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EUROSYSTEM

Working Paper

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events: Evidence from the COVID-19 outbreak

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ISSN: 2654-1912 (online)
DOI: <https://doi.org/10.52903/wp2025351>

This paper contains research conducted within the network “Challenges for Monetary Policy Transmission in a Changing World Network” (ChaMP). It consists of economists from the European Central Bank (ECB) and the national central banks (NCBs) of the European System of Central Banks (ESCB). ChaMP is coordinated by a team chaired by Philipp Hartmann (ECB), and consisting of Diana Bonfim (Banco de Portugal), Margherita Bottero (Banca d’Italia), Emmanuel Dhyne (Nationale Bank van België/Banque Nationale de Belgique) and Maria T. Valderrama (Oesterreichische Nationalbank), who are supported by Melina Papoutsis and Gonzalo Paz-Pardo (both ECB), 7 central bank advisers and 8 academic consultants. ChaMP seeks to revisit our knowledge of monetary transmission channels in the euro area in the context of unprecedented shocks, multiple ongoing structural changes and the extension of the monetary policy toolkit over the last decade and a half as well as the recent steep inflation wave and its reversal. More information is provided on its website.

BOND PORTFOLIO REBALANCING DURING DASH-FOR-CASH EVENTS: EVIDENCE FROM THE COVID-19 OUTBREAK

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ABSTRACT

Using a granular dataset of bond fund holdings at the security-level, we examine how non-bank financial intermediaries respond to extreme liquidity crises like the COVID-19 shock of March 2020. U.S. funds primarily liquidated high-quality bonds, like Treasuries, while Euroarea funds sold across the rating spectrum. Despite these large liquidations, portfolio allocations across ratings and sectors remained stable, suggesting proportional rebalancing to maintain investment mandates. Funds with larger shares of highly-rated bonds sold lower-rated bonds less aggressively and experienced smaller losses. Our results highlight the importance of portfolio composition for the resilience of market-based finance and the transmission of monetary policy.

Keywords: non-banking financial intermediaries, credit ratings, portfolio allocations, bond funds

JEL classification: E52, G12, G15, G20

Acknowledgments: This paper was prepared under the European System of Central Banks ChaMP research network (Challenges for the Transmission of Monetary Policy in a Changing World). We would like to thank Philipp Hartmann, Diana Bonfim, Margherita Bottero, Björn Imbierowicz, Laura Moretti, Jean-David Sigaux, Hiona Balfoussia and participants of the 5th Workstream 1 workshop of the ESCB ChaMP research network (13-14 February 2025, Dublin Ireland), of the 23rd Conference on Research on Economic Theory and Econometrics (CRETE, 7-11 July 2025, Tinos Greece) and of the 2025 Annual FMA conference (22-25 October 2025, Vancouver Canada). The views expressed in this paper are those of the authors alone and may not necessarily represent those of the Bank of Greece, or the Eurosystem.

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1 Introduction

This paper examines two seemingly opposing forces that shape bond portfolio rebalancing during periods of severe liquidity shocks. On the one hand, in times of economic turmoil, bond funds can liquidate highly rated bonds with minimal price impact to meet redemption pressures from investors and shareholders, a phenomenon commonly referred to as dash-for-cash (e.g., [Barone et al. \(2023\)](#)). On the other hand, funds are constrained by their investment mandates to maintain a specific risk profile, as reflected by the composition of bond portfolios across credit ratings (e.g., [Baghai et al. \(2024\)](#)). Consequently, following excessive sales of highly rated bonds, rebalancing toward benchmark allocations compels funds to also reduce holdings of lower-rated bonds.

These two opposing forces have important implications for portfolio composition and fund performance during dash-for-cash shocks. Selling primarily high-quality liquid assets increases the risk of the remaining portfolio. Hence, such shocks could induce higher risk-taking by funds, with significant consequences for financial stability. In contrast, selling lower-rated bonds reduces overall portfolio risk but also undermines fund performance, since these securities tend to suffer larger losses during crises. To study how these motives affect both portfolio composition and fund performance, we focus on the onset of COVID-19, an exogenous and unexpected shock, and examine the rebalancing of bond portfolios of non-bank financial intermediaries (NBFIs), given their growing role in bond markets.

Investment funds often rebalance their portfolios in order to maintain certain benchmark allocations. Portfolio rebalancing relies on a desired strategic allocation that serves as an anchor against the fluctuations of the prices in the securities included in the portfolio that may alter its weights (e.g., [Perold and Sharpe \(1988\)](#)). While for mixed funds, the weighting scheme entails cross-asset weights (e.g., 60% equities 40% bonds) the balance of risks of bond funds may be associated to the bonds' creditworthiness. Hence, the onset of COVID-19 provides a unique setting to examine how investment funds allocate their portfolios under

stressed market conditions. As illustrated in Figure 1, the outbreak triggered severe turbulence in financial markets: implied volatility indices for both equities and bonds surged and peaked around mid-March 2020, coinciding with a sharp deterioration in financial conditions. At the same time, the non-bank financial sector was at the epicenter of the turmoil, as the sudden spike in liquidity needs, driven by large-scale shareholder redemptions, put intense pressure on investment funds and other key market participants.

According to [Vissing-Jorgensen \(2021\)](#), U.S. mutual funds addressed the sharp increase in liquidity needs by selling U.S. Treasury bonds. The shock also affected corporates, with firms drawing bank credit to be able to address adverse liquidity and capital shocks (e.g., [Acharya and Steffen \(2020\)](#)). Similar liquidity needs drove European funds to liquidate their positions, adversely affecting their role in supporting corporate funding during turmoil (e.g., [Nicoletti et al. \(2024\)](#)).

The goal of this study is to investigate whether the above dash-for-cash events during March 2020 triggered a rebalancing of bond fund portfolios across credit rating categories. Because investment mandates require funds to maintain binding risk profiles reflected in the distribution of holdings across ratings (e.g., [Baghai et al. \(2024\)](#)), a shock to the higher-rated segment of the portfolio may transmit to other risk classes as well. We therefore explore the hypothesis that, while COVID-19 led to substantial liquidations of highly rated bonds, as documented in prior studies, it also induced reductions in lower-rated holdings, consistent with portfolio rebalancing. In sum, our study focuses on how bond funds rebalanced their portfolios across credit rating categories, shedding light on whether the dash-for-cash effect was concentrated in high-quality bonds or extended more broadly across the rating spectrum.

To this end, we build a dataset that combines accounting information for fund holdings with security-level data, such as credit ratings and other characteristics of the securities held by these funds. Using this dataset, we infer the factors that determine the portfolio allocation process of bond funds during the period around the COVID-19 shock. Our dataset covers bond fund holdings at the security level of about six trillion U.S. dollars, representing

more than two-thirds of the market for U.S. and Euroarea (EA) bond funds. Since U.S. and Euroarea bond funds combined represent approximately 80% of the global market, our sample is broadly representative of global markets. In this granular sample, we use rating information of each security to dynamically trace portfolio allocations and identify the determinants of bond fund rebalancing under stress.

Our analysis focuses on changes in the dollar book values and portfolio weights of bond fund holdings, both at the security and fund levels. We define portfolio weights as the ratio of a security’s book value to the total book value of the fund’s portfolio. The distinction between book and market values is central to capturing portfolio allocation decisions. Changes in market values may primarily reflect fluctuations in bond prices rather than active reallocation by funds. In contrast, changes in book values capture shifts in quantities, since book entries record the amount of each security at the initially recorded price (as reported to the Lipper database), which does not vary over time.

The empirical methodology proceeds in several steps. *First*, we verify that the onset of the COVID-19 epidemic coincided with an unusual surge in bond portfolio rebalancing activity. These tests confirm that the dash-for-cash shock materialized in March 2020. Specifically, in March 2020, U.S. bond funds liquidated on average \$422k of each bond relative to their position in the previous month. Euroarea funds liquidated an average \$398k of each bond. The magnitude of this activity is one to two orders greater than sales during adjacent months. Importantly, we find little to no evidence of a comparable, time-specific rebalancing episode in any other month of our sample period (December 2018 to January 2021).

Second, we examine how credit ratings (AAA, AA, etc.) shaped portfolio rebalancing by regressing changes in holdings, measured both in dollar book values and in portfolio weights, on the interaction between March 2020 and credit rating categories. This analysis is conducted at the security-fund and rating-fund levels, where securities are aggregated by rating within each fund. Our estimates indicate that in March 2020, U.S. funds predominantly liquidated in dollar terms highly rated bonds, with a monotonic pattern across ratings: ap-

proximately \$600k per AAA bond, \$380k per AA, \$200k per A and \$100k per BBB. This is in line with the evidence in [Vissing-Jorgensen \(2021\)](#). In contrast, Euroarea funds sold across the rating spectrum largely indiscriminately with liquidations of about \$900k for per AAA-, BB-, and CCC-rated bonds, \$300k per AA, \$330k per A and \$350k per BBB bonds.

These findings at the bond-fund level are similar to the estimates at the rating-fund level. In March 2020, the average U.S. fund liquidated \$216 million of AAA-rated bonds, \$50 mil. AA, and \$54 mil. BBB bonds, without any significant sales activity among lower-rated securities. By contrast, Euroarea funds sold across all rating categories, liquidating about \$66 million AAA, \$27 mil. AA, \$60 mil. BBB, \$47 mil. BB bonds, and \$38 mil. B-rated bonds. The monotonic liquidation pattern observed among U.S. funds, compared with the more uniform pattern of Euro area funds, likely reflects structural differences in the composition of their holdings. Specifically, Euroarea funds hold a much larger share of lower-rated government bonds than U.S. NBFIs due to the segmented nature of European sovereign bond markets and the limited supply of AAA-rated securities in Europe.

The novel contribution of this paper is that, in addition to examining dollar sales, we also analyze changes in portfolio weights. Interestingly, despite the large dollar sell-off of highly rated bonds in March 2020, portfolio weights remained essentially unchanged for both U.S. and Euroarea funds. In particular, we find no statistically or economically significant shifts in portfolio weights at either the bond or fund levels. In other words, although funds, especially in the U.S., liquidated substantial amounts of high-quality assets to address liquidity needs (dash-for-cash), they did so proportionally across rating categories, thereby keeping portfolio weights stable. We interpret this as direct evidence that bond funds seek to preserve a specific risk profile, as dictated by their investment mandates, even under severe systemic shocks such as COVID-19.

Third, beyond credit ratings, we also examine changes in fund holdings across sectors of bond issuer (government, financial, non-financial, other) using both security- and fund-level data. We find that the dollar reduction in government bond holdings in March 2020 was

highly negative and much larger in absolute value than the changes in other sectors, both at the bond (U.S. -\$800k per bond, Euroarea -\$1.2 mil. per bond) and fund levels (U.S. -\$190 mil. per fund, Euroarea -\$170 mil. per fund). While U.S. funds show no statistically significant reductions in financial and non-financial bonds, Euroarea funds substantially decreased their dollar holdings in these sectors (-\$70 to -\$80 mil. per fund). Most importantly, and consistent with the results based on credit ratings, the sharp dollar reductions in government bonds did not translate into lower portfolio weights. Instead, portfolio weights across sectors remained stable for U.S. and Euroarea funds even after the COVID-19 shock in March 2020.

Finally, we conclude our empirical analysis by testing whether a larger share of high-quality bonds shaped funds' responses to the COVID-19 shock. Specifically, we examine whether funds with above-median holdings of highly rated bonds before the COVID-19 shock differed in their portfolio returns and rebalancing behavior compared to other funds. Indeed, we find that during the COVID-19 shock (March 2020), funds with stronger AAA positions were able to significantly moderate both the liquidation of lower-rated bonds (as percentage of overall book value), as well as the adverse impact on portfolio returns by 9% for U.S. funds (from -16% to -7%), and by 6% for Euroarea funds (from -20% to -14%).

Our empirical findings contribute to the existing literature along several dimensions. *First*, our paper contributes to the mutual fund literature by unveiling the implications of mutual fund liquidity transformation on their portfolio composition, portfolio risk and performance during periods of severe market stress such as the onset of the COVID-19 crisis. The literature on liquidity transformation of mutual funds examines whether funds tend to follow a 'liquidity pecking order' by reducing cash and liquid assets such as Treasuries first in order to meet investor redemptions before they reduce less liquid holdings.

Specifically, [Chernenko and Sunderam \(2016\)](#) show that mutual funds accommodate a substantial fraction of fund flows through changes in cash holdings as opposed to trading in less liquid securities. [Vissing-Jorgensen \(2021\)](#) shows that U.S. mutual funds were among the largest sellers of U.S. Treasuries in the first quarter of 2020. [Jiang et al. \(2021\)](#) show

that the findings of [Chernenko and Sunderam \(2016\)](#) hold when market uncertainty is low. However, when market uncertainty is high, as measured by a higher VIX index, bond funds liquidate assets proportionally. [Ma et al. \(2022\)](#) uses ratings as a proxy of liquidity with Treasuries ranked as the most liquid asset class and corporate bonds assigned into liquidity groups defined by their rating and provides evidence that mutual bond funds followed a liquidity pecking order at the onset of the COVID-19 crisis by first selling their most liquid assets before more illiquid ones.

Confirming the findings of [Ma et al. \(2022\)](#), we show that, during the dash-for-cash shock of March 2020, U.S. funds predominantly liquidated large amounts (in dollar terms) of high-quality liquid holdings such as U.S. Treasuries. However, we find that Euroarea funds do not follow a pecking order of liquidations, likely due to the segmented nature of Euroarea bond markets, where government bonds differ across countries in terms of credit risk and liquidity. Interestingly, however, we find that, independently of their liquidation policy, both U.S. and Euroarea funds did not change their portfolio allocation towards more risky assets.

Second, our paper also contributes to the literature on investment mandates. [Baghai et al. \(2024\)](#) show that the mandates of bond funds prescribe specific allocations tied to the credit ratings of the bonds in their portfolios. Related studies also document the close connection between bond fund allocations and credit risk. [Choi et al. \(2022\)](#) find a strong relation between portfolio composition and credit risk, while [Converse and Malucci \(2023\)](#) show that adjustments in government bond holdings in response to changes in sovereign risk are closely linked to the sovereign’s risk level. Using granular data and the COVID-19 shock as a natural experiment, we extend this literature by showing that even under extreme liquidity stress, when bond funds liquidate large volumes of highly rated bonds, they also reduce lower-rated holdings in proportions that preserve the overall portfolio composition. This behavior underscores how funds strive to maintain the balance of risks prescribed by their investment mandates, even in the face of severe market disruptions.

