bank bond* is a dummy that equals one if the bond is issued by a bank, and is zero otherwise. *COVID* is a dummy that equals one in March 2020, and is zero otherwise. *Industry's QoQ exposure change* is the change in the investment fund industry's relative exposure to a bond between Q4 2019 and Q1 2020. The industry's relative exposure is defined as the ratio between the aggregate principal amount of a bond held across all investment funds and the bond's total principal amount outstanding. *ECB-eligible* is a dummy that equals one if the bond is listed in the Eurosystem's list of eligible marketable assets at least once in Q4 2019 and zero otherwise. Bond fixed effects, ultimate parent issuer×day fixed effects, initial rating×day fixed effects, and maturity bucket×day fixed effects are included where indicated. The sample period spans 31. December 2019 to 31. March 2020. The data come from Refinitiv Lipper, Refinitiv Workspace, and Dealogic. Standard errors are clustered at the bond level and are reported in squared brackets. Statistical significance is denoted by ***, **, and * at the 1%, 5%, and 10% levels, respectively.

Table 12: Duration of the COVID-induced price impact on corporate bonds

	Weeks until yield spread reversal				
	(1)	(2)	(3)	(4)	(5)
ECB-eligible * (Ind. QoQ exp. chng) * Bank bond					-47.476
					[34.124]
(Ind. QoQ exp. chng) * Bank bond					40.197*
					[23.133]
ECB-eligible * (Ind. QoQ exp. chng)				-35.226**	-11.009
				[17.152]	[25.195]
Industry's QoQ exposure change				-11.900	-26.781
				[12.273]	[16.323]
ECB-eligible * (Ind. rel. exp. in Q4 2019)			0.249		
			[0.482]		
Industry's relative exposure in Q4 2019			20.174***		
			[3.874]		
ECB-eligible * Bank bond		-4.341***			-4.742***
		[0.656]			[0.722]
Bank bond		-1.830**			-1.333*
		[0.728]			[0.747]
ECB-eligible	-4.025***	-1.237*	-3.685***	-4.324***	-1.447**
	[0.498]	[0.676]	[0.628]	[0.553]	[0.738]
Constant	37.841***	40.097***	33.392***	37.773***	40.304***
	[6.477]	[6.506]	[6.654]	[6.484]	[6.541]
Observations	5,257	5,257	5,257	5,257	5,257
R-squared	0.502	0.510	0.506	0.503	0.511
Controls	Yes	Yes	Yes	Yes	Yes

The table presents the results of cross-sectional regressions on the secondary market corporate bond price reversal in the aftermath of the COVID outbreak in March 2020. The dependent variable measures the number of weeks until the average weekly yield spread reverts to its pre-COVID baseline level. The baseline level is defined as the average yield spread in the first week of March 2020. *Bank bond* is a dummy that equals one if the bond is issued by a bank, and is zero otherwise. *Industry's relative exposure in Q4 2019* is the ratio between the aggregate principal amount of a bond held across all investment funds in Q4 2019 and the bond's total principal amount. *Industry's QoQ exposure change* is the change in the investment fund industry's relative exposure to a bond between Q4 2019 and Q1 2020. *ECB-eligible* is a dummy that equals one if the bond is listed in the Eurosystem's list of eligible marketable assets, and is zero otherwise. Bond controls are (i) log(principal amount), the average (ii) yield spread and (iii) time-to-maturity in the baseline week, (iv) issuer's industry sector, (v) bond currency, and (vi) a dummy indicating whether the bond is callable. The data come from Refinitiv Lipper and Refinitiv Workspace. Robust standard errors are reported in squared brackets. Statistical significance is denoted by ***, **, and * at the 1%, 5%, and 10% levels, respectively.

Appendix

A Theoretical model

To motivate our empirical analysis, we construct a theoretical model that allows asset managers to use collateralised borrowing to fund redemptions. We use the model to study the relationship between asset pledgeability, aggregate investment, liquidation volume during redemption waves, and the overall welfare implications. Our model builds on the work of Aldasoro et al. (2021).

