EUROPEAN CENTRAL BANK

EUROSYSTEM

Working Paper Series

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Bond funds’ risk taking and monetary policy

ChaMP

No 3196

Challenges for Monetary Policy Transmission in a Changing World Network (ChaMP)

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 Papoutsi 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.

Abstract

Using granular security-level data from bond funds domiciled in the US and the euro area, we identify a market-based risk-taking channel of monetary policy transmission via the credit-risk and the maturity structure of bond funds' portfolios. We measure credit risk at the fund level as the weighted average credit rating of the fund's bond holdings. We find that accommodative monetary policies by the Fed and the ECB are associated with increased risk in bond funds' portfolios. Interestingly, risk-taking is more pronounced for funds with longer-term holdings relative to short-term ones and unconventional monetary policy exerts stronger market-based risk-taking effects than interest rate policy. Finally, we find that Fed's monetary policy has a stronger impact on funds' risk-taking behaviour than the ECB's, highlighting the dominant role of US monetary policy in global financial markets.

Keywords: Monetary policy; non-bank financial intermediation; investment funds; risk-taking channel

JEL Codes: E52, G12, G15, G20

Non-technical summary

This paper examines whether investment funds operate as a market-based risk-taking channel for the global transmission of monetary policy. While the literature has established that investment fund flows respond to monetary policy and that monetary easing disproportionately increases inflows into funds investing in riskier asset classes, it remains whether the portfolio holdings of investment funds *themselves* become riskier during periods of expansionary monetary policy, i.e., whether asset allocation shifts accordingly.

We use granular security-level data on more than 5,000 bond funds domiciled in the United States and the euro area to study how funds adjust the credit quality and maturity structure of their portfolios in response to both conventional and unconventional monetary policy by the Fed and the ECB. Our measure of time-varying risk-taking is the weighted- average credit rating of each fund's portfolio, constructed from granular data on bond fund holdings credit ratings from the three major agencies, with the first-best long-term issuer rating serving as a proxy for the risk level of each security. We combine quarterly security-level portfolio data from Lipper with security characteristics from LSEG-Datastream. To ensure our measure captures risk-taking behavior, we calculate portfolio weights using Book Value (BV) rather than market value. This allows us to track changes in the weighted average credit rating of a fund's portfolio, serving as a proxy for credit quality at a given point in time.

We find clear evidence of a global monetary policy transmission mechanism operating through a market-based risk-taking channel working through the credit risk profile of bond fund portfolios. When monetary policy eases, captured through shadow rates that reflect both interest-rate cuts and asset purchases programs, bond funds shift toward riskier securities. A one-percentage-point reduction in the Fed's shadow rate leads to a decline in the average credit rating of fund portfolios. With a total reduction of about six percentage points in the shadow Fed funds rate between 2019 and 2022, our findings imply a decline of 0.45 of a notch in the weighted average credit rating of bonds held by bond funds. The effect is stronger for longer-maturity holdings: for portfolios of 10-year bonds, the weighted average rating falls by 0.6 of a notch. Results for the ECB are qualitatively similar but smaller in magnitude. We also find strong evidence that Fed policy exerts a global influence. US monetary easing increases risk-taking not only among US-domiciled funds but also among euro-area funds. ECB policy affects both EA and US bond funds, though with more muted effects. Across fund types, the response is more broad-based by more pronounced for active funds, institutional funds and funds with long-duration portfolios.

Three policy implications follow.

First, the stronger cross-border transmission of Fed shocks compared to ECB shocks reflects the structural composition of euro-area bond funds. With safe assets scarce and domestic safe assets in relative short supply, these funds hold a higher proportion of US securities, making their portfolios more directly exposed to US monetary policy. This underscores the global dominance of US monetary policy and highlights the vulnerability of euro-area financial markets to external shocks. Therefore, the increase in the supply of European safe assets could strengthen the transmission of ECB monetary policy through bond funds.

Second, the finding that expansionary monetary policy induces greater risk-taking among funds with longer-maturity holdings is consistent with portfolio rebalancing toward higher-yielding corporate bonds, which tend to carry greater credit risk. The duration channel amplifies the risk-taking effect, suggesting that monitoring maturity structures is crucial for macroprudential oversight.

Finally, the finding that for longer-term bond positions, the risk-taking channel is more pronounced for unconventional monetary policies than for interest-rate policies reflects two mechanisms: (i) asset purchases directly affect bond funds through portfolio rebalancing, intensifying the hunt-for-yield effect; and (ii) unconventional measures typically occur in low-rate environments, which further encourage risk-taking. Together, these dynamics imply that unconventional monetary policy has disproportionate effects on non-bank financial intermediaries.

1 Introduction

Do investment funds operate as a market-based risk-taking channel for the global transmission of monetary policy? We explore this question by examining how both conventional and unconventional monetary policy actions affect the credit-risk and maturity structure of investment fund portfolios across different phases of the policy cycle. Using granular security-level data on portfolio holdings from more than 5,000 bond funds domiciled in the US and the euro area, we provide empirical evidence of a global monetary policy transmission mechanism operating through a market-based risk-taking channel working through the credit risk profile of bond fund portfolios.