Third, our paper contributes to the literature on the transmission of monetary policy

through the NBFIs sector to the financial system (e.g., [Hau and Lai \(2016\)](#), [Choi and Kromlund \(2018\)](#), [Ciminelli et al. \(2022\)](#), [Converse and Malucci \(2023\)](#), [Banegas et al. \(2022\)](#), [Kaufmann \(2023\)](#), [Giuzzio et al. \(2021\)](#), [Hodge and Weber \(2023\)](#), [Nenova \(2025\)](#)). The main finding of this literature is that expansionary monetary policy leads to greater risk taking by NBFIs, thus contributing to transmitting monetary policy to the broader economy. Our findings suggest that, despite the large-scale asset purchases of central banks on both sides of the Atlantic, bond funds did not take more risk in their portfolios. One possible interpretation of this result is that during large economic shocks such as the COVID-19 shock, which lead to a sharp decline in economic activity and a deterioration of firms’ fundamentals, funds are more risk averse and less willing to take more risk in their portfolios, despite the accommodating asset purchase policies by central banks.

The final contribution of our paper is to the literature on the behavior of NBFIs. The expansion of NBFIs’ financial assets, combined with banks’ tightening of credit standards, has strengthened the role of markets in financing the economy [Altavilla et al. \(2019\)](#). In the finance literature, bank-based and market-based financing are often presented as separate categories. However, this distinction does not imply that one is necessarily more efficient than the other. Indeed, [Acharya et al. \(2024\)](#) argue that banks and non-banks should be viewed as complementary and interconnected rather than as substitutes. This perspective highlights the growing importance of market-based financing, such as bond issuance, and thus the central role of non-banks in funding the real economy. Because of their procyclicality and vulnerability to runs (e.g., [Raddatz and Schmukler \(2012\)](#)), certain NBFIs, notably investment funds, have attracted increasing attention from policymakers as their footprint in financial markets has expanded (e.g., [Goldstein et al. \(2017\)](#)).

Our analysis contributes to this strand of the literature by providing comparative evidence on U.S. and Euroarea NBFIs, offering cross-regional insights that may inform policy design on both sides of the Atlantic. A central mechanism in this comparison is the composition of bond portfolios, which plays a key role in the transmission of monetary policy. We show

that U.S. funds hold significantly larger shares of AAA-rated bonds than Euroarea funds (46% vs. 26%). As a result, during the onset of COVID-19 in March 2020, U.S. funds were able to liquidate substantially more AAA bonds compared to lower-rated bonds than their Euroarea counterparts.

This difference translated into better relative performance. In March 2020, the aggregate portfolio returns of U.S. NBFIs were -0.4% , compared with -0.8% for Euroarea NBFIs (Figure A.1). The performance gap was largely driven by the fact that AAA bond returns were zero or slightly positive during the crisis, while lower-rated bonds suffered steep losses. The relatively low share of AAA holdings in Euroarea funds implies that, unlike U.S. funds, they have limited access to liquidity through assets supported by central bank open market operations. This structural difference highlights how portfolio composition shapes resilience to shocks and facilitates the effectiveness of monetary policy.

The remainder of the paper is organized as follows. Section 2 describes the construction of our micro-level security dataset and the key variables used in the analysis. Section 3 presents the first set of empirical results on bond fund portfolio allocation, with particular emphasis on the COVID-19 shock of early 2020. Section 4 examines the differential effects of holding highly rated bonds on both portfolio holdings and fund returns. Section 5 concludes.

2 Data and Methodology

2.1 Data

The focus of our empirical analysis is NBFIs in the United States and Europe that invest primarily in bond markets, that is, bond funds. We gather monthly security-level data on portfolio composition from December 2018 to January 2021, yielding a granular dataset that is representative of the global market for bond funds. The dataset combines security-level fund holdings with market-based information on the characteristics of these securities.

Specifically, we collect reports on bond fund holdings at the security level from London

Stock Exchange Group’s (LSEG) Lipper for Investment Management. From these reports, we gather the securities holdings for each fund by aggregating these entries according to security identifiers (ISINs and/or CUSIPs). For every security, we record both book and market values. Consistent with standard practice, these holdings are measured both in absolute terms, i.e., security-level holdings measured in U.S. dollars, and in relative terms (portfolio weights), that is, security-level holdings relative to the overall portfolio of each fund. Although bond funds invest primarily in fixed-income instruments, they may also hold small amounts of cash or other financial assets. These positions are limited in relation to the overall portfolios and are excluded from the sample. We also exclude fund holdings that correspond to shares of other funds. Overall, to obtain a comprehensive and informative dataset, we restrict our analysis to fund holdings of bonds only.

Next, we obtain security-level characteristics from LSEG’s Refinitiv for all bonds held in fund portfolios. We use these data to classify securities according to their characteristics. These characteristics may be dynamic or static. Dynamic attributes vary over time, such as the time to maturity of the bond or the credit rating of the issuer. In contrast, static attributes are time-invariant, such as instrument type or sector of issuer. With respect to credit ratings, we collect monthly data on long-term credit ratings for bond issuers from at least one of the three largest rating agencies, i.e., Fitch, Moody’s, and Standard & Poor’s, and follow the first-best regulatory principle. If a given issuer is rated differently by two or more agencies, we use the best among the various ratings for this issuer. Regarding the sector of the issuer, we consider economic sectors derived from the NAICS system and the Refinitiv Business Classification system. We divide these sectors into four large groups: Government, Financial, Non-financial, and Other. The government sector also includes agencies and supranational entities, whereas the financial sector includes banks and non-bank financial intermediaries, such as securitization vehicles.

After merging the two datasets, we apply standard filters, removing observations with missing identifiers, missing currency codes, duplicates, or missing book values. Entries with-

out identifiers typically correspond to cash and cash equivalents or other non-security items (e.g., derivatives, accounts payable/receivable, administrative fees, taxes). We drop observations with missing currency because book values are converted from local currencies to USD for comparability. We also eliminate a negligible number of duplicates, defined as multiple records of the same asset held by the same fund on the same date. These filters reduce the total market value to about 2.58 trillion USD for U.S. funds and 408 billion USD for Euroarea funds, that is, a reduction of approximately 4.9% and 4.6% in market value terms. Finally, to construct a balanced panel, we require funds to report their holdings every month over the sample period. We also impose size-based inclusion thresholds to maintain a manageable yet representative granular sample: we exclude U.S. funds with total asset value (TAV) below 1.5 billion USD and Euroarea funds with TAV below 1 billion USD.

Our dataset is representative of the global market for bond funds and, in particular, of the U.S. and Euroarea segments. According to the International Investment Funds Association, in 2020:Q1, the combined total net asset value of U.S. and Euroarea bond funds was 8.7 trillion USD.¹ In the Lipper database, the total asset value of U.S. and Euroarea bond funds at the end of 2020:Q1 was 7.9 trillion USD, and roughly two-thirds of the funds reported holdings every month. Consistent with this coverage, Figure 2 shows that our sample represents approximately one-half of the aggregate assets of U.S. and Euroarea bond funds that report monthly.² On 2020:Q1, U.S. and Euroarea funds, reporting each month in Lipper, had a TAV of 5.3 trillion USD; our dataset includes funds with a TAV of 2.9 trillion USD, i.e. we capture 54% of the TAV of U.S. and Euroarea funds that report monthly.

Table 1 summarizes the composition of aggregate bond portfolios across issuer ratings and sectors for NBFIs in the U.S. and the Euroarea. Panel A reports aggregate dollar holdings, while Panel B reports aggregate portfolio weights, defined as the total book value

¹These figures are for the total net asset value of open-end regulated funds, excluding funds-of-funds, based on the International Investment Funds Association report entitled “Worldwide regulated open-end fund assets and flows, first quarter of 2020.”

²Our sample includes 432 funds that report holdings monthly: 276 U.S. funds and 156 Euroarea funds. The number of funds is comparable to, though smaller than, that in [Chen et al. \(2010\)](#) and [Moneta \(2015\)](#), who analyze approximately 1,000 funds.

in each rating or sector across all funds divided by the aggregate book value of all funds. U.S. funds hold approximately half of their portfolios (\$900 billion) in AAA-rated bonds, while investment-grade (IG) securities account for roughly 90% (\$1.6 trillion) of their portfolios. For Euroarea funds, IG securities likewise comprise about 86% (\$285 billion) of total portfolios, but the share of lower-IG bonds (A and BBB) exceeds that of AAA and AA.

[Insert Table 1, around here]

Figure 3 visualizes the aggregate composition of bond portfolios summarized in Panel B, Table 1, classifying the monthly NBFBI bond holdings along two dimensions. Panel A reports portfolio shares by credit rating, from investment-grade (AAA, AA, A, BBB) to high-yield (BB, B, CCC, C/D). Panel B reports portfolio shares by sector, i.e., government bonds (including U.S. federal agencies), non-financial corporations, financials, and other.

[Insert Table 2, around here]

Tables 2 and 3 report summary statistics by credit rating and sector for bond holdings, both in dollar terms and portfolio weights, at the fund and bond-fund levels. At the fund level, we pool, within each fund, all bonds that share the same rating or sector. At the bond-fund level, each individual bond position in a fund’s portfolio is an observation. Summary statistics for fund-level dollar holdings (Panel A, Table 2) and portfolio weights (Panel B, Table 2), which are computed as the total book value in each rating or sector within a fund divided by the fund’s total book value, closely resemble the patterns in aggregate portfolio weights (Panel B, Table 1). That is U.S. fund predominately hold AAA bonds, which tend to be Treasuries, while Euroarea fund hold more uniform portfolios across ratings and sectors. In contrast, at the bond-fund level, dollar holdings (Panel A, Table 3) and portfolio weights (Panel B, Table 3) differ from the fund- and aggregate-level measures. This is because in Table 3, the book value of each bond in the fund’s portfolio is scaled by the total book value of the fund, resulting in very small weights per bond.

[Insert Table 3, around here]

2.2 Construction of variables

Our main dependent variables track changes in fund holdings over time. To address endogeneity from price changes, we compute the dependent variables in our regressions using book value holdings. Specifically, at each time t , each fund j reports the book and market values of each security i in its portfolio. For each bond, book values reflect the product of the quantity and the initially recorded price (as reported to the Lipper database by funds), which does not vary over time, while market values reflect current mark-to-market pricing of the bonds.

The distinction between book and market values is central for identifying portfolio allocation decisions. Changes in market valuations may reflect price movements without any active rebalancing. In contrast, changes in book values reflect changes in bond quantities since book value entries are recorded as the product of the quantities of purchased bonds with the initially recorded price. Hence, book value entries are invariant to price fluctuations and change only when new bonds are added to the portfolio or when the quantities of existing bonds are adjusted. In other words, book values only increase through purchases or decrease through partial or full sales. These changes do not reflect shifts in market prices, but rather deliberate rebalancing decisions by funds.

Specifically, we discuss three portfolio decisions that are reflected in bond book values. (i) *Additions of new bonds in the portfolio.* If a fund adds a bond to its portfolio during month t that was not held in the previous month, the bond's identifying code, i.e., its ISIN or its CUSIP, will appear in the fund's portfolio. This holding is recorded in the fund's book value account as $Q \times P_0$, where Q is the purchase quantity and P_0 is the initially recorded price. Unlike market values, book values do not vary over time unless the fund changes the quantity of bonds.³

(ii) *Increases in holdings of existing bonds.* When a fund already holds a bond, its ISIN

³Note that investment funds record these transactions in the bond's local currency, that is, the currency the bond is denominated to. For bonds denominated in currencies other than the U.S. dollar, we transformed all values in local currency into U.S. dollars by taking the foreign exchange rates at the end of each month.

or CUSIP appears in the accounts with a recorded book value. A positive change in this book value indicates that the fund has increased its position by purchasing additional units, i.e., committing more dollars to the security. This change in book values reflects an active portfolio allocation decision to increase exposure to that bond and is not driven by market price movements.

(iii) *Decreases in holdings of existing bonds.* In this case, bond sales are reflected as declines in book values. Any differences between the initially recorded price and the price at which the fund sells part or all of its position do not affect the book value account. Regardless of the realized profit or loss, a decrease in book value reflects a deliberate decision to reduce the position of the bond and does not capture contemporaneous movements in market prices.

Following the discussion above, the first variable of interest in our regressions is the monthly change in the book value of bond i held by fund j :

$$\Delta BV_{i,j,t} = BV_{i,j,t} - BV_{i,j,t-1}, \quad (1)$$

where $BV_{i,j,t}$ and $BV_{i,j,t-1}$ are book value holdings (in USD) of bond i by NBFI j at time t and $t - 1$, respectively. We also distinguish between changes in book value holdings in absolute (dollar) terms and changes in weights. Although absolute (dollar) changes are easily understood, in practice, funds consider bond holdings relative to the total book value of their bond portfolio. Hence, we examine portfolio adjustments in relative terms by analyzing changes in portfolio weights

$$\Delta w_{i,j,t} = w_{i,j,t} - w_{i,j,t-1}. \quad (2)$$

Portfolio weights, $w_{i,j,t}$, are defined as the ratio of the book value of bond i ($BV_{i,j,t}$) held by fund j to the fund's total book value at time t ($\sum_{i \in j} BV_{i,j,t}$):

$$w_{i,j,t} = \frac{BV_{i,j,t}}{\sum_{i \in j} BV_{i,j,t}}. \quad (3)$$

Motivated by evidence linking bond-fund allocation mandates to credit ratings (e.g., [Baghai et al. \(2024\)](#)), our analysis pays particular attention to ratings. As shown in Panel A of Figure 3, fund allocations across ratings remain notably stable over time, even during the onset of COVID-19 in March 2020. This stability suggests that rating-based risk classifications constrain portfolio choices. It also raises the question of whether, when confronted with external shocks, funds actively manage the balance of risks in their portfolios. Similar patterns emerge in Panel B of Figure 3, which shows fund allocations across sectors.

To assess whether bond portfolio rebalancing during COVID-19 shifted the balance of risks, we relate changes in portfolio allocations, both in dollars and in weights, to the ratings composition of these portfolios. Consequently, we classify the bond holdings of each fund by rating category and compute changes in the book value of these categories at the fund level:

$$\frac{\Delta BV_{z,j,t}}{BV_{j,t}} = \frac{\sum_{i \in z} \Delta BV_{i,j,t}}{\sum_{i \in j} BV_{i,j,t}}. \quad (4)$$

In the above equation, z denotes the rating category of each bond. Thus, $\Delta BV_{z,j,t}/BV_{j,t}$ measures the dollar change in book value of each rating category z as a percentage of the fund's total book value in rated bonds. Prior work identifies additional drivers of bond-portfolio performance (e.g., [Camanho et al. \(2022\)](#), [Maggiori et al. \(2020\)](#), [Raddatz and Schmukler \(2012\)](#), [Forbes et al. \(2016\)](#), [Raddatz et al. \(2018\)](#)). Consistent with this literature, we also examine the roles of bond prices and the issuer's sector in portfolio rebalancing.⁴

We also examine performance across funds with varying exposures to highly rated bonds. In particular, we test whether fund performance during the COVID-19 shock depends on the relative share of AAA-rated holdings. To this end, we construct fund-level returns by aggregating the returns of all bonds in a fund's portfolio. Specifically, the return for bond i in fund j 's portfolio is

$$Return_{i,j,t} = \frac{MarketValue_{i,j,t}/BookValue_{i,j,t}}{MarketValue_{i,j,t-1}/BookValue_{i,j,t-1}} - 1. \quad (5)$$

⁴In untabulated results, we also examine the effects of issuer headquarters.