Assume a three-period economy with two types of market participants; asset managers (AMs) and dealers (Ds). There are two types of assets; a risk-free and a risky asset. The risk-free asset pays a zero return and can be considered cash, while the risky asset's payoff structure is given as $R = \{1, R_1, \tilde{R}_2\}$. That is, the price of the risky asset at $t = 0$ is 1. $R_1 < 1$ is secondary-market price in $t = 1$ and $\tilde{R}_2$ is the uncertain payoff in $t = 2$, with mean $R_2 > 1$ and variance σ^2. Furthermore, assume that an exogenously given fraction, $p \in [0, 1]$, of the risky asset can be pledged by the AM as collateral for borrowing. The borrowing costs are denoted by c. The order of events is the following. In $t = 0$, AMs allocate their capital across the two asset types. In $t = 1$, each asset manager i is exposed to redemption risk with outflows of size o_i. Depending of the size of o_i, the AM faces one of the three options to fund the redemptions: (i) use the fund's cash holdings, (ii) borrow additional cash against pledgeable collateral, or (iii) sell the risky asset to a dealer. In $t = 2$, the uncertain payoff of the risky asset materialises and the final payoffs to AMs and Ds are revealed.

A.1 Asset managers

There is a continuum of risk-neutral asset managers with unit mass. Each AM i is endowed with one unit of risk-free asset in $t = 0$, of which she allocates α_i units into the risky asset and $1 - \alpha_i$ units into the risk-free asset. The decision to buy the risky asset depends on the AM's risk of early liquidation at $t = 1$. There is no liquidation if the AM's risk-free asset holding is sufficient to fund the redemptions in $t = 1$. The probability of this event is $1 - \epsilon_i$, where ϵ_i is independent across AMs and follows a continuous uniform distribution, i.e., $\epsilon_i \sim U[0, 1]$. If redemptions exceed the risk-free holding, the AM is exposed to a liquidity mismatch and faces one of the two options: either engage in collateralised borrowing or sell the risky asset. In the former case, assume that with probability $p\epsilon_i$ the redemptions can be covered by the risk-free asset and the pledgeable part of the risky asset. The AM incurs borrowing costs c but remains exposed to the risky asset's final payoff. With probability $(1 - p)\epsilon_i$, collateralised borrowing is insufficient to cover the outflows. In this case, the AM sells the risky asset and thus liquidates the fund in $t = 1$. Both, ϵ_i and p are known to the AM in $t = 0$. The AM's total payoff is therefore given as:

$$\text{AM's payoff} = \begin{cases} 1 - \alpha_i + \alpha_i \tilde{R}_2 & \text{with } \mathbb{P}(o_i \leq 1 - \alpha_i) = 1 - \epsilon_i \\ 1 - \alpha_i + \alpha_i \tilde{R}_2 - \alpha_i p R_1 c & \text{with } \mathbb{P}(1 - \alpha_i < o_i \leq 1 - \alpha_i + \alpha_i p R_1) = p\epsilon_i \\ 1 - \alpha_i + \alpha_i R_1 & \text{with } \mathbb{P}(o_i > 1 - \alpha_i + \alpha_i p R_1) = (1 - p)\epsilon_i \end{cases}$$

The AM's expected utility is the probability-weighted sum of the above payoffs:

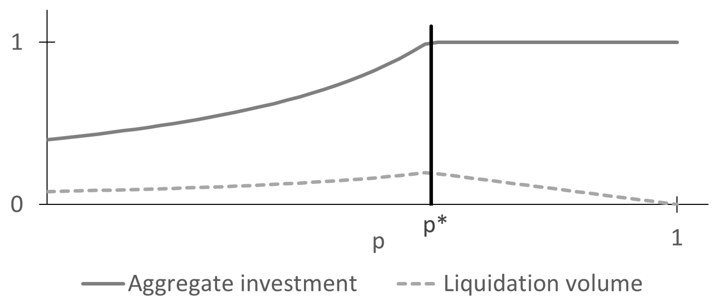
$$\mathbb{E}[U_i] = 1 \underbrace{+\alpha_i(R_2 - 1)}_{\substack{\text{gain from investing} \\ \text{in risky asset}}} \underbrace{-\epsilon_i \alpha_i s(1 - p)}_{\substack{\text{loss from} \\ \text{early liquidation}}} \underbrace{-\epsilon_i \alpha_i p R_1 c}_{\substack{\text{cost of collateralised} \\ \text{borrowing}}} , \tag{7}$$

where the spread $s = R_2 - R_1$ is the market-clearing risk premium in $t = 1$.

An AM will fully invest in the risky asset ($\alpha_i = 1$) only if her expected utility is above one, otherwise she will choose to hold only the risk-free asset ($\alpha_i = 0$). Rearranging eq. (7) with respect to ϵ_i yields an interior threshold probability $\hat{\epsilon} = \min\left(\frac{R_2 - 1}{s(1-p) + pR_1 c}, 1\right) \in [0, 1]$, suggesting that AMs invest in the risky asset if and only if $\epsilon_i < \hat{\epsilon}$. Consequently, the total demand for the risky asset is given as $q = \int_0^{\hat{\epsilon}} d\epsilon_i = \hat{\epsilon}$ and the overall risky asset liquidation amount is $y_{AM} = \int_0^{\hat{\epsilon}} (1-p)\epsilon_i d\epsilon_i = \frac{1}{2}(1-p)\hat{\epsilon}^2$.

Figure A1 depicts q and y_{AM} as a function of p. With increasing p, the demand for the risky asset and the corresponding liquidation amount rise. However, aggregate investment experiences a stronger increase than the liquidation volume, which means that the liquidation amount as percentage share of total amount invested drops with increasing p. At p^*, investors are fully invested in the risky asset and the liquidation amount starts dropping. When p reaches 100%, AMs do not need to liquidate the risky asset at all as they can borrow up to the total portfolio value to fund any redemption volumes. In practice, pledgeability p can be either interpreted as a fraction of assets in a fund that can be used for collateralised borrowing or it can be regarded as a haircut at the level of the individual asset. For an individual asset, $p = 0$ is equivalent to a haircut of 100%, while $p = 1$ means that a 0%-haircut is applied to the asset. The latter case does not exist in practice as any risky asset is subject to a positive haircut.

Figure A1: Asset pledgeability and investor demand for the risky asset



This figure depicts the asset managers' aggregate investment demand for the risky asset in $t = 0$ and the corresponding liquidation volume in $t = 1$ as a function of pledgeability p.

The threshold probability $\hat{\epsilon}$ is a monotonically increasing function in p if the return on the risky asset is above the borrowing costs (i.e., $\frac{R_2}{R_1} - 1 > c$). In this case, there exists an upper bound p^* such that the threshold probability simplifies to

$$\hat{\epsilon} = \frac{R_2 - 1}{s(1-p) + pR_1c} \tag{8}$$

where $p \in [0, p^*]$ and $\hat{\epsilon} \in [0, 1]$. For traceability of the model, but without loss of generality, we will use eq. (8) henceforth.

A.2 Dealers

There is a continuum of dealers with constant absolute risk aversion (CARA) utility. Their purpose is to make the markets in $t = 1$, when AMs are forced to liquidate their risky asset holdings. All dealers are unconstrained in their purchases; they can use their capital and borrow additional funds at a risk-free rate if necessary. Each dealer j is competitive and takes the market clearing spread s as given when deciding on the purchase amount of the risky asset y_j. The dealer's expected utility is given as:

$$U_j \quad = \quad \mathbb{E}[\tilde{R}_2 - R_1]y_j - \frac{\rho}{2}Var(\tilde{R}_2 - R_1)y_j^2 = sy_j - \frac{\rho\sigma^2}{2}y_j^2, \tag{9}$$

where $\rho > 0$ is the dealer's relative risk aversion parameter. The utility-maximising purchase amount for each dealer is given as $y_j = \frac{s}{\rho\sigma^2}$ if $s \geq 0$ and zero otherwise. Since dealers can buy but not sell the risky asset in this setting, their demand is bounded at zero. Given that there is a unit mass of dealers, the dealers' aggregate purchase volume is $y_D = \int_0^1 y_j dj = \frac{s}{\rho\sigma^2}$.

A.3 Equilibrium

In equilibrium, markets clear (i.e., $y_{AM} = y_D$) such that the spread s is given as:

$$s \quad = \quad \frac{1}{2}(1-p)\rho\sigma^2\hat{\epsilon}^2 \tag{10}$$

Solving equations (8) and (10) in terms of exogenous fundamentals yields:

$$\hat{\epsilon} = \left(\frac{2(R_2-1)}{\rho\sigma^2}\right)^{\frac{1}{3}} \left(\frac{1}{(1-p)(1-p+pR_1r)}\right)^{\frac{1}{3}} \tag{11}$$

$$s = \left(\frac{\rho\sigma^2}{2}\right)^{\frac{1}{3}} (R_2-1)^{\frac{2}{3}} \left(\frac{1-p}{(1-p+pR_1r)^2}\right)^{\frac{1}{3}} \tag{12}$$

where the cost of collateralised borrowing is defined as $c = rs$, with parameter $r > 0$. c can be interpreted as AM's monitoring and overhead costs that move proportionally with the risky asset's spread.