The market value of bond i held by fund j is defined as the number of bonds ($Q_{i,j,t}$) held by fund j multiplied by its market price $P_{i,t}$ ($MarketValue_{i,j,t} = Q_{i,j,t} \times P_{i,t}$). In contrast, book value ($BookValue_{i,j,t} = Q_{i,j,t} \times P_{i,0}$) is the number of bonds multiplied by the initial recorded price $P_{i,0}$, which does not vary over time. Fixing the holdings of bond i by fund j to be constant ($Q_{i,j,t} = Q_{i,j,t-1}$), bond returns become

$$Return_{i,j,t} = \frac{P_{i,t}}{P_{i,t-1}} - 1. \quad (6)$$

Equation (6) derives the return on each bond i in fund's j portfolio. Summing the returns of all bonds in fund j weighted by their respective market values, we derive fund-level returns

$$Return_{j,t} = \sum_{i \in j} \frac{MarketValue_{i,j,t} \times Return_{i,j,t}}{\sum_{i \in j} MarketValue_{i,j,t}}. \quad (7)$$

We use these fund-level returns to assess how fund valuations and performance evolved during COVID-19. More importantly, we use these returns to examine heterogeneity across funds as a function of their risk profiles, proxied by the share of highly rated bonds. Given the procyclicality of bond-fund allocations and the documented feedback from returns to subsequent portfolio choices (e.g., [Timmer \(2018\)](#)), analyzing fund performance is central to understanding how shocks transmit through market-based finance. Specifically, during COVID-19, funds were reluctant to extend financing to the real economy (e.g., [Nicoletti et al. \(2024\)](#)). If the effects of COVID-19 on fund performance depend on the risk-composition of each fund, then this implies that the risk composition of bond portfolios amplifies the procyclicality of market-based finance. In particular, portfolios tilted toward assets that reduce return vulnerability during periods of stress should help sustain the supply of market-based funding.

Finally, throughout our analysis, we report most tests separately for two samples: U.S.-based NBFIs and Euroarea-based NBFIs. This split, which is done for expositional clarity, highlights cross-regional differences in the response to adverse liquidity shocks such as the one

induced by COVID-19. For completeness, full-sample estimates are available upon request.

2.3 Initial findings

The first set of tests highlights the importance of the initial COVID-19 shock for bond portfolio rebalancing. To this end, we estimate bond holdings regressions with two-way fixed effects across the bond-NBFI panel. Time fixed effects around the outbreak are reported in detail to show that the COVID shock is concentrated in March 2020, when sales of fund holdings were unusually large relative to any other month. The fixed effects specification is given by the following regression

$$\Delta BV_{i,j,t} = b'_T \cdot \mathbf{T}_t + Controls_{i,t} + a_{i,j} + u_{i,j,t}. \quad (8)$$

$\Delta BV_{i,j,t}$ is change in dollar book value of bond i held by fund j at time t , and $\mathbf{T}_t$ is the vector of time fixed effects. $Controls_{i,t}$ are the contemporaneous (at time t) and lagged (at $t - 1$) returns of security i held by fund j , and $a_{i,j}$ captures bond-NBFI fixed effects. Finally, standard errors in the above regression are clustered by date and bond-NBFI.

The results of these regressions are summarized in Table 4 and are grouped according to different specifications. Panel A reports the results for U.S. NBFIs and Panel B for Euroarea NBFIs. In each panel, column 1 reports results for the two-way fixed-effects, while column 2 also controls for the contemporaneous return of bond i . Column 3 controls for lagged returns, and column 4 includes both contemporaneous and lagged returns.

[Insert Table 4, around here]

Panel A of Table 4 shows that for U.S. bond funds, the fixed effects specification captures deviations in portfolio changes relative to average behavior. Column 1 shows that in March 2020, U.S. bond funds, on average, reduced their bond positions in book-value terms by approximately \$422k per bond. Estimates in columns 2 to 4 also control for contemporaneous and lagged returns, which, nevertheless, are not statistically significant in the case of U.S.

funds. Panel B of Table 4 reports estimates for Euroarea funds, indicating that during the onset of COVID-19, Euroarea funds also sold highly rated bonds aggressively. Specifically, in column 1, Euroarea funds reduced the per-bond book values of AAA-rated bonds by about \$398k relative to the previous month.

In summary, funds substantially reduced per-bond holdings in March 2020. Most importantly, the magnitude of this activity is one to two orders greater than sales during adjacent months, while no other month in the sample exhibits a comparable time-specific shift. Hence, the focus of our empirical tests is bond fund portfolio rebalancing during March 2020. According to Table 4, during this period, both U.S. and Euroarea funds liquidated a fair amount of their positions. As shown in Figure 4, Panel A, the total book value of U.S. funds declined by about 5% and that of Euroarea funds by almost 10%. These findings align with those in [Falato et al. \(2021\)](#), with one key difference: our sample spans all bond types, whereas [Falato et al. \(2021\)](#) focuses solely on corporates. Panels B and C of Figure 4 show that the March 2020 contraction in bond portfolios was driven by elevated sales, consistent with evidence that funds liquidated positions to meet investor outflows after the COVID shock (e.g., [Vissing-Jorgensen \(2021\)](#)).

3 Portfolio Rebalancing during COVID-19

3.1 Credit rating effects on portfolio holdings

The granularity of our dataset allows us to examine the implications of adverse economic conditions, such as the COVID-19 shock, on portfolio allocation at the bond level. We test the role of credit ratings in fund portfolio rebalancing during the onset of the pandemic using regressions with categorical variables for each rating, i.e., rating-specific fixed effects, and interactions with an indicator for March 2020, as follows:

$$\begin{aligned} \Delta Holdings_{i,j,t} = & b_1 \cdot \mathbf{1}\{March\ 2020\} + \sum_z b_{2z} \cdot \left(IRating_{i,z,t} \times \mathbf{1}\{March\ 2020\} \right) \\ & + Controls_{i,t} + a_z + a_{i,j} + u_{i,j,t}. \end{aligned} \quad (9)$$

In the above specification, the dependent variable ($\Delta Holdings_{i,j,t}$) denotes changes in bond holdings at the bond-fund level. These changes are either in dollar book values, $\Delta BV_{i,j,t}$ (million USD) or in portfolio weights, $\Delta w_{i,j,t}$ (%). The portfolio weight of bond i in fund j at time t is defined as the book value of bond i divided by the fund's total book value ($w_{i,j,t} = BV_{i,j,t} / \sum_{i \in j} BV_{i,j,t}$). The term $\mathbf{1}\{March\ 2020\}$ is an indicator variable for March 2020, and $IRating_{i,z,t}$ is an indicator variable for the rating z of bond i ($Rating_{i,z,t} = \text{AAA, AA, A, BBB, etc.}$). This setup allows us to examine whether U.S. and Euroarea funds adjusted their bond holdings in March 2020 and whether those adjustments differed across rating categories. In our estimations, we control for both the contemporaneous and lagged returns of bond i ($Controls_{i,t}$), as reported in the portfolio accounts of fund j . We also include rating and bond-fund fixed effects ($a_z, a_{i,j}$). Since these fixed effects are perfectly collinear with the C/D rating indicator, that category is omitted from regressions and, therefore, not reported.

[Insert Table 5, around here]

Table 5 reports changes in bond holdings: dollar amounts in columns 1-2 and portfolio weights in columns 3-4. Panel A reports results for U.S. funds and Panel B for Euroarea NBFIs. These estimates underscore the importance of credit ratings for bond-fund allocation decisions. Specifically, the March 2020 coefficient in column 1 of both panels indicates a broad sell-off that month. U.S. funds reduced holdings by about \$332k per bond (Panel A), and Euroarea funds by about \$416k per bond (Panel B). These findings are consistent with the Table 4 results discussed above.

Column 2 in both panels of Table 5 examines the interaction between the COVID-19

shock and credit-rating indicators. The increasingly negative interaction coefficients in Panel A indicate that, in March 2020, U.S. funds liquidated more AAA bonds, in absolute dollar terms, than lower-rated bonds. In particular, estimates in column 2 of Panel A imply that, in March 2020, U.S. funds liquidated about \$595k per AAA bond ($\text{March 2020} + \text{AAA} \times \text{March 2020} = \$348\text{k} - \$943\text{k}$), about \$376k from AA's, \$200k from A's, and \$100k from BBB's, etc.

Panel B, Table 5 reports somewhat different patterns for dollar rebalancing of Euroarea funds in March 2020. As with U.S. funds, Euroarea funds sold considerably more AAA bonds than lower-rated investment-grade bonds. Column 2 in Panel B implies liquidations of \$899k from AAA holdings, i.e., $-\$899\text{k} + \0k (since the $\text{AAA} \times \text{March 2020}$ coefficient is insignificant), \$296k from AA (i.e., $-\$899\text{k} + \603k), \$327k from A, and \$347k from BBB. However, Euroarea funds also sold sizable amounts of high-yield bonds, about \$899k per bond from BB-rated bonds and \$899k from their CCC holdings.

Hence, portfolio rebalancing at the onset of COVID-19 differs markedly between U.S. and Euroarea funds. U.S. funds reduced AAA positions far more than high-yield bonds, displaying a clear, monotonic pattern in dollar liquidations across ratings (column 2 in Panel A, Table 5), confirming the finding of [Ma et al. \(2022\)](#) that U.S. funds followed a pecking order of liquidations. In contrast, although Euroarea funds also sold substantial amounts of AAA bonds in March 2020, their sales did not follow a monotonic pattern across ratings because they also disposed of sizable BB, B, and CCC positions.

An important contribution of this paper is that, beyond dollar rebalancing, we examine changes in portfolio weights under adverse shocks, proxied here by the COVID-19 pandemic. Regarding portfolio weights, column 4 of Table 5 reveals a novel finding. In March 2020, funds on both sides of the Atlantic altered the weights of lower-rated bonds by amounts similar to those of higher-rated bonds, leaving overall portfolio risk essentially unchanged during the dash-for-cash episode. For U.S. funds, the sum of the March 2020 coefficient and the interaction term ($\text{March 2020} + \text{Rating} \times \text{March 2020}$) implies negligible per-bond weight changes from 0.003% to 0.001% across ratings (Panel A, column 4). For CCC-rated bonds,

weights increased by about 0.01% per bond. All these changes in weights are economically insignificant, one to two orders of magnitude smaller than the average per-bond weight reported in Panel B, Table 3 (0.14% for CCC to 0.04% for A bonds of U.S. funds).

For Euroarea funds, the weights regressions (column 4 in Panel B, Table 5) reveal that lower-rated IG bonds (e.g., A, BBB) were liquidated proportionately more than highly-rated ones (e.g., AAA, AA) in relative terms (-0.007% vs. 0.000%). Nevertheless, most of the interaction coefficients (Ratings $\times$ March 2020) in column 4 are statistically insignificant. Notably, the sum of the interaction coefficients with the March 2020 coefficient, which is insignificant, results in portfolio changes close to zero (-0.009% to 0.000%) that are economically negligible compared to the average bond weights in Euroarea funds reported in Panel B, Table 3, ranging from 0.10% for A bonds to 0.39% for AAA-rated bonds.

In sum, the results in Table 5 indicate that U.S. funds sold greater dollar amounts of each highly rated bond, following a monotonic pattern across ratings (column 2 of Panel A, Table 5). This behavior is consistent with evidence that bond funds liquidated high-quality assets to meet liquidity needs during the onset of COVID-19 (e.g., [Ma et al. \(2022\)](#)). By contrast, Euroarea funds reduced their bond holdings in dollar terms regardless of ratings (e.g., AAA, BB, B, CCC in column 2 of Panel B, Table 5). A plausible interpretation is that Euroarea funds hold larger shares of government bonds rated below AAA, reflecting the segmented nature of Euroarea sovereign bond markets. Importantly, in percentage terms, NBFIs on both sides of the Atlantic reduced allocations proportionally, without significantly altering portfolio weights across ratings. This underscores the emphasis placed by NBFIs on maintaining a balanced risk profile.

The seemingly contradictory result that large liquidations of AAA bonds in dollar terms generated almost no shifts in portfolio weights can be reconciled through simple aggregate calculations. Panel A of Table 1 shows that on average U.S. NBFIs held approximately \$900 billion in AAA bonds, compared to only \$50 billion in B-rated bonds. In terms of portfolio weights, these positions translate to 50% and 3%, respectively (Table 1, Panel B). According

to Figure 5, Panel A, U.S. NBFIs liquidated approximately \$60 billion AAA bonds and \$2 billion B-rated bonds in March 2020. However, because AAA bonds are the largest portfolio position, this liquidation had little effect on their relative weight. As a result, portfolio weights after the March 2020 selloff remained virtually unchanged from the previous month, and the estimated changes in weights are economically insignificant.

Similar calculations across all ratings, reported in Table A.1 of the Appendix, illustrate the mechanism by which substantial dollar liquidations of AAA bonds translate into negligible changes in portfolio weights at the bond-fund level, owing to the large preexisting positions in AAA securities. Importantly, through the end of our sample in January 2021, funds did not undertake significant bond purchases to reverse the excess sales activity in March 2020 (Figure 5, Panel A).

We conclude this section by noting that in untabulated tests, results remain virtually unchanged when we use fund fixed effects instead of bond-fund fixed effects, or when we exclude all bonds downgraded in March 2020 from the sample. Regarding bond downgrades, our results are not driven by changes in credit ratings but by funds actively adjusting their positions. In March 2020, when the large-scale bond sell-off occurred (Table 4), only about 60 bonds were downgraded, reflecting the inherently slow adjustment of credit ratings after an economic shock. Consistent with this, Panels A in Figures 3 and 6 show that AAA bond downgrades, evidenced by a sharp shift in the respective aggregate portfolio weights, occurred between April and June 2020, up to three months after the initial COVID-19 shock. However, as reported in Table 4, between April and June 2020, NBFIs did not engage in drastic portfolio rebalancing comparable to that observed in March of the same year.