A.4 Welfare

From eq. (7) and (10), we obtain asset managers' aggregate utility as:

$$U_{AM} = 1 + q(R_2-1) - \rho\sigma^2\frac{\hat{\epsilon}^4}{4}\left((1-p)^2 + p(1-p)R_1r\right) \tag{13}$$

From eq. (9), we obtain dealers' aggregate utility:

$$U_D = \frac{s^2}{2\rho\sigma^2} \tag{14}$$

Asset managers' aggregate utility is given as:

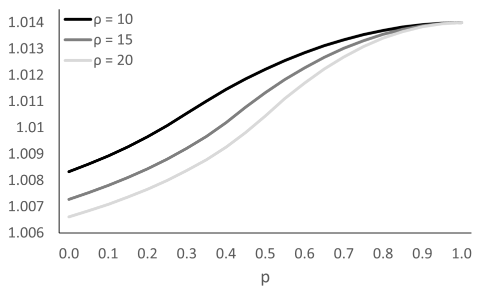
$$\begin{aligned} U_{AM} = \int_0^1 \mathbb{E}[U_i]d\epsilon_i &= \int_0^1 1 + \alpha_i(R_2-1) - \epsilon_i\alpha_i s(1-p) - \epsilon_i\alpha_i pR_1 c d\epsilon_i && (15) \\ &= 1 + \int_0^{\hat{\epsilon}} (R_2-1) - \epsilon_i s(1-p) - \epsilon_i pR_1 c d\epsilon_i && (16) \\ &= 1 + \hat{\epsilon}(R_2-1) - \frac{1}{2}\hat{\epsilon}^2 s(1-p) - \frac{1}{2}\hat{\epsilon}^2 pR_1 c && (17) \\ &= 1 + q(R_2-1) - y_{AM}(s + \frac{p}{1-p}R_1 c) && (18) \\ &= 1 + q(R_2-1) - \frac{1}{4}\rho\sigma^2\hat{\epsilon}^4((1-p)^2 + p(1-p)R_1 r) && (19) \end{aligned}$$

The social welfare is then given as the sum of the two utilities U_{AM} and U_D:

$$W = 1 + \hat{\epsilon}(R_2 - 1) - \rho\sigma^2 \frac{\hat{\epsilon}^4}{8} \left((1-p)^2 + 2p(1-p)R_1 r \right) \tag{20}$$

To illustrate the impact of the risky asset's pledgeability on the aggregate social welfare of the economy, we calibrate the model using market data. As a proxy for the risky asset, we employ an investment grade corporate bond index for the euro area covering the period Q4 2007 to Q1 2020.[5] Using quarterly data, $R_0 = 1$ is defined as the price of the index in Q4 2019. $R_1 = 0.953$ is the realised price in Q1 2020 and $R_2 = 1.014$ is the expected two-period return of the risky asset at the date of the initial investment in $t = 0$. The historical return variance is $\sigma^2 = 0.0056$. Following the ECB's securities lending arrangements, we set the borrowing cost, c, equal to the fixed minimum fee of 5 basis points (bp), which results in $r = \frac{c}{s} = 0.0082$.

Figure A2: Asset pledgeability and aggregate welfare



This figure depicts for different risk aversion parameters, ρ, the aggregate welfare as a function of pledgeability p.

Figure A2 illustrates the improvement in overall welfare with increasing pledgeability of the risky asset. The welfare is calculated for three types of dealers with different levels of risk aversion. We can observe that for $p = 0$, dealers' risk aversion affects welfare negatively. More risk averse dealers are less willing to buy the distressed risky asset, thus reducing overall welfare. As pledgeability increases, the role of dealers diminishes as

[5]The data for the MSCI IG EUR Corporate Bond Index come from Bloomberg.

asset managers are more likely to fund redemptions via collateralised borrowing. In the extreme case, when 100% of the risky asset is pledgeable as collateral, asset managers will prefer not to sell the asset at all, rendering dealers meaningless. Overall, our model predicts that going from no pledgeability ($p = 0$) to full pledgeability ($p = 1$), will improve welfare by 0.56% (for $\rho = 10$) to 0.73% (for $\rho = 20$).