3.1.1 Credit rating effects on portfolio holdings: Fund level tests

The previous tests were conducted at the bond-fund level to exploit the full granularity of our dataset. To verify the robustness of our results, we re-estimate equation (9) at the rating-fund level with security holdings aggregated by rating within each fund. In this case,

indicator variables $IRating_{z,t}$ capture rating-specific rebalancing effects at the fund level:

$$\begin{aligned} \Delta Holdings_{z,j,t} = & b_1 \cdot \mathbf{1}\{March\ 2020\} + \sum_z b_{2z} \cdot \left(IRating_{z,t} \times \mathbf{1}\{March\ 2020\} \right) \\ & + Controls_{z,j,t} + a_z + a_j + u_{z,j,t}. \end{aligned} \quad (10)$$

As with the tests at the bond–NBFI level, the dependent variable $\Delta Holdings_{z,j,t}$ is defined in two ways: the change in the dollar book value of all bonds in fund j belonging to rating category z ($\Delta BV_{z,j,t}$, in millions of USD), or the change in portfolio weights of all bonds in fund j within rating category z ($\Delta w_{z,j,t}$, in percent). Portfolio weights are computed as the book value of each rating category (e.g., AAA) divided by the total bond holdings of the respective NBFI ($w_{z,j,t} = BV_{z,j,t} / \sum_z BV_{z,j,t}$). The control variables, $Controls_{z,j,t}$, consist of the contemporaneous and lagged (equal-weighted) average returns of all bonds in fund j with rating z . Finally, regression (10) includes rating (a_z) and fund fixed effects (a_j). Standard errors are clustered by fund-rating.⁵

Results are reported in Table 6, with columns 1–4 presenting estimates for U.S. funds and columns 5–8 for Euroarea funds. Columns 1 and 2 for the U.S. and columns 5 and 6 for the Euroarea report changes in dollar holdings, while columns 3 and 4 for the U.S. and columns 7 and 8 for the Euroarea report changes in portfolio weights. The estimates (March 2020 + Rating×March 2020) in columns 2 and 6 confirm that both U.S. and Euroarea funds liquidated larger amounts of AAA bonds (U.S. -\$216 mil.; Euroarea -\$66 mil.) relative to lower-rated categories. These columns also show that in book value dollar terms, investment-grade bonds were liquidated more intensively than lower-rated ones. Taken together, the results suggest that, in absolute terms, funds primarily sold bonds that could provide liquidity without generating substantial losses.

[Insert Table 6, around here]

An important difference between U.S. and Euroarea funds is that the dollar liquidation

⁵Clustering by fund-rating generates stricter standard errors than clustering by date and fund-rating.

of U.S. funds follows a steeply monotonic pattern across ratings, with significantly larger sales of AAA-rated bonds relative to high-yield ones (AAA: −\$216 million; AA: −\$49 million; A: −\$36 million; BBB: −\$54 million). By contrast, Euroarea funds exhibit a much more uniform pattern in liquidations across ratings (AAA: −\$66 million; AA: −\$27 million; A: −\$48 million; BBB: −\$60 million). This divergence likely reflects the more uniform composition of Euroarea bond portfolios across investment-grade credit ratings, as documented in Tables 1 and 2 and Figure 3, compared to U.S. funds that mainly hold AAA-rated bonds.

The results of fund-level tests differ substantially when examining changes in portfolio weights. None of the coefficients in columns 4 and 8 of Table 6 are statistically significant, and their magnitudes (−0.551% to 0.635%) are much smaller than the average fund-level weights of each credit category (46.67% to 1.84% in Panel B, Table 2) for both U.S. and Euroarea funds. Table 6 therefore highlights two key findings at the fund level that reinforce our earlier results at the more granular bond-fund level. First, in March 2020, funds liquidated large amounts of high-quality bonds, most likely to address urgent liquidity needs, with U.S. funds displaying a strongly monotonic pattern of sales across credit ratings, while Euroarea funds sold bonds more uniformly. Second, in doing so, both U.S. and Euroarea funds reduced their holdings proportionally across rating categories. These findings suggest that, while funds addressed the COVID-19 dash-for-cash by selling assets that could readily provide liquidity, they simultaneously maintained a balanced risk profile across their portfolios, as prescribed by their investment mandates.

The findings on portfolio rebalancing across credit ratings at both the security and fund levels are consistent with the aggregate patterns shown in Figures 5 and 6, which report changes in the dollar value and portfolio weights of bond holdings by credit rating in the NBFIs sample. Panel A of Figure 5 shows that U.S.-based NBFIs sharply reduced their dollar positions in AAA bonds in March 2020, with the magnitude of these liquidations far exceeding those of lower-rated bonds. A similar pattern is observed for Euroarea funds (Figure 5, Panel A), where the reduction in AAA bond holdings was also substantial. However, unlike

U.S. funds, the differential in dollar sales across credit ratings (e.g., AAA versus A or BBB) is much less pronounced for Euroarea NBFIs, reflecting the more uniform composition of their bond portfolios.

In contrast, as shown in Panel A of Figure 6, the extreme dollar reduction in AAA holdings during March 2020 in Figure 5, particularly for U.S. funds, does not carry over to extreme decreases in portfolio weights. This outcome reflects the dominance of AAA bonds in portfolio composition (Figure 3), which dampens the effect of even sizable dollar liquidations on portfolio weights. As a result in March 2020, both U.S. and Euroarea NBFIs maintained portfolio weights of their aggregate bond holdings constant across ratings.

3.2 Changes in portfolio holdings across sectors

Our main empirical results examine the relation between portfolio allocations and credit ratings during adverse economic shocks, highlighting the trade-off between liquidity needs and investment mandates. In this section, we extend the analysis by investigating whether other bond characteristics influence the portfolio strategies of U.S. and Euroarea funds during liquidity crises such as the onset of the COVID-19 pandemic. Motivated by prior findings (e.g., [Vissing-Jorgensen \(2021\)](#); [Acharya and Steffen \(2020\)](#)), we focus on changes in portfolio holdings across economic activity sectors. To this end, we estimate the following regression:

$$\begin{aligned} \Delta Holdings_{i,j,t} = & b_1 \cdot \mathbf{1}\{March\ 2020\} + \sum_z b_{2z} \cdot \left(ISector_{i,z,t} \times \mathbf{1}\{March\ 2020\} \right) \\ & + Controls_{i,t} + a_{i,j} + u_{i,j,t}. \end{aligned} \tag{11}$$

The structure of equation (11) mirrors that of equation (9), with the key difference being that, instead of rating indicators ($IRating_{i,z,t}$), we include indicators for the sector z of bond issuer ($ISector_{i,z,t}$). These indicators distinguish between government, non-financial corporate, and financial corporate bonds. The dependent variable, $\Delta Holdings_{i,j,t}$, is defined either as the change in book values of bond i held by fund j ($\Delta BV_{i,j,t}$) or as the change

in portfolio weights ($\Delta w_{i,j,t}$), which are the ratio of book value of bond i to the total book value of fund j 's portfolio. Regression (11) also controls for bond returns ($Controls_{i,t}$) and bond-fund fixed effects ($a_{i,j}$), while standard errors are clustered by date and bond-fund.⁶

[Insert Table 7, around here]

Results of security-level tests on sector of issuer are presented in Table 7, and follow the structure of the previous tables. Panel A reports estimates for U.S. funds and Panel B for Euroarea funds. In both panels, the first two columns present results on changes in dollar book values (million USD), while the next two columns report changes in portfolio weights (%). Consistent with [Ma et al. \(2022\)](#) and [Vissing-Jorgensen \(2021\)](#), the findings show that both U.S. and Euroarea funds tapped liquidity primarily by selling government bonds, U.S. funds through Treasury sales and Euroarea funds through sovereign bond sales.

Specifically, column 2 in both panels indicates that, in March 2020, U.S. and Euroarea funds sold, on average, approximately \$800k and \$924k (Govt $\times$ March 2020 estimate), respectively, from each government bond in their portfolios, in addition to their across-the-board liquidations. While U.S. funds did not significantly reduce their holdings of non-government bonds, in March 2020 Euroarea funds sold significant amounts of corporate securities, both financial ($-\$280k$) and non-financial ($-\$320 = -\$280k - \$40k$). This pattern is consistent with the evidence in [Nicoletti et al. \(2024\)](#), which documents that Euroarea investors relied more heavily on corporate bond sales to generate liquidity.

Regarding changes in portfolio weights across sectors (column 4 in Table 7), U.S. funds changed their positions by about 0.004% to 0.002% per bond (March 2020 + Sector $\times$ March 2020), while Euroarea funds decreased their holdings in similar proportions across sectors (-0.005% to -0.003%). Similarly to the credit rating tests, the magnitude of these changes in portfolio weights is very small compared to the average weight of each bond by sector (0.04% to 0.45%) as reported in Panel B of Table 3.

⁶Since sector of issuer is a static characteristic, we do not consider sector fixed effects, which are subsumed by bond-fund fixed effects.

To verify these granular results at the bond-fund level, we also analyze portfolio adjustments across sectors using fund-level data. Specifically, we estimate equation (11) at the sector-fund level, where the security holdings of each fund are aggregated by sector. The results, reported in Table 8, follow the same structure as in Table 7, where Panels A and B present estimates for U.S. and Euroarea funds, respectively. Columns 1 and 2 report changes in dollar terms, while columns 3 and 4 report changes in weights.

[Insert Table 8, around here]

The estimates in Table 8 largely reinforce our earlier findings. Reductions in government bond holdings are strongly negative, indicating that the sell-off of government securities was much larger in absolute terms than that of other sectors. On average, each U.S. fund sold about \$190 million of government bonds, while each Euroarea fund liquidated roughly \$170 million (March 2020 + Govt $\times$ March 2020). Importantly, whereas U.S. funds show no statistically significant reductions in financial or non-financial corporate bonds, Euroarea funds tapped an additional \$70–80 million of liquidity by selling securities from these sectors. These differences likely reflect portfolio composition effects across U.S. and Euroarea funds. As shown in Tables 1 and 2 and Figure 3, Panel B, Euroarea funds hold comparatively larger shares of financial and corporate bonds than their U.S. counterparts.

In terms of portfolio weights, the results in column 4, Panel A of Table 8 show that, despite the large dollar sales of government bonds by U.S. funds, these liquidations did not materially alter the relative weight of this category in their overall portfolios. Changes in sectoral portfolio weights range only from -0.805% to 0.659% . Similarly, for Euroarea funds (Panel B), changes in sector weights are small (-0.552% to 0.107%) and statistically insignificant, with the exception of the changes in weights of government bonds. These adjustments are quite marginal compared to the average sector-level weights reported in Panel B of Table 2 (6.37% to 55.72%). Taken together, the sector-level evidence in Table 8 and the credit-rating results in Table 6 point to the same conclusion. During March 2020, funds liquidated large volumes of assets, mainly highly-rated government bonds, to

meet liquidity needs but did so in a manner that preserved the balance of risks within their portfolios. These findings are illustrated in Panel B of Figures 5 and 6, which show changes in dollar book values and portfolios weights across sectors for U.S. and Euroarea funds at the aggregate level.

4 Fund Portfolio Allocation and Performance

In many regulatory frameworks, IG securities are classified as High-Quality Liquid Assets (HQLA). For example, the Basel Committee on Banking Supervision defines HQLA as low-risk instruments that can be readily converted into cash and are ideally eligible for central bank liquidity operations ([Basel Committee on Banking Supervision, 2019](#)). Consistent with this approach, both the U.S. ([United States Department of Treasury, 2014](#); [Board of Governors of the Federal Reserve, 2019](#)) and European regulatory authorities ([European Commission, 2015](#)) require that securities must be rated investment grade to qualify as HQLA.⁷

The implementation of new supervisory rules following the 2007–2008 global financial crisis enhanced bank resilience during the COVID-19 shock (e.g., [Giese and Haldane \(2020\)](#); [Duncan et al. \(2022\)](#)). At the same time, the post-crisis regulatory framework reshaped secondary bond market operations by requiring central counterparties to lend cash only against HQLA, thus mitigating counterparty risk ([Aldasoro et al., 2023](#)). Consequently, as [Macchiavelli and Zhou \(2022\)](#) show, HQLA securities influence market liquidity by shaping fund liquidity. Consistent with this mechanism, bond funds in our sample sold IG bonds in March 2020 for the same reason they sold AAA bonds, namely, to access liquidity.

Building on the above premises, we conclude our empirical analysis by testing whether a larger share of high-quality bonds in fund portfolios shaped their response to the COVID-19 shock. Specifically, we estimate the following regression at the fund level:

⁷In the European framework, government bonds are considered HQLA by definition.

$$\begin{aligned} \frac{\Delta BV_{j,t}^{non-AAA}}{BV_{j,all\ rated,t}} &= b_1 \cdot \mathbf{1}\{March2020\} \\ &+ b_2 \cdot \left(\mathbf{1}\{\%BV_{j,12/2019}^{AAA} > median(\%BV_{j,12/2019}^{AAA})\}_j \times \mathbf{1}\{March2020\} \right) + Controls_{j,t} + a_j + e_{j,t}. \end{aligned} \quad (12)$$

The dependent variable, $\Delta BV_{j,t}^{non-AAA}/BV_{j,all-rated,t}$, measures the change in the book value of non-AAA holdings of fund j relative to the fund's total book value. The key explanatory variable is the indicator $\mathbf{1}\{\%BV_{j,12/2019}^{AAA} > median(\%BV_{j,12/2019}^{AAA})\}$, which equals one if fund j held an above-median share of AAA bonds in December 2019 relative to the cross-sectional median of its region in that month, interacted with the March indicator, $\mathbf{1}\{March2020\}$. Regression (12) controls for fund fixed effects (a_j) and (equal-weighted) average bond returns, both contemporaneous and lagged, at the fund level ($Controls_{j,t}$). Standard errors are also clustered at the fund level.⁸

Based on equation (12), we examine the effects of portfolio composition on changes in non-AAA bond holdings expressed as a share of total book value. Specifically, we focus on funds that, in December 2019, prior to the COVID-19 shock, held above-median proportions of AAA-rated bonds. The regression tests whether such funds liquidated lower-rated bonds to a lesser extent than funds with fewer AAA holdings. This test has real-economy implications as almost all corporate bonds and most Euroarea government bonds fall below the AAA category. If funds with higher-quality portfolios reduced non-AAA holdings less aggressively, it would support the regulatory view that high-quality portfolios enhance financial stability in the market-based finance.

[Insert Table 9, around here]

Panel A of Table 9 reports estimates of equation (12). Specifications 1 and 3 report results with fund fixed effects. In regressions 2 and 4, we replace fund fixed effects with above-median share of AAA bonds in December 2019, $\mathbf{1}\{\%BV_{j,12/2019}^{AAA} > median(\%BV_{j,12/2019}^{AAA})\}$. Estimates

⁸Clustering by fund generates stricter standard errors than double-clustering by date and fund.

in Panel A, Table 9 show that funds holding a higher-than-median proportion of AAA-rated bonds at the onset of COVID tend to sell their non-AAA holdings less aggressively than the median group. For example, U.S. funds with above-median AAA holdings sold 4.5% less of their non-AAA bonds in March 2020 than the average fund, while Euroarea (EA) funds sold 9% less. Given that during this period, on average, U.S. funds sold 3% and Euroarea funds 15% of their non-AAA portfolios, this reduction in non-AAA bonds was largely offset for funds with large AAA exposures.

These findings suggest that the procyclicality of bond fund allocations, and its potential adverse effects on real-economy financing, may be mitigated when funds hold a substantial share of high-quality assets. Importantly, the negative coefficients (-3.3% and -1.2%) for above-median holdings indicator ($\mathbf{1}\{\%BV_{j,12/2019}^{AAA} > \text{median}(\%BV_{j,12/2019}^{AAA})\}$) in specifications 2 and 4 of Panel A, Table 9 highlight that, on average, above-median holdings of AAA bonds are correlated with more, rather than less, sales of non-AAA bonds. This alleviates concerns that the positive coefficients (4.5% and 8.8%) of the interaction term $\left(\mathbf{1}\{\%BV_{j,12/2019}^{AAA} > \text{median}(\%BV_{j,12/2019}^{AAA})\}_j \times \mathbf{1}\{March2020\}\right)$ merely reflect a mechanical relation.