B Data

B.1 Asset categorisation

All investment fund holdings in the Lipper database are accompanied by asset type information. This information is not consistently assigned across investment funds and does not necessarily align with asset categories from other sources. For instance, we observe that the same bond held by two different funds is categorised as a corporate bond in one fund and a sovereign bond in the other. This can happen when the government is the ultimate shareholder of the company, while the company (e.g. a utility company) is considered by certain market participants as a corporate bond issuer. In other cases, we observe derivatives or mortgage-backed securities being assigned to the corporate bond category.

To achieve a cleaner separation of the assets into unique categories, we first employ two different asset categorisations: (i) using Lipper's asset type information, and (ii) using ISIN-level information from Refinitiv Workspace. We refer to the former as Lipper-based categorisation and the latter as our own categorisation. In the second step, we compare the two categorisations and allocate those assets that we consider to be incorrectly categorised by Lipper into more appropriate asset type categories.

Using Lipper's asset type variable, we define the following seven categories: cash, corporate bonds, derivatives, repurchase agreements, term notes, sovereign bonds, and other. Holdings are defined as cash if Lipper's asset type is one of the following: "Cash", "Cash Equivalent", and "Currency". Corporate bonds are: "Corporate Medium Term Notes", "CORP", "Global Bonds", or "Corporate Intermediate and Long Term Debt", "Bank Debt". Derivatives are: "Commodity Future", "Commodity Future Option", "Futures", "FX Forward", "Asset Swap", "Cash Options", "Credit Default Swap", "Currency Future", and similar categories. Repurchase agreements are: "Repurchase Agreement". Term notes are: "Time / Term Deposit", "Treasury Notes/Bonds", "Discount Note", "Commercial Paper", "Certificate of Deposit", and "Agency Notes/Bonds". The remaining assets are allocated to the category other.

In the following step, we focus on fund holdings that are accompanied with an ISIN and use Refinitiv Workspace to obtain for these assets their asset category (Data Item Codes: TR.AssetCategory and TR.AssetCategoryCode), the industry sector of the issuer (TR.FiIndustrySector), the industry sector of the immediate parent (TR.FiParentImmedIndustrySector), the general description of the company's industry from the Standard and Poor's (TR.FiSPIndustryDescription), and the issuer's company name (TR.CompanyName). Using this information, we construct our own five asset categories: bank bonds, derivatives, liquid assets, non-bank corporate bonds, and residual assets. We begin with liquid assets, which we define as bonds with the following industry sectors: sovereign, municipality, agency, or supranational. In addition, we assign certificates of deposit and money market funds to the liquid asset category. We classify all assets with an asset category that resembles derivatives (e.g., futures, options) in the derivatives category. The residual assets category is used for all remaining assets that are not corporate bonds: e.g., various types of asset-backed securities, equities, exchange-traded notes and funds, closed/open-end funds, credit card receivables, to name a few. Then, we identify bank bonds using the industry sector variables and by scanning for banks using the issuer's company name. In the last step, we identify non-bank corporate bonds that were not assigned to either of the previous four asset categories.

In the last step, we compare the two asset type categorisations and assign those assets that we consider to be incorrectly categorised by Lipper into the more suitable asset type category. For instance, we find that the Lipper-based categorisation incorrectly labelled some derivative instruments as corporate bonds. We therefore remove these derivatives from the corporate bond category and assign them to the derivatives category. We do the same exercise for all other categories and eventually arrive with a much cleaner Lipper-based asset categorisation. In particular, this approach gives us confidence that our final sample of bonds in the corporate bond category is not contaminated by derivatives, asset-backed securities, agency bonds, and the like. In addition, we achieve a clean separation of corporate bonds into one of the two subcategories: bank bonds and non-bank corporate bonds.

C Idiosyncratic large outflows

Table C1: ECB-eligible corporate bond allocation during large outflow periods

	ECB-eligible corporate bond share		
	(1)	(2)	(3)
(Outflows$\geq$ 20%) * Bank-affiliated			-0.006
			[0.011]
(Outflows $\geq$ 20%) * (Outflows > Sov. share)		0.099	
		[0.067]	
Outflows > Sov. share (t-1)		-0.003	
		[0.002]	
Outflows $\geq$ 20%	-0.016***	-0.108	-0.011
	[0.006]	[0.067]	[0.008]
Eligible corp. bond share (t-1)	-0.056	-0.064	-0.057
	[0.088]	[0.088]	[0.088]
Observations	6,326	6,326	6,326
R-squared	0.987	0.987	0.987
No. clusters	681	681	681
Fund$\times$half year FE	Yes	Yes	Yes
Controls	Yes	Yes	Yes

The table presents the results of quarterly panel regressions on the effect of large outflows on investment funds' asset allocation decisions. The dependent variable is the share of ECB-eligible corporate bonds as percentage of total corporate bond holdings. *(Outflows $\geq$ 20%)* is a dummy that equals one if a fund experiences an outflow of 20% or more of its (previous quarter) fund size, and is zero otherwise. *Outflows > Sov. share* is a dummy that equals one if the fund's outflows are larger than the fund's sovereign holdings (as % of fund size) in the previous quarter, and is zero otherwise. *Bank-affiliated* is a dummy that equals one if the fund is affiliated with a bank, and is zero otherwise. Fund and fund$\times$half year fixed effects are included where indicated. Additional control variables are *ECB-eligible corporate bond share (t-1)* (the lagged dependent variable), *Size (t-1)* (the total market value of the fund's portfolio holdings at the end of the previous quarter), *Sov. share (t-1)* (the share of sovereign holdings (as % of fund size) in t-1), and *Time trend* (a linear time-varying control variable). The sample period spans Q1 2015 to Q4 2019. The data come from Refinitiv Lipper. Standard errors are clustered at fund level and are reported in squared brackets. Statistical significance is denoted by ***, **, and * at the 1%, 5%, and 10% levels, respectively.

Table C2: ECB-eligible corporate bond holding changes during large outflow periods

	Par value (QoQ % change)				
	(1)	(2)	(3)	(4)	(5)
(Outflows $\geq$ 20%) * Bank-affiliated * ECB-eligible					-0.013
					[0.013]
Bank-affiliated * ECB-eligible					-0.004
					[0.005]
(Outflows $\geq$ 20%) * (Outflows > Sov. share) * ECB-eligible				-0.089	
				[0.061]	
(Outflows >Sov. share) * ECB-eligible				-0.005	
				[0.004]	
(Outflows $\geq$ 20%) * Bank bond * ECB-eligible			0.003		
			[0.014]		
Bank bond * ECB-eligible			0.087		
			[0.063]		
(Outflows $\geq$ 20%) * Bank bond			-0.005		
			[0.012]		
(Outflows $\geq$ 20%) * ECB-eligible		-0.022***	-0.022***	0.069	-0.014
		[0.007]	[0.008]	[0.060]	[0.009]
ECB-eligible	-0.058***	-0.057***	-0.066***	-0.055***	-0.054**
	[0.020]	[0.020]	[0.022]	[0.020]	[0.021]
Observations	1,805,523	1,805,523	1,805,523	1,805,523	1,805,523
R-squared	0.334	0.334	0.334	0.334	0.334
No. clusters	711	711	711	711	711
Fund×year×quarter FE	Yes	Yes	Yes	Yes	Yes
Bond×half year FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes

The table presents the results of quarterly panel regressions on the effect of large outflows on investment funds' purchases. The dependent variable the relative quarter-on-quarter change in corporate bond holdings. *(Outflows $\geq$ 20%)* is a dummy that equals one if a fund experiences an outflow of 20% or more of its (previous quarter) fund size, and is zero otherwise. *Bank bond* is a dummy that equals one if the bond is issued by a bank, and is zero otherwise. *ECB-eligible* is a dummy that equals one if the bond is listed in the Eurosystem's list of eligible marketable assets, and is zero otherwise. *Outflows > Sov. share* is a dummy that equals one if the fund's outflows are larger than the fund's sovereign holdings (as % of fund size) in the previous quarter, and is zero otherwise. *Bank-affiliated* is a dummy that equals one if the fund is affiliated with a bank, and is zero otherwise. Fund×year×quarter and bond×half year fixed effects are included where indicated. Additional control variables are *Log par value (t-1)* (the logarithm of the fund's portfolio holdings' par value at the end of the previous quarter) and *Bond matured* (a dummy that equals one if the bond matures in quarter *t*). The sample period spans Q1 2015 to Q4 2019. The data come from Refinitiv Lipper. Standard errors are clustered at fund level and are reported in squared brackets. Statistical significance is denoted by ***, **, and * at the 1%, 5%, and 10% levels, respectively.