For our final test, we examine whether holding high-quality bonds affects the returns of bond funds during periods of high liquidity needs and market turbulence, such as the onset of COVID-19. For this analysis, we rely on the following regression:

$$\begin{aligned} Return_{j,t} = & b_1 \cdot \mathbf{1}\{March2020\} \\ & + b_2 \cdot \left(\mathbf{1}\{\%BV_{j,12/2019}^{AAA} > \text{median}(\%BV_{j,12/2019}^{AAA})\}_j \times \mathbf{1}\{March2020\}\right) + a_j + e_{j,t}. \end{aligned} \quad (13)$$

Equation (13) tests for differences in value-weighted returns between funds that entered the COVID-19 shock with relatively high versus low exposures to AAA bonds. The key explanatory variable is the interaction $\mathbf{1}\{\%BV_{j,12/2019}^{AAA} > \text{median}(\%BV_{j,12/2019}^{AAA})\}_j \times \mathbf{1}\{March2020\}$ as in regression (12). Regression (13) also controls for fund fixed effects (a_j).

Results for the return regressions are reported in Panel B of Table 9. Funds with AAA

exposures above the median experienced significantly lower losses than those with lower AAA holdings. Overall, the COVID-19 shock reduced returns by -16.4% for U.S. funds and -19.5% for Euroarea funds. However, for funds holding larger proportions of AAA bonds, these losses were partially offset: by about 8.8 percentage points for U.S. funds and 6.1 percentage points for Euroarea funds.

These results are important because they also relate to the procyclicality of portfolio allocation by funds. In particular, if we assume that, as shown in [Timmer \(2018\)](#), funds allocate their portfolios based on past returns, then negative returns that occurred due to COVID-19, increase the reluctance of fund managers to finance economic activity (e.g., [Nicoletti et al. \(2024\)](#)). In this regard, the economic effects of a crisis could be accentuated by the lack of funding, consistent with the results in [Acharya and Steffen \(2020\)](#). Our findings provide a remedy, even if partial, to this negative feedback loop: investment funds that hold high-quality bonds experience more moderate effects from adverse systemic shocks, which could be important for their willingness to provide funding to the real economy.

Finally, the results in Table 9 align with the evidence in Figure 7, which plots aggregate bond returns by credit rating for U.S. (Panel A) and Euroarea NBFIs (Panel B). The figure shows that the impact of COVID-19 on returns of high-rated bonds was minimal compared to the sharp price declines of lower-rated bonds. Notably, AAA-rated bonds experienced almost no price decline in March 2020, likely reflecting explicit policy interventions by the Federal Reserve and the European Central Bank to support the valuations of these bonds.

5 Concluding Remarks

In this study, we analyze how bond funds adjust their portfolio allocations across credit rating categories when faced with extreme liquidity shocks. We use the COVID-19 crisis of March 2020 as a natural experiment to study the rebalancing decisions of non-bank financial intermediaries (NBFIs). Our findings show that portfolio rebalancing is systematically linked

to credit ratings.

We find that during the COVID-19 crisis of March 2020, funds liquidated substantially more of their highly rated positions than their lower-rated ones in absolute dollar terms. This pattern is consistent with the well-documented dash-for-cash effect that marked the onset of the pandemic, particularly among U.S. NBFIs. However, we show that this effect was not limited to U.S. Treasuries or AAA-rated bonds, as previously emphasized. Instead, it extended proportionally across all rating categories. As a result, portfolio weights remained broadly stable across ratings despite the large sell-off of highly rated bonds in dollar terms. This novel finding underscores the role of investment mandates in requiring bond funds to maintain portfolio risk balances even during systemic crises.

Finally, we show that during the COVID-19 shock, funds with above-median AAA holdings were able to moderate both the liquidation of lower-rated bonds and the negative impact on portfolio returns. Given the procyclical nature of bond fund portfolio allocation and the growing importance of this sector in financing the real economy, these findings carry important policy implications. Specifically, if funds maintain a larger share of high-quality assets, they can mitigate the effects of extreme liquidity shocks, such as COVID-19, and reduce the amplification of financial instability.

References

- Acharya, V., Cetorelli, N., and Tuckman, B. (2024). Where do banks end and nbfis begin. National Bureau of Economic Research, working paper 32316.
- Acharya, V. and Steffen, S. (2020). The risk of being a fallen angel and the corporate dash for cash in the midst of Covid. *Review of Corporate Finance Studies*, 9(3):430–471.
- Aldasoro, I., Avalos, F., and Huan, W. (2023). Liquid assets at CCPs and systemic liquidity risks. Bank for International Settlements, BIS Quarterly Review.
- Altavilla, C., Darracq Pariès, M., and Nicoletti, G. (2019). Loan supply, credit markets and the euro area financial crisis. *Journal of Banking and Finance*, 109:105658.
- Baghai, R., Becker, B., and Pitschner, S. (2024). The use of credit ratings in the delegated management of fixed income assets. *Management Science*, 70(5):3059–3079.
- Banegas, A., Montes-Rojas, G., and Sigas, L. (2022). The effects of u.s. monetary policy shocks on mutual fund investing. *Journal of International Money and Finance*, 123:102595.
- Barone, J., Chabout, A., Copeland, A., Kavoussi, C., Keane, F., and Searls, S. (2023). The global dash for cash: Why sovereign bond market functioning varied across jurisdictions in march 2020. Federal reserve bank of new york, Economic Policy Review, Vol. 29, Nr 3.
- Basel Committee on Banking Supervision (2019). Liquidity Coverage Ratio - high-quality liquid assets. Technical report, Bank for International Settlements.
- Board of Governors of the Federal Reserve (2019). Changes to applicability thresholds for regulatory capital and liquidity requirements. *Federal Register*, 84(212).
- Camanho, N., Hau, H., and Rey, H. (2022). Global portfolio rebalancing and exchange rates. *Review of Financial Studies*, 35(11):5228–5274.

- Chen, Y., Ferson, W., and Peters, H. (2010). Measuring the timing ability and performance of bond mutual funds. *Journal of Financial Economics*, 98:72–89.
- Chernenko, S. and Sunderam, A. (2016). Liquidity transformation in asset management: Evidence from the cash holdings of mutual funds. National Bureau of Economic Research, working paper 22391.
- Choi, J., Dasgupta, A., and Oh, J. (2022). Bond funds and credit risk. London School of Economics and Political Science, Paul Wooley Centre working paper no. 87.
- Choi, J. and Kromlund, M. (2018). Reaching for yield by corporate mutual funds. *Review of Financial Studies*, 31(5):1930–1965.
- Ciminelli, G., Rogers, J., and Wu, W. (2022). The effects of U.S. monetary policy on international mutual fund investment. *Journal of International Money and Finance*, 123:102676.
- Converse, N. and Malucci, E. (2023). Differential treatment in the bond market: sovereign risk and mutual fund portfolios. *Journal of International Economics*, 145:103823.
- Duncan, A., Horvath, A., Iercosan, D., Loudis, B., Maddrey, A., Martinez, F., Mooney, T., Ranish, B., Wag, K., Warusawitharana, M., and Wix, C. (2022). Covid-19 as a stress test: assessing the bank regulatory framework. *Journal of Financial Stability*, 61:101016.
- European Commission (2015). Delegated Regulation 2015/61: Liquidity Coverage Ratio. *Official Journal of the European Union*, L11/1.
- Falato, A., Goldstein, I., and Hortaçsu, A. (2021). Financial fragility in the covid-19 crisis: the case of investment funds in corporate bond markets. *Journal of Monetary Economics*, 123:35–52.
- Forbes, K., Fratzscher, M., Kostka, T., and Straub, R. (2016). Bubble thy neighbour: portfolio effects and externalities from capital controls. *Journal of International Economics*, 99:85–104.

- Giese, J. and Haldane, A. (2020). Covid-19 and the financial system: a tale of two crises. *Oxford Review of Economic Policy*, 36(81):S200–S214.
- Giuzzio, N., Kaufmann, C., Ryan, E., and Cappiello, L. (2021). Investment funds, risk-taking and monetary policy in the euro area. European Central Bank, working paper no. 2605.
- Goldstein, I., Jiang, H., and Ng, D. (2017). Investor flows and fragility in corporate bond funds. *Journal of Financial Economics*, 126(3):592–613.
- Hau, H. and Lai, S. (2016). Asset allocation and monetary policy: evidence from the euro-zone. *Journal of Financial Economics*, 120(2):309–329.
- Hodge, A. and Weber, A. (2023). The heterogeneous effects of U.S. monetary policy on non-bank finance. International Monetary Fund, working paper no. 23/55.
- Jiang, H., Li, D., and Wang, A. (2021). Dynamic liquidity management by corporate bond mutual funds. *Journal of Financial and Quantitative Analysis*, 56:1622–1652.
- Kaufmann, C. (2023). Investment funds, monetary policy, and the global financial cycle. *Journal of the European Economic Association*, 21(2):593–636.
- Ma, J., Xiao, K., and Zeng, Y. (2022). Mutual fund liquidity transformation and reverse flight to liquidity. *Review of Financial Studies*, 35:4674–4711.
- Macchiavelli, M. and Zhou, X. (2022). Funding liquidity and market liquidity: the broker-dealer perspective. *Management Science*, 68(5):3379–3398.
- Maggiore, B., Neiman, B., and Schreger, J. (2020). International currencies and capital allocation. *Journal of Political Economy*, 128(6):2019–2066.
- Moneta, F. (2015). Measuring bond mutual fund performance with portfolio characteristics. *Journal of Empirical Finance*, 33:223–242.

- Nenova, T. (2025). Global or regional safe assets: Evidence from bond substitution patterns. Bank for International Settlements, BIS working paper no. 1254.
- Nicoletti, G., Rariga, J., and Rodriguez d’Arci, C. (2024). Spare tyres with a hole: investment funds under stress and credit to firms. European Central Bank, Working Paper no. 2917.
- Perold, A. and Sharpe, W. (1988). Dynamic strategies for asset allocation. *Financial Analysts Journal*, 44:16–27.
- Raddatz, C. and Schmukler, S. (2012). On the international transmission of shocks: Micro-evidence from mutual fund portfolios. *Journal of International Economics*, 88:357–374.
- Raddatz, C., Schmukler, S., and Williams, T. (2018). International asset allocations and capital flows: the benchmark effect. *Journal of International Economics*, 108:413–430.
- Timmer, Y. (2018). Cyclical investment behavior across financial institutions. *Journal of Financial Economics*, 129:268–286.
- United States Department of Treasury (2014). Liquidity coverage ratio: Liquidity risk measurement standards. *Federal Register*, 79(197).
- Vissing-Jorgensen, A. (2021). The Treasury market in spring 2020 and the response of the Federal Reserve. *Journal of Monetary Economics*, 124:19–47.

Figures

Figure 1 Financial Indicators at the Onset of the COVID-19 Pandemic

This figure illustrates the time series of several financial indicators during the onset of the COVID-19 pandemic from November 2019 to January 2021. Panel A shows the time series of the VIX, the Option Volatility Estimate (MOVE), and the National Financial Conditions Index (NFCI). To facilitate comparison, the NFCI is re-scaled by adding one to each observation, and all three indicators are normalized to their initial values at the start of the sample. Panel B shows the time series of the Composite Index for Systemic Stress (CISS) for the U.S. and the Euroarea.

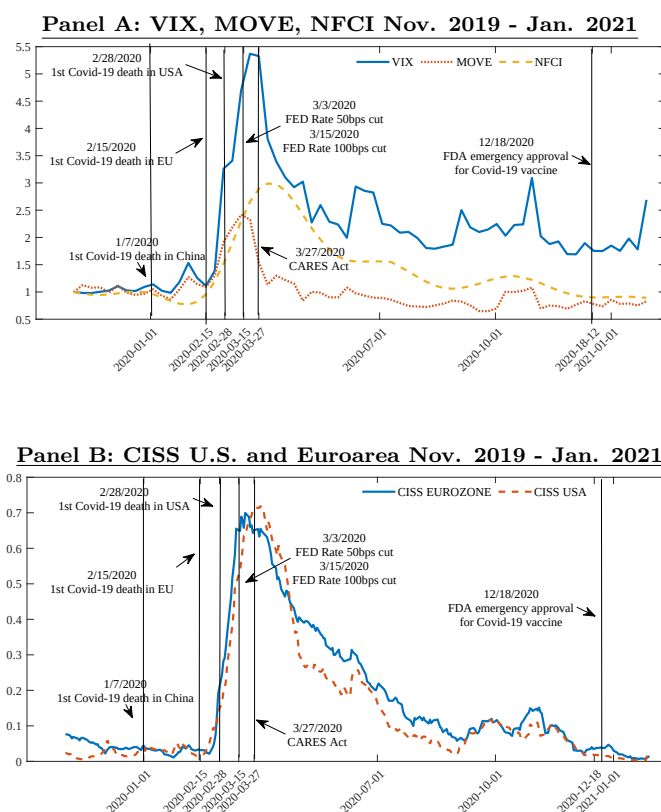


Figure 2 Availability of NBF1 Data for Different Value Thresholds

This figure shows the representativeness of our sample based on reporting frequency and assets under management at the fund level for the U.S. and Euroarea (EA). Data is from December 2018 to January 2021.

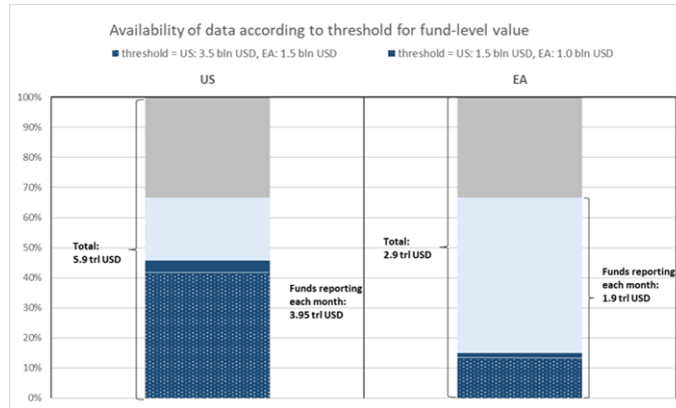
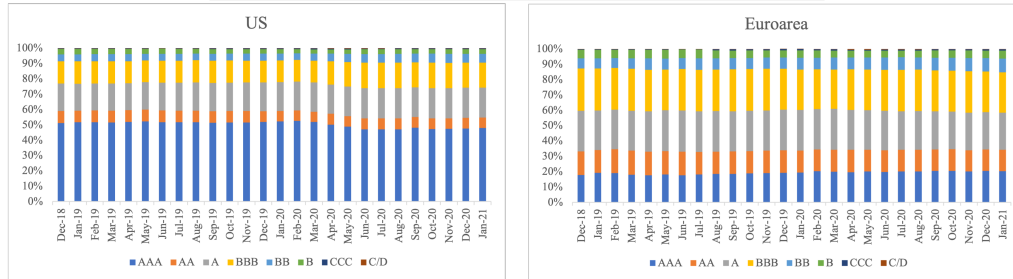


Figure 3 Value-Weighted Composition of Aggregate NBFI Bond Holdings in the U.S. and the Euroarea (2019-2021)

This figure illustrates the aggregate composition of NBFI bond holdings in the U.S. and the Euroarea from December 2018 to January 2021. The composition of bond portfolios is the book value of each bond category as a percentage the total book value of NBFI bond holdings in a given month. Panel A shows aggregate bond portfolio weights by credit rating. Credit ratings are from three rating agencies: S&P, Moody's, and Fitch. The composition of aggregate bond portfolios by credit ratings is with respect the set of rated bonds. Panel B reports aggregate bond portfolio weights by economic sector of the issuing institutions.