Table C3: ECB-eligible corporate bond holdings during large outflow periods

	Log par value				
	(1)	(2)	(3)	(4)	(5)
(Outflows $\geq$ 20%) * Bank-affiliated * ECB-eligible					-0.171
					[0.145]
Bank-affiliated * ECB-eligible					-0.057
					[0.051]
(Outflows $\geq$ 20%) * (Outflows > Sov. share) * ECB-eligible				-0.911	
				[0.594]	
(Outflows $\geq$ Sov. share) * ECB-eligible				-0.091**	
				[0.043]	
(Outflows $\geq$ 20%) * Bank bond * ECB-eligible			0.057		
			[0.137]		
Bank bond * ECB-eligible			0.584		
			[0.637]		
(Outflows $\geq$ 20%) * Bank bond			-0.115		
			[0.102]		
(Outflows $\geq$ 20%) * ECB-eligible		-0.324***	-0.338***	0.635	-0.219**
		[0.078]	[0.090]	[0.582]	[0.100]
ECB-eligible	-0.630**	-0.617**	-0.678**	-0.584**	-0.578**
	[0.255]	[0.256]	[0.283]	[0.255]	[0.263]
Observations	1,845,504	1,845,504	1,845,504	1,845,504	1,845,504
R-squared	0.417	0.417	0.417	0.417	0.417
No. clusters	711	711	711	711	711
Fund×year×quarter FE	Yes	Yes	Yes	Yes	Yes
Bond×half year FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes

The table presents the results of quarterly panel regressions on the effect of the COVID outbreak in Q1 2020 on investment funds' asset holdings. The dependent variable is the logarithm of the corporate bond par value (in EUR) held by the fund. *(Outflows $\geq$ 20%)* is a dummy that equals one if a fund experiences an outflow of 20% or more of its (previous quarter) fund size, and is zero otherwise. *Bank bond* is a dummy that equals one if the bond is issued by a bank, and is zero otherwise. *ECB-eligible* is a dummy that equals one if the bond is listed in the Eurosystem's list of eligible marketable assets, and is zero otherwise. *Outflows > Sov. share* is a dummy that equals one if the fund's outflows are larger than the fund's sovereign holdings (as % of fund size) in the previous quarter, and is zero otherwise. *Bank-affiliated* is a dummy that equals one if the fund is affiliated with a bank, and is zero otherwise. Fund×year×quarter and bond×half year fixed effects are included where indicated. Additional control variables are *Log par value (t-1)* (the logarithm of the fund's portfolio holdings' par value at the end of the previous quarter) and *Bond matured* (a dummy that equals one if the bond matures in quarter t). The sample period spans Q1 2015 to Q4 2019. The data come from Refinitiv Lipper. Standard errors are clustered at fund level and are reported in squared brackets. Statistical significance is denoted by ***, **, and * at the 1%, 5%, and 10% levels, respectively.

D Construction of liquidation and price pressure measures

D.1 Liquidation pecking order

Following Ma et al. (2022), we establish the liquidation pecking order within mutual funds by (i) estimating the liquidation-to-outflow sensitivity and (ii) constructing a fund-level liquidation rank based on the relative liquidity of assets held.

The liquidation-to-outflow sensitivity, $\beta_{g(j)}$, is obtained from the following regression equation:

$$Liquidation_{i,j} = \beta_{g(j)} Outflows_i + Fund\ controls_i + \gamma_j + \epsilon_{i,j}, \tag{21}$$

where $Liquidation_{i,j}$ denotes the percentage change in the par value of bond j held by fund i between Q4 2019 and Q1 2020. $Outflows_i$ measure net fund outflows over the same period, expressed as a share of the fund's size in Q4 2019. $Fund\ controls_i$ include the natural logarithm of the fund's size (Q4 2019), the fund return between Q3 and Q4 2019, the percentage share of the fund's cash holdings in Q4 2019, and the fund's regional investment focus (Europe, Global, Global Emerging Markets, North America). γ_j captures bond fixed effects. Liquidity groups, $g(j)$, are determined by the bonds' initial effective credit rating from Dealogic, defined as the average of the available ratings from S&P, Fitch, and Moody's.[6]

The liquidation rank of bonds held by a fund, following Ma et al. (2022), is defined as:

$$Liquidation\ rank_{i,j} = \sum_{g(j')} Share_{i,g(j')} \times \mathbb{1}\{Liq.\ group_{g(j)} > Liq.\ group_{g(j')}\} + \frac{1}{2} Share_{i,g(j)}, \tag{22}$$

[6] If a bond is rated by only one rating agency, that rating is used. When ratings differ (e.g., S&P: AAA, Moody's: Aa2), the average is computed and rounded to the nearest standard notch (e.g., AA+).

where $Share_{i,g(j')}$ denotes the ratio of the total par value of bonds j' within liquidity group $g(j')$ to the total par value of all bonds held by fund i as of Q4 2019. The last term in the equation accounts for the discrete nature of the rating-based liquidity groups (i.e., AAA, AA+, AA, ...), assuming equal liquidity within a group.

To examine how the liquidation rank influences the liquidity-to-outflow sensitivity, we estimate the following baseline regression:

$$Liquidation_{i,j} = \beta_1 Outflows_i \times Liquidation\ rank_{i,j} + \beta_2 Outflows_i + Fund\ controls_i + \gamma_j + \epsilon_{i,j}, \tag{23}$$

where *Fund controls* include the natural logarithm of fund size (Q4 2019), the fund return between Q3 and Q4 2019, the share of cash holdings in Q4 2019, and the fund's regional investment focus. γ_j denotes the bond fixed effects.

D.2 Fund-induced price pressure

To measure the mutual-fund-induced price pressure on the bond market, we construct four proxies: (i) *Flow-implied trade*, (ii) *Price pressure*, (iii) *Imputed outflow*, and (iv) *Liquidation-adjusted outflow (LAO)*.

The flow-implied trade measure, following Jiang et al. (2021), is defined as:

$$Flow\text{-}implied\ trade_j = \frac{\sum_i Fund\ flows_i \times Par\ value_{i,j}}{Principal\ amount_j}, \tag{24}$$

where $Fund\ flows_i$ are the net inflows and outflows of fund i between Q4 2019 and Q1 2020, expressed as a share of the fund's size in Q4 2019. $Par\ value_{i,j}$ is par value amount of bond j held by fund i in Q4 2019, and $Principal\ amount_j$ is the bond's principal amount at issuance.[7]

The price pressure measure (Coval & Stafford, 2007; Jiang et al., 2021) captures

[7] All foreign-currency-denominated values are converted into EUR using official ECB exchange rates.

realized trading activity stemming from large fund flows:

$$Price\ pressure_j = \frac{\sum_i (Buy_{i,j}|Fund\ flows_i > Fund\ flows^{P90} - Sell_{i,j}|Fund\ flows_i < Fund\ flows^{P10})}{Principal\ amount_j}, \tag{25}$$

where $Buy_{i,j}$ ($Sell_{i,j}$) denotes the positive (negative) change in par value of bond j held by fund i between Q4 2019 and Q1 2020. $Fund\ flows^{P90}$ and $Fund\ flows^{P10}$ refer to the 90th and 10th percentiles of fund flows in Q1 2020, respectively, identifying the largest inflow and outflow funds.

The imputed outflow measure, following Ma et al. (2022), is defined as:

$$Imputed\ outflow_j = \sum_i Outflows_i \times \frac{Par\ value_{i,j}}{\sum_k Par\ value_{k,j}}, \tag{26}$$

where $Outflows_i$ measure net fund outflows between Q4 2019 and Q1 2020, expressed as a share of the fund's size in Q4 2019. $Par\ value_{i,j}$ is par value amount of bond j held by fund i in Q4 2019.

The liquidation-adjusted outflow measure is defined as:

$$LAO_j = \sum_i Outflows_i \times (\hat{\beta}_1 Liquidation\ rank_{i,j} + \hat{\beta}_2) \times \frac{Par\ value_{i,j}}{\sum_k Par\ value_{k,j}}, \tag{27}$$

where $\hat{\beta}_1$ and $\hat{\beta}_2$ are the estimated coefficients from the regression equation (23).

European Stability Mechanism

6a Circuit de la Foire Internationale
L-1347 Luxembourg

Tel: +352 260 292 0

www.esm.europa.eu

info@esm.europa.eu

Publications Office
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