Panel A: Aggregate Bond Portfolios by Credit Rating



Panel B: Aggregate Bond Portfolios by Sector of Issuer

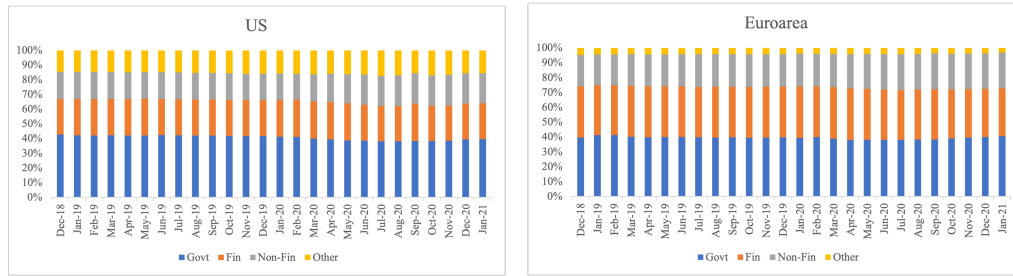
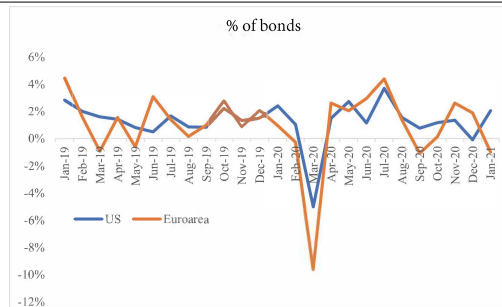


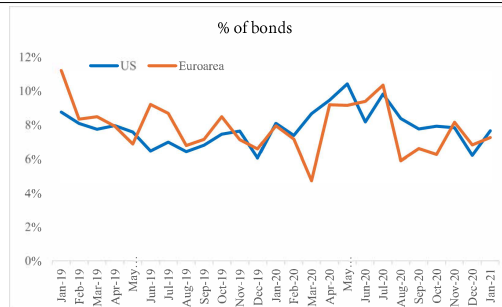
Figure 4 Aggregate Changes in NBF1 Bond Holdings (2019-2021)

This figure shows monthly changes in the book value of aggregate NBF1 bond holdings in the U.S. and the Euro Area from January 2019 to January 2021. Panel A reports changes in total asset holdings expressed as a percentage of the previous month's portfolio value. Panel B displays all bond purchases by NBFIs, and Panel D displays all bond sales, each expressed as a percentage of the previous month's total portfolio value.

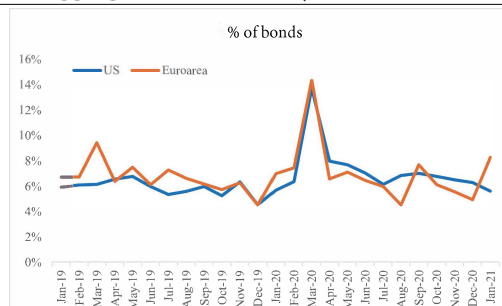
Panel A: Aggregate Changes in Total Book Value (as % of total bond value)



Panel B: Aggregate Bond Purchases (as % of total bond value)



Panel C: Aggregate Bond Sales (as % of total bond value)



This figure illustrates changes in the composition of aggregate NBFI bond holdings in the U.S. and the Euro Area by bond category (credit rating and sector) from December 2019 to January 2021. For clarity of exposition, we report results only through June 2020. Dollar changes represent monthly changes in the aggregate book value of each bond category, expressed in trillions of U.S. dollars. Panel A reports changes in aggregate bond holdings by credit rating, based on classifications from S&P, Moody's, and Fitch. The composition of aggregate portfolios by rating is calculated with respect to the set of rated bonds. Panel B reports changes in aggregate bond holdings by sector of the issuing institutions.

[illegible]

US

Month	Govt	Fin	Non-Fin	Other
Dec-19	0.018	-0.005	0.005	0.005
Jan-20	0.012	0.032	0.008	0.005
Feb-20	-0.002	0.015	-0.005	0.008
Mar-20	-0.078	-0.032	-0.005	-0.012
Apr-20	-0.002	0.012	0.030	-0.005
May-20	0.005	0.012	0.032	0.018
Jun-20	0.008	-0.012	0.020	0.010

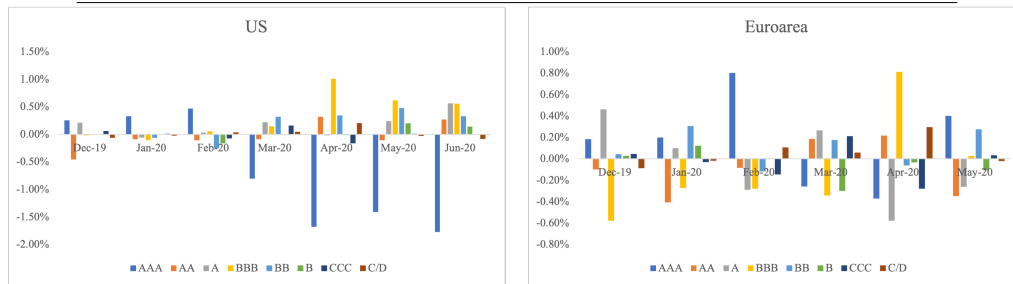
Euroarea

Month	Govt	Fin	Non-Fin	Other
Dec-19	0.003	0.002	0.001	0.000
Jan-20	0.000	0.002	0.001	-0.001
Feb-20	0.001	-0.001	-0.001	-0.001
Mar-20	-0.018	-0.010	-0.005	-0.001
Apr-20	0.002	0.003	0.004	0.001
May-20	0.003	0.001	0.003	-0.001
Jun-20	0.003	0.002	0.004	0.001

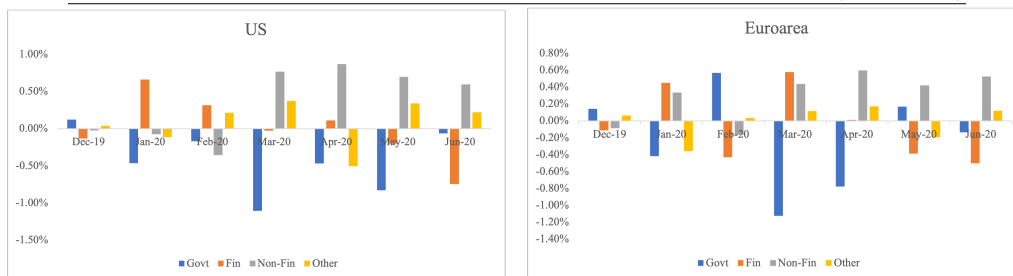
Figure 6 Changes in Weights in the Composition of Aggregate NBFI Bond Holdings in the U.S. and the Euroarea

This figure shows changes in the portfolio weights of aggregate NBFI bond holdings in the U.S. and the Euro Area by bond category (credit rating and sector). Weight changes represent month-to-month variations in the aggregate share of each bond category. Aggregate portfolio weights are measured as the book value of each category relative to the total book value of all NBFI bond holdings in a given month. Panel A reports weight changes by credit rating, based on classifications from S&P, Moody's, and Fitch, calculated with respect to the set of rated bonds. Panel B reports weight changes by issuer sector. The sample covers December 2019 to January 2021. For clarity of exposition, we report results only through June 2020.

Panel A: Changes in Aggregate Bond Holdings by Credit Rating (weights %)

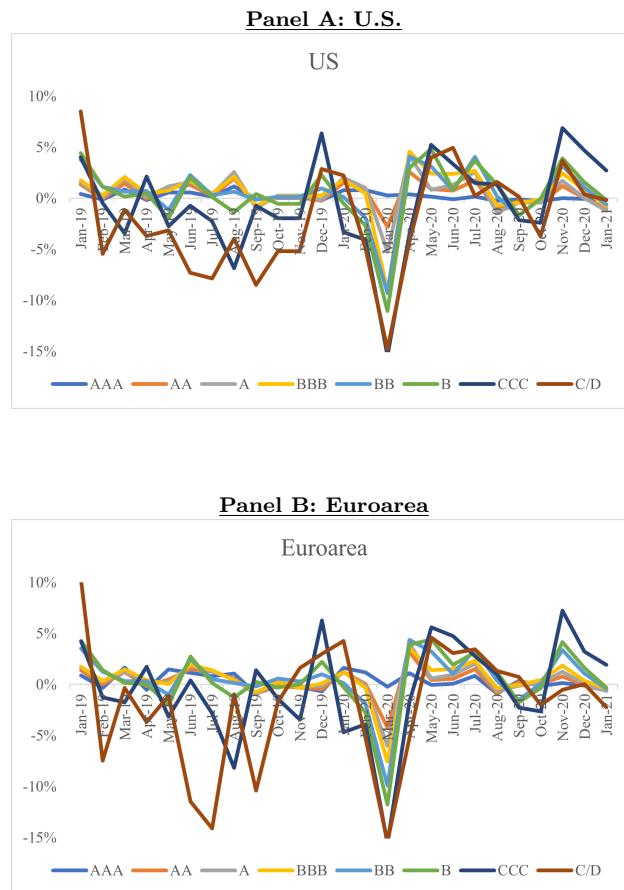


Panel B: Changes in Aggregate Bond Holdings by Sector of Issuer (weights %)



**Figure 7 Average Bond Returns by Credit Rating
for NBFIs in the U.S. and the Euroarea (2019-2021)**

This figure illustrates average monthly returns by bond rating for NBFIs in the U.S. and the Euroarea. Panel A reports average returns of bond holdings by credit rating for U.S. NBFIs, and Panel B for Euroarea NBFIs. Bond returns are computed from clean prices and winsorized at the 0.5% level. Average returns are calculated as simple averages across all bonds within the same rating category. Credit ratings are based on classifications from S&P, Moody's, and Fitch. The sample covers January 2019 to January 2021.



Tables

Table 1 Summary Statistics for NBFI Bond Holdings: Aggregate Level

This table reports summary statistics for key variables in our sample at the aggregate level. Statistics are computed monthly at the NBFI headquarter level (U.S. or Euro Area). Panel A provides summary statistics by bond category (credit rating and sector) for the aggregate book value of NBFI bond holdings (trillions of USD). Panel B reports summary statistics by bond category for aggregate portfolio weights, defined as the book value of each category relative to the total book value of all NBFI bond holdings in a given month. Credit ratings are based on S&P, Moody's, and Fitch, and portfolio composition by rating is measured with respect to the set of rated bonds. N denotes the number of time-series observations. The sample covers December 2018 to January 2021.

Panel A: Summary Statistics for Aggregate Bond Portfolio Book Values in trillion USD

Aggregate Bond Portfolio Book Values by Credit Rating

	U.S.					Euroarea			
	mean	st. dev.	min	max		mean	st. dev.	min	max
AAA	0.869	0.057	0.743	0.972	AAA	0.064	0.008	0.050	0.076
AA	0.126	0.008	0.112	0.140	AA	0.048	0.002	0.043	0.051
A	0.326	0.042	0.259	0.395	A	0.085	0.005	0.075	0.091
BBB	0.263	0.040	0.212	0.331	BBB	0.088	0.006	0.078	0.099
BB	0.086	0.018	0.065	0.116	BB	0.025	0.004	0.019	0.033
B	0.053	0.004	0.047	0.063	B	0.016	0.001	0.014	0.019
CCC	0.008	0.002	0.004	0.011	CCC	0.002	0.001	0.001	0.004
C/D	0.003	0.001	0.001	0.006	C/D	0.001	0.000	0.000	0.002

Aggregate Bond Portfolio Book Values by Sector of Issuer

	U.S.					Euroarea			
	mean	st. dev.	min	max		mean	st. dev.	min	max
Govt	0.957	0.056	0.852	1.083	Govt	0.144	0.009	0.126	0.163
Fin	0.583	0.050	0.482	0.665	Fin	0.123	0.007	0.131	0.131
Non-Fin	0.451	0.066	0.368	0.562	Non-Fin	0.082	0.009	0.067	0.097
Other	0.372	0.048	0.292	0.447	Other	0.015	0.001	0.013	0.017

Panel B: Summary Statistics for Aggregate Bond Portfolio Weights

Aggregate Bond Portfolio Weights by Credit Rating

U.S.					Euroarea				
	mean	st. dev.	min	max		mean	st. dev.	min	max
AAA	50.26%	2.07%	47.00%	52.67%	AAA	19.27%	0.99%	17.56%	20.56%
AA	7.28%	0.33%	6.75%	7.74%	AA	14.57%	0.58%	13.83%	15.72%
A	18.73%	0.74%	17.58%	19.78%	A	25.84%	0.79%	24.13%	26.93%
BBB	15.09%	1.00%	14.09%	16.78%	BBB	26.83%	0.42%	25.71%	27.51%
BB	4.94%	0.60%	4.22%	5.92%	BB	7.61%	0.64%	6.41%	8.89%
B	3.09%	0.22%	2.75%	3.60%	B	5.00%	0.47%	4.38%	5.74%
CCC	0.44%	0.10%	0.25%	0.64%	CCC	0.62%	0.26%	0.24%	0.97%
C/D	0.16%	0.07%	0.08%	0.36%	C/D	0.26%	0.13%	0.07%	0.53%

Aggregate Bond Portfolio Weights by Sector of Issuer

U.S.					Euroarea				
	mean	st. dev.	min	max		mean	st. dev.	min	max
Govt	40.63%	1.67%	38.11%	42.72%	Govt	39.49%	0.89%	38.06%	41.23%
Fin	24.70%	0.48%	23.91%	25.50%	Fin	33.87%	0.64%	32.34%	34.66%
Non-Fin	19.00%	1.20%	17.52%	20.79%	Non-Fin	22.43%	1.17%	20.59%	24.18%
Other	15.68%	0.79%	14.64%	17.41%	Other	4.21%	0.32%	3.12%	4.78%

Table 2 Summary Statistics for NBFBI Bond Holdings: NBFBI Level

This table reports summary statistics (mean, standard deviation, minimum, and maximum) of NBFBI bond holdings in the U.S. and the Euro Area at the NBFBI level. Panel A provides summary statistics for the book value (million USD) of bond holdings by category (credit rating and sector). Panel B reports summary statistics for percentage portfolio weights, defined as the book value of each bond category (e.g., AAA) relative to the total book value of the fund's bond portfolio. Credit ratings are from S&P, Moody's, and Fitch, and portfolio composition by rating is measured with respect to the set of rated bonds. N denotes the number of observations. The sample covers December 2018 to January 2021.

Panel A: Summary Statistics for Bond Fund Portfolio Book Values in million USD*Fund Portfolio Book Values by Credit Rating*

U.S.						Euroarea					
	mean	st. dev.	min	max	N		mean	st. dev.	min	max	N
AAA	4,596	15,187	-350	178,420	4,918	AAA	562	1,103	-1	7,745	2,938
AA	818	3,036	0	41,499	3,999	AA	358	427	0	3,460	3,465
A	1,531	4,451	0	49,024	5,534	A	624	816	0	7,328	3,532
BBB	1,404	3,141	0	29,955	4,871	BBB	650	935	2	9,845	3,526
BB	525	1,236	0	16,077	4,280	BB	243	501	0	4,799	2,687
B	436	1,003	0	8,352	3,177	B	235	372	0	2,460	1,811
CCC	99	194	0	1,366	2,008	CCC	56	86	0	846	962
C/D	53	153	0	1,382	1,357	C/D	39	65	0	466	562

Fund Portfolio Book Values by Sector of Issuer

U.S.						Euroarea					
	mean	st. dev.	min	max	N		mean	st. dev.	min	max	N
Govt	4,050	11,145	-350	124,548	6,141	Govt	1,308	1,680	-1	10,684	2,851
Fin	2,394	6,954	0	89,182	6,332	Fin	983	1,171	1	10,265	3,253
Non-Fin	1,873	3,891	0	45,584	6,256	Non-Fin	752	898	-1	6,959	2,826
Other	1,404	3,620	-26	45,122	6,878	Other	141	384	-6	3,872	2,802

Panel B: Summary Statistics for Bond Fund Portfolio Weights

Fund Portfolio Weights by Credit Rating

U.S.						Euroarea					
	mean	st. dev.	min	max	N		mean	st. dev.	min	max	N
AAA	46.67%	36.35%	-38.83%	100%	4,918	AAA	26.11%	32.37%	0%	100%	2,938
AA	8.05%	7.86%	0%	70.11%	3,999	AA	18.33%	18.02%	-0%	100%	3,465
A	33.92%	29.82%	0%	100%	5,534	A	28.34%	16.88%	0%	100%	3,532
BBB	26.38%	22.36%	0%	100%	4,871	BBB	29.07%	14.82%	0%	100%	3,526
BB	12.49%	16.99%	0%	100%	4,280	BB	12.55%	15.83%	0%	69.61%	2,687
B	15.45%	21.31%	0%	100%	3,177	B	13.44%	15.02%	0%	80.58%	1,811
CCC	3.53%	6.62%	0%	63.48%	2,008	CCC	3.18%	3.88%	0%	31.37%	962
C/D	3.52%	11.43%	0%	82.90%	1,357	C/D	1.84%	2.20%	0%	16.03%	562

Fund Portfolio Weights by Sector of Issuer

U.S.						Euroarea					
	mean	st. dev.	min	max	N		mean	st. dev.	min	max	N
Govt	44.38%	32.49%	-30.47%	100%	6,141	Govt	55.72%	40.02%	-0.07%	100%	2,851
Fin	23.77%	18.50%	0%	100%	6,332	Fin	41.40%	23.96%	0.08%	100%	3,253
Non-Fin	24.45%	17.84%	0%	95.02%	6,256	Non-Fin	33.33%	21.18%	0%	94.79%	2,826
Other	20.58%	20.59%	-0.32%	100%	6,878	Other	6.37%	13.60%	-0.48%	100%	2,802

Table 3 Summary Statistics for NBFi Bond Holdings: Bond-NBFi Level

This table reports summary statistics (mean, standard deviation, minimum, and maximum) for NBFi bond holdings in the U.S. and the Euro Area at the bond–NBFi level. Panel A provides statistics for the book value (million USD) of each bond in NBFi portfolios by category (credit rating and sector). Panel B reports statistics for percentage portfolio weights, defined as the book value of each bond relative to the total bond holdings of the respective NBFi. Credit ratings are from S&P, Moody’s, and Fitch. N denotes the number of observations. The sample covers December 2018 to January 2021.

Panel A: Summary Statistics for Bond Book Values in million USD*Bond Book Values by Credit Rating*

U.S.						Euroarea					
	mean	st. dev.	min	max	N		mean	st. dev.	min	max	N
AAA	12.68	70.55	-1,436	6,372	1,781,420	AAA	9.19	34.80	-102	1,762	179,757
AA	7.37	20.34	0	805	443,933	AA	3.79	12.89	-2	1,433	327,726
A	5.49	14.33	-1	783	1,541,507	A	2.66	7.72	-30	537	829,016
BBB	4.48	11.50	-4	1,024	1,526,417	BBB	2.93	14.37	-32	1,481	781,882
BB	5.50	24.98	-1	5,534	408,323	BB	4.06	6.68	-5	158	160,778
B	6.28	12.00	0	387	220,725	B	4.40	6.60	-1	503	96,589
CCC	6.35	14.42	0	390	31,449	CCC	4.75	8.50	0	150	11,414
C/D	9.71	21.53	0	307	7,516	C/D	5.86	8.09	0	84	3,743

Bond Book Values by Sector of Issuer

U.S.						Euroarea					
	mean	st. dev.	min	max	N		mean	st. dev.	min	max	N
Govt	14.87	74.73	-198	6,372	1,671,733	Govt	10.58	34.20	-2	1,762	352,498
Fin	4.91	16.43	-1,436	1,986	3,082,669	Fin	2.72	6.98	-102	1,433	1,174,362
Non-Fin	4.27	14.34	-8	3,179	2,740,283	Non-Fin	2.11	4.36	-32	1,249	1,006,809
Other	6.82	37.45	-852	7,662	1,416,186	Other	2.79	9.70	-6	668	141,961

Panel B: Summary Statistics for Bond Weights

Bond Weights by Credit Rating

U.S.						Euroarea					
	mean	st. dev.	min	max	N		mean	st. dev.	min	max	N
AAA	0.10%	0.54%	-26.22%	35.67%	1,781,420	AAA	0.39%	1.09%	-0.84%	49.31%	179,757
AA	0.05%	0.11%	0%	4.33%	443,933	AA	0.18%	0.66%	-0.05%	66.80%	327,726
A	0.04%	0.11%	-0.03%	10.43%	1,541,507	A	0.10%	0.32%	-1.28%	100%	829,016
BBB	0.04%	0.10%	-0.01%	9.37%	1,526,417	BBB	0.11%	0.35%	-1.13%	88.61%	781,882
BB	0.09%	0.21%	-0.01%	21.31%	408,323	BB	0.16%	0.25%	-0.53%	15.26%	160,778
B	0.12%	0.26%	0%	8.97%	220,725	B	0.20%	0.48%	-0.17%	30.09%	96,589
CCC	0.11%	0.39%	0%	25.00%	31,449	CCC	0.22%	0.47%	0%	9.08%	11,414
C/D	0.14%	0.28%	0%	5.98%	7,516	C/D	0.24%	0.45%	0%	8.46%	3,743

Bond Weights by Sector of Issuer

U.S.						Euroarea					
	mean	st. dev.	min	max	N		mean	st. dev.	min	max	N
Govt	0.16%	0.58%	-26.22%	35.67%	1,671,733	Govt	0.45%	1.05%	-0.05%	49.31%	352,498
Fin	0.04%	0.16%	-10.48%	24.98%	3,082,669	Fin	0.11%	0.33%	-0.84%	100%	1,174,362
Non-Fin	0.05%	0.19%	-0.10%	51.30%	2,740,283	Non-Fin	0.09%	0.23%	-1.29%	88.60%	1,006,809
Other	0.09%	0.60%	-4.19%	100%	1,416,186	Other	0.12%	1.07%	-0.48%	100%	141,961

Table 4 NBFI Bond Portfolio Rebalancing During the Onset of COVID-19: Bond-NBFI Level

This table reports the direction and magnitude of NBFI bond portfolio rebalancing during the onset of COVID-19. Panel A presents results for U.S.-based NBFIs, and Panel B for Euro Area-based NBFIs. The dependent variable is the change in bond i held by NBFI j at time t , measured in million USD ($\Delta BV(i, j, t)$). Explanatory variables include month-year indicators (e.g., March 2020), contemporaneous bond returns ($Return(i, j, t)$), and lagged returns ($Return(i, j, t-1)$). Returns are calculated from clean prices and winsorized at the 0.5% level. All regressions include bond-NBFI fixed effects. t-statistics, reported in parentheses, are based on two-way cluster-robust standard errors by date and bond-NBFI. Asterisks (*, **, ***) denote significance at the 10%, 5%, and 1% levels, respectively. The sample covers January 2019 to January 2021.

Panel A: Changes in Bond Holdings, U.S. NBFIs				
	$\Delta BV(i,j,t)$ (USD)			
	(1)	(2)	(3)	(4)
Jan-20	0.122 (0.88)	-0.018 (-1.00)	-0.002 (-0.04)	-0.015 (-0.98)
Feb-20	0.009 (0.06)	-0.030* (-1.67)	-0.038 (-0.69)	-0.034** (-2.23)
March-20	-0.422*** (-2.74)	-0.251*** (-6.19)	-0.443*** (-8.75)	-0.246*** (-6.58)
April-20	-0.022 (-0.13)	-0.024 (-1.31)	-0.090 (-1.51)	-0.030 (-1.39)
May-20	0.028 (0.16)	-0.015 (-0.82)	-0.080* (-1.83)	-0.013 (-0.78)
June-20	-0.103 (-0.61)	0.012 (0.64)	-0.043 (-0.94)	0.012 (0.81)
Returns(i,j,t)		-0.460 (-0.74)		-0.439 (-0.69)
Returns(i,j,t-1)			0.301 (0.64)	-0.070 (-0.22)
Bond-NBFI FE	Yes	Yes	Yes	Yes
N	8,831,067	8,260,236	7,900,156	7,695,478
R ²	0.038	0.092	0.153	0.078

Panel B: Changes in Bond Holdings, Euroarea NBFIs

	$\Delta BV(i,j,t)$ (USD)			
	(1)	(2)	(3)	(4)
Jan-20	-0.005 (-0.07)	-0.002 (-0.10)	-0.025 (-0.70)	0.011 (0.55)
Feb-20	-0.061 (-0.84)	-0.074*** (-3.79)	-0.089*** (-2.58)	-0.079*** (-4.34)
March-20	-0.398*** (-5.49)	-0.445*** (-8.17)	-0.334*** (-9.38)	-0.441*** (-7.90)
April-20	0.005 (0.07)	0.079*** (2.68)	0.063 (1.20)	0.140*** (2.72)
May-20	-0.026 (-0.37)	0.007 (0.34)	-0.098*** (-3.31)	-0.023 (-1.16)
June-20	-0.014 (-0.20)	0.040* (1.89)	-0.024 (-0.77)	0.037* (1.91)
Returns(i,j,t)		-2.487*** (-3.31)		-2.592*** (-3.24)
Returns(i,j,t-1)			1.198*** (2.68)	0.779* (1.69)
Bond-NBFI FE	Yes	Yes	Yes	Yes
N	2,665,507	2,470,256	2,360,292	2,292,528
R ²	0.048	0.088	0.165	0.090

**Table 5 NBFI Bond Portfolio Rebalancing by Credit Rating
During the Onset of COVID-19: Bond-NBFI Level**

This table reports the direction and magnitude of NBFI bond portfolio rebalancing by credit rating during the onset of COVID-19 at the bond–NBFI level. Panel A shows results for U.S.-based NBFIs, and Panel B for Euroarea funds. The dependent variables are the changes in NBFI's j book-value holdings of bond i at time t in million USD ($\Delta BV(i, j, t)$) and in weights ($\Delta w(i, j, t)$). Percentage weight is the book value of each bond in the NBFI portfolio divided by the total book value of bond holdings of each NBFI. The explanatory variables are an indicator for March 2020 and its interaction with a categorical ratings variable. The ratings score has been substituted by a categorical variable that takes the value one when the bond rating falls in each category (i.e., AAA, AA, A, etc.) and zero otherwise. All specifications control for rating and bond–NBFI fixed effects, as well as contemporaneous and lag bond returns. Returns are from clean prices and winsorized at the 0.5% level. Numbers in parentheses are t -statistics based on two-way cluster-robust standard errors by date and bond–NBFI. Asterisks (*, **, ***) denote significance at the 10%, 5%, and 1% levels, respectively. Data are from January 2019 to January 2021.

Panel A: Changes in Bond Holdings, U.S. NBFIs				
	$\Delta BV(i,j,t)$ (USD)		$\Delta w(i,j,t)$ (%)	
	(1)	(2)	(3)	(4)
March 2020	-0.332*** (-5.81)	0.348* (1.86)	0.001%*** (5.27)	0.017%*** (4.34)
AAA×March 2020		-0.943*** (-4.77)		-0.016%*** (-4.06)
AA×March 2020		-0.724*** (-4.19)		-0.014%*** (-3.67)
A×March 2020		-0.547*** (-3.35)		-0.015%*** (-3.88)
BBB×March 2020		-0.452*** (-3.05)		-0.016%*** (-4.16)
BB×March 2020		-0.350** (-2.43)		-0.015%*** (-3.82)
B×March 2020		-0.378*** (-2.78)		-0.015%*** (-3.77)
CCC×March 2020		-0.338** (-2.52)		-0.007%* (-1.75)
Return Controls	Yes	Yes	Yes	Yes
Ratings FE	Yes	Yes	Yes	Yes
Bond-NBFI FE	Yes	Yes	Yes	Yes
N	5,138,513	5,138,513	5,138,513	5,138,513
R ²	0.121	0.121	0.109	0.109

Panel B: Changes in Bond Holdings, Euroarea NBFIs

	$\Delta BV(i,j,t)$ (USD)		$\Delta w(i,j,t)$ (%)	
	(1)	(2)	(3)	(4)
March 2020	-0.416*** (-7.92)	-0.899*** (-6.75)	-0.002% (-1.15)	0.004% (0.84)
AAA×March 2020		0.073 (0.43)		0.000% (0.02)
AA×March 2020		0.603*** (5.72)		-0.005% (-1.56)
A×March 2020		0.572*** (6.07)		-0.007%** (-2.33)
BBB×March 2020		0.552*** (6.46)		-0.007%*** (-2.73)
BB×March 2020		0.086 (1.06)		-0.002% (-0.87)
B×March 2020		0.141* (1.75)		-0.004% (-1.61)
CCC×March 2020		-0.092 (-1.15)		-0.009%*** (-4.21)
Return Controls	Yes	Yes	Yes	Yes
Ratings FE	Yes	Yes	Yes	Yes
Bond-NBFI FE	Yes	Yes	Yes	Yes
N	2,052,304	2,052,304	2,052,304	2,052,304
R ²	0.106	0.106	0.038	0.038

**Table 6 NBFI Bond Portfolio Rebalancing by Credit Rating
During the Onset of COVID-19: Rating-NBFI Level**

This table examines aggregate portfolio rebalancing in the NBFI sample across rating categories during the onset of COVID-19 at the Rating-NBFI level. The dependent variables are changes in book value (million USD), $\Delta BV(z, j, t)$, and in portfolio weights, $\Delta w(z, j, t)$, across credit ratings z at time t for NBFI j . Percentage weights are defined as the book value of each rating category in an NBFI's portfolio (e.g., AAA rating) divided by the total book value of all bond holdings of that NBFI. The explanatory variables are an indicator for March 2020 and its interaction with categorical rating dummies. The ratings score is replaced by categorical variables that equal one when the bond rating falls into each category (AAA, AA, A, etc.) and zero otherwise. All specifications control for rating and NBFI fixed effects, as well as contemporaneous and lagged average bond returns at the rating-fund level. Returns are based on clean prices and winsorized at the 0.5% level. The composition of aggregate bond portfolios by credit rating is measured with respect to the set of rated bonds. Numbers in parentheses are t -statistics based on one-way cluster-robust standard errors by rating-NBFI. Asterisks (*, **, ***) denote significance at the 10%, 5%, and 1% levels, respectively. The sample covers January 2019 to January 2021.

	U.S. NBFIs				Euroarea NBFIs			
	$\Delta BV(z, j, t)$ (USD)		$\Delta w(z, j, t)$ (%)		$\Delta BV(z, j, t)$ (USD)		$\Delta w(z, j, t)$ (%)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
March 2020	-60.681*** (-3.39)	7.285 (0.96)	-0.091% (-0.84)	-0.218% (-0.73)	-47.508*** (-7.31)	-13.409** (-2.34)	-0.103% (-0.65)	-0.108% (-0.46)
AAA×March 2020		-216.728*** (-2.88)		-0.551% (-1.09)		-53.340** (-2.19)		-0.356% (-1.16)
AA×March 2020		-49.178** (-2.15)		0.316% (1.06)		-14.247** (-2.11)		0.091% (0.47)
A×March 2020		-36.867 (-1.17)		0.635% (1.62)		-35.538*** (-3.15)		0.204% (1.06)
BBB×March 2020		-54.169** (-2.13)		0.266% (0.84)		-47.891*** (-3.74)		-0.017% (-0.08)
BB×March 2020		-16.547 (-1.18)		0.013% (0.04)		-34.705*** (-2.85)		0.077% (0.71)
B×March 2020		-9.401 (-0.78)		0.037% (0.11)		-25.595** (-2.51)		0.095% (0.81)
CCC×March 2020		-5.217 (-0.65)		0.462% (1.17)		-10.980* (-1.78)		-0.075% (-0.71)
Return Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ratings FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NBFI FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	27,455	27,455	27,455	27,455	17,747	17,747	17,747	17,747
R ²	0.290	0.291	0.042	0.042	0.133	0.134	0.008	0.009

**Table 7 NBFI Bond Portfolio Rebalancing by Sector of Issuer
During the Onset of COVID-19: Bond-NBFI Level**

This table reports the direction and magnitude of NBFI portfolio rebalancing during the onset of COVID-19 by issuer sector at the bond–NBFI level. Panel A presents results for U.S.-based NBFIs, and Panel B for Euroarea-based NBFIs. The dependent variables are changes in book-value holdings of bond i by NBFI j at time t (million USD, $\Delta BV(i, j, t)$) and changes in portfolio weights ($\Delta w(i, j, t)$). Percentage weight is defined as the book value of each bond in the NBFI portfolio divided by the total book value of that NBFI's bond holdings. The explanatory variables are an indicator for March 2020 and its interaction with sector dummies. Sector is a categorical variable equal to one for the issuer's sector (Govt, Fin, Non-Fin, etc.) and zero otherwise. All specifications control for bond–NBFI fixed effects, as well as contemporaneous and lagged bond returns. Returns are computed from clean prices and winsorized at the 0.5% level. Numbers in parentheses are t -statistics based on two-way cluster-robust standard errors by date and bond–NBFI. Asterisks (*, **, ***) denote significance at the 10%, 5%, and 1% levels, respectively. The sample covers January 2019 to January 2021.

Panel A: Changes in Bond Holdings by Sector, U.S. NBFIs				
	$\Delta BV(i, j, t)$ (USD)		$\Delta w(i, j, t)$ (%)	
	(1)	(2)	(3)	(4)
March 2020	-0.243*** (-6.56)	-0.075 (-1.55)	0.002%*** (12.53)	0.005%*** (11.98)
Govt×March 2020		-0.801*** (-14.93)		-0.001%*** (-2.81)
Fin×March 2020		-0.025 (-0.66)		-0.002%*** (-6.89)
Non-Fin×March 2020		-0.015 (-0.42)		-0.003%*** (-8.99)
Return Controls	Yes	Yes	Yes	Yes
Bond-NBFI FE	Yes	Yes	Yes	Yes
N	7,695,478	7,695,478	7,695,478	7,695,478
R ²	0.078	0.078	0.051	0.051

Panel B: Changes in Bond Holdings by Sector, Euroarea NBFIs				
	$\Delta BV(i, j, t)$ (USD)		$\Delta w(i, j, t)$ (%)	
	(1)	(2)	(3)	(4)
March 2020	-0.436*** (-7.87)	-0.279*** (-4.90)	-0.002% (-1.33)	0.001 (0.74)
Govt×March 2020		-0.924*** (-15.46)		-0.004%*** (-2.88)
Fin×March 2020		-0.012 (-0.83)		-0.003%*** (-4.13)
Non-Fin×March 2020		-0.043** (-2.02)		-0.005%*** (-6.52)
Return Controls	Yes	Yes	Yes	Yes
Bond-NBFI FE	Yes	Yes	Yes	Yes
N	2,292,528	2,292,528	2,292,528	2,292,528
R ²	0.090	0.090	0.036	0.036

**Table 8 NBFI Bond Portfolio Rebalancing by Sector of Issuer
During the Onset of COVID-19: Sector-NBFI Level**

This table reports the direction and magnitude of NBFI portfolio rebalancing during the onset of COVID-19 by issuer sector at the Sector-NBFI level. Panel A presents results for U.S.-based NBFIs, and Panel B for Euroarea-based NBFIs. The dependent variables are the changes in NBFI j 's book-value holdings of all bonds from sector z at time t , measured in million USD ($\Delta BV(z, j, t)$), and changes in portfolio weights ($\Delta w(z, j, t)$). Percentage weights are defined as the book value of each sector in the NBFI portfolio divided by the total book value of all bond holdings of that NBFI. The explanatory variables are an indicator for March 2020 and its interaction with sector dummies. Sector is a categorical variable equal to one for the issuer's sector (Govt, Fin, Non-Fin, etc.) and zero otherwise. All specifications include sector and NBFI fixed effects as well as contemporaneous and lagged average bond returns at the sector-fund level. Returns are based on clean prices and winsorized at the 0.5% level. Numbers in parentheses are t -statistics based on one-way cluster-robust standard errors by sector-NBFI. Asterisks (*, **, ***) denote significance at the 10%, 5%, and 1% levels, respectively. The sample covers January 2019 to January 2021.

Panel A: Changes in Bond Holdings by Sector, U.S. NBFIs				
	$\Delta BV(z, j, t)$		$\Delta w(z, j, t)$	
	(1)	(2)	(3)	(4)
March 2020	-83.868*** (-2.82)	-29.452 (-0.95)	-0.013% (-0.13)	-0.096% (-0.56)
Govt×March 2020		-189.366*** (-2.67)		-0.805%*** (3.54)
Fin×March 2020		-18.666 (-0.45)		0.682%*** (2.77)
Non-Fin×March 2020		19.459 (0.51)		0.659%*** (3.02)
Return Controls	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes
NBFI FE	Yes	Yes	Yes	Yes
N	23,370	23,370	23,370	23,370
R ²	0.276	0.277	0.038	0.039

Panel B: Changes in Bond Holdings by Sector, Euroarea NBFIs				
	$\Delta BV(z, j, t)$		$\Delta w(z, j, t)$	
	(1)	(2)	(3)	(4)
March 2020	-85.911*** (-5.75)	-18.140** (-2.30)	-0.061% (-0.22)	0.041% (0.17)
Govt×March 2020		-152.071*** (-3.62)		-0.552%** (-2.43)
Fin×March 2020		-59.597*** (-5.27)		0.107% (0.51)
Non-Fin×March 2020		-51.549*** (-3.24)		0.077% (0.34)
Return Controls	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes
NBFI FE	Yes	Yes	Yes	Yes
N	10,568	10,568	10,568	10,568
R ²	0.151	0.156	0.013	0.013

Table 9 Effects of AAA Bonds on NBFI Portfolio Rebalancing and Returns: NBFI Level

This table examines the effects of AAA-rated bonds on NBFI bond portfolio rebalancing and returns during the onset of COVID-19. In Panel A, the dependent variable is the change in NBFI j 's book-value holdings of non-AAA bonds as a percentage of the total book value of NBFI j 's rated bond portfolio ($\Delta BV(\text{non-AAA}, j, t) / BV(j, t)$), winsorized for values below -100% and above 100%. In Panel B, the dependent variable is NBFI j 's return ($Return(j, t)$), defined as the market value of NBFI j at time t relative to its market value at time $t - 1$. The explanatory variables include an indicator for March 2020, and its interaction with an indicator for whether NBFI j 's AAA bond holdings in December 2019 as a percentage of total rated bond holdings, $\%BV(AAA, j, 12/2019)$, exceeded the sample median, $\mathbf{1}\{\%BV(AAA, j, 12/2019) > median(\%BV(AAA, j, 12/2019))\}$. For reference, the December 2019 medians are 1% and 0.03% for the U.S. and Euroarea samples, respectively. Specifications 1 and 3 in Panel A and all specification in Panel B include NBFI fixed effects. In Panel A, we also control for contemporaneous and lagged average bond returns at the fund level. Numbers in parentheses are t -statistics based on cluster-robust standard errors by NBFI. Asterisks (*, **, ***) denote significance at the 10%, 5%, and 1% levels, respectively. The sample covers January 2019 to January 2021.

Panel A: Changes in non-AAA Bond Holdings as Percentages of Total NBFI Rated Portfolios

	U.S. NBFIs		Euroarea NBFIs	
	$\Delta BV(\text{non-AAA}, j, t) / BV(j, t)$ (1)	$\Delta BV(\text{non-AAA}, j, t) / BV(j, t)$ (2)	$\Delta BV(\text{non-AAA}, j, t) / BV(j, t)$ (3)	$\Delta BV(\text{non-AAA}, j, t) / BV(j, t)$ (4)
March 2020	-0.023* (-1.80)	-0.030** (-2.33)	-0.148*** (-3.20)	-0.150*** (-3.31)
$\mathbf{1}\{\%BV(AAA, j, 12/2019) > median(12/2019)_{(sub)sample}\}$		-0.033*** (-6.99)		-0.012** (-2.21)
$\mathbf{1}\{\%BV(AAA, j, 12/2019) > median(12/2019)_{(sub)sample}\} \times \text{March 2020}$	0.042*** (3.04)	0.045*** (3.29)	0.087*** (3.78)	0.088*** (3.88)
Return Controls	Yes	Yes	Yes	Yes
NBFI FE	Yes	No	Yes	No
N	6,394	6,394	3,720	3,720
R ²	0.317	0.054	0.214	0.054

Panel B: NBFI Bond Portfolio Returns

	U.S. NBFIs Return(j, t) (1)	Euroarea NBFIs Return(j, t) (2)
March 2020	-0.164*** (-16.77)	-0.195*** (-17.84)
$\mathbf{1}\{\%BV(AAA, j, 12/2019) > median(12/2019)_{(sub)sample}\} \times \text{March 2020}$	0.088*** (5.42)	0.061*** (3.23)
NBFI FE	Yes	Yes
N	6,675	3,875
R ²	0.097	0.112

Appendix

Figure A.1 Aggregate Returns for NBF1 Bond Holdings (2019-2021)

This figure reports the aggregate value-weighted monthly returns of NBF1 bond holdings in the U.S. and the Euro Area. Returns are computed from clean prices and winsorized at the 0.5% level to limit the influence of outliers. The sample covers the period from January 2019 to January 2021.

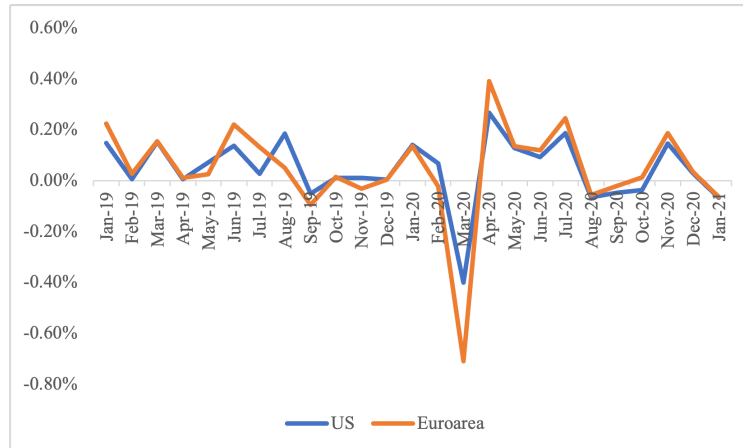


Table A.1 Back-of-the-Envelope Calculations for Changes in Portfolio Weights

This table presents back-of-the-envelope calculations based on the aggregate bond portfolio data (Table 1 and Figure 5). The results illustrate how the sharp dollar reductions in highly rated bonds during March 2020 translated into near-zero changes in portfolio weights, owing to the highly skewed exposure of U.S. NBFIs portfolios toward AAA-rated bonds.

Ratings	Book Values 2/2020 (tril. USD)	Weights 2/2020 (%)	Dollar Changes 3/2020	New Book Values 3/2020	New Weights 3/2020	Weight Changes 3/2020
AAA	0.972	47.788%	-0.061	0.911	46.922%	-0.866%
AA	0.140	6.883%	-0.008	0.132	6.808%	-0.075%
A	0.395	19.420%	-0.010	0.385	19.854%	0.434%
BBB	0.331	16.273%	-0.011	0.320	16.471%	0.197%
BB	0.116	5.703%	-0.001	0.115	5.918%	0.215%
B	0.063	3.097%	-0.002	0.061	3.153%	0.057%
CCC	0.011	0.541%	-0.001	0.011	0.558%	0.017%
C/D	0.006	0.295%	0.000	0.006	0.314%	0.020%
Total	2.034	100%		1.940	100%	

BANK OF GREECE WORKING PAPERS

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