The effects of monetary policy on the real economy through the risk-taking of financial intermediaries and investors has been dubbed "the risk-taking channel" of monetary policy (Borio & Zhu 2012). The key mechanism operates through risk appetite - investors'willingness to bear risk (Bauer et al. 2015). Risk appetite may vary for two broad reasons: (i) changes in the economic outlook, as investors update their expectations about future growth or volatility of the economy; and (ii) changes in preferences due to time-varying risk aversion. One explanation for time-variation in risk aversion is habit formation in consumption: as expected consumption increases above habit levels, people become less risk averse and more willing to take risks (Campbell & Cochrane 1999). In such models, risk appetite is procyclical: it increases during expansions, when expected consumption exceeds habit levels, and declines during recessions. In this context, accommodative monetary policy may increase investors' risk appetite by improving the perceived outlook of the economy and reducing uncertainty.

Our paper is motivated by the growing importance of non-bank financial intermediaries (NBFIs) in global financial markets. Since the global financial crisis, there has been a structural shift toward market-based financing in the global economy. This transition was driven by tighter bank lending standards (Basset et al. 2014, De Bondt et al. 2010) and a secular decline in traditional credit provision (Buchak et al. 2024). At the same time, corporate bond issuance increased by more than 60% (OECD 2024), increasing reliance of both advanced and emerging economies on financial markets for funding. This trend not only persisted but intensified in the post-pandemic period (Aldasoro et al. 2021, Calomiris et al. 2022, Darmouni & Papoutsi 2022). A key feature of this evolution has been the rapid growth of non-bank financial intermediaries. As shown in Panel A of Figure 1, NBFIs in G20 countries held USD 196 trillion in assets in 2023, more than double their level in 2009 (USD 92 trillion) and slightly larger than the respective total value of assets held by banks in 2023 (USD 181 trillion). This growth has been driven largely by collective investment vehicles, including bond funds, money market funds, equity funds and mixed funds. By the end of 2023, investment funds represented more than 70% of the NBFI sector, up from about 40% in 2008

(Panel B of Figure 1).

[Insert Figure 1 here]

Central banks, through large-scale asset purchase programs, have reinforced this structural shift by strengthening the link between monetary policy and market-based financing (Avdjiev et al. 2020). Amid growing fragility in the banking sector, central banks have increasingly focused on market dynamics, amplifying the role of financial markets in the transmission of monetary policy (Altavilla et al. 2019, Lo Duca et al. 2016). Monetary easing has been central in this dynamic. It has redirected savings into investment funds holding stocks, corporate bonds and high-yield bonds (Hau & Lai 2016, Giuzzio et al. 2021, Banegas et al. 2022), while simultaneously lowering rates, thereby reducing investment opportunities for "yield hunters" (Fratzscher et al. 2017, Alpanda & Kabaca 2019, Malliaropulos & Migiakis 2023). Crucially, these effects have spilled across borders, with accommodative monetary policy exerting significant cross-country fund flows spillovers (Kaufmann 2023). In the low-rate environment following successive rounds of monetary easing, investment funds found themselves with ample liquidity and increasingly engaged in yield-seeking behaviour. Evidence from Choi & Kromlund (2018), one of the few studies using actual holdings data, shows that mutual funds investing in corporate bonds reallocate toward higher-yield securities as interest rates decline and safe assets become scarce. In the euro area, Albertazzi et al. (2021) document a portfolio rebalancing channel whereby ECB asset purchases prompted funds to increase holdings of higher-yield securities, particularly those issued by corporates in more vulnerable euro-area economies. Ahmed & Hofmann (2023) find that institutional investors, via investment funds, search for yield by shifting their holdings away from low-yielding bond markets, such as the euro area and Japan, into higher-yielding US bonds.

Overall, the literature has established that (i) investment fund flows respond to monetary policy; and (ii) monetary easing disproportionately increases inflows into funds investing in riskier asset classes. What remains unclear is whether the portfolio holdings of investment funds *themselves* become riskier during periods of expansionary monetary policy, i.e., whether asset allocation shifts accordingly.

The main objective of our paper is to examine how bond fund managers adjust portfolio risk in response to monetary policy, with attention to both conventional and unconventional measures by the Fed and the ECB. Central to our empirical strategy is a time-varying measure of risk-taking at the fund level -the weighted- average credit rating of a fund's portfolio- constructed from granular data on bond fund holdings. We combine quarterly security-level portfolio data from Lipper with security characteristics from LSEG-Datastream. We collect credit ratings from the three major agencies, with the first-best long-term issuer rating serving as a proxy for the risk level of each security. To ensure our measure captures risk-taking behavior, we calculate portfolio weights using Book Value (BV) rather than market value. This allows us to track changes in the weighted average credit rating of a fund's portfolio, serving as a proxy for credit quality at a given point in time.

We proxy the stance of monetary policy with shadow rates developed by Wu & Xia (2016), which capture the full spectrum of monetary policy (conventional and unconventional), and isolate the unconventional (UMP) component by subtracting the effective policy rate from the corresponding shadow rate. To identify the effects of monetary policy, we employ a two-stage least squares instrumental variable approach with Jarociński & Karadi (2020) pure monetary policy shocks as our instrument. We control for fund-level and, in some specifications, for time fixed effects as well as a rich set of fund characteristics, including asset allocation, liquidity, duration risk and past returns.

Finally, we investigate heterogeneity in the risk-taking response to monetary policy across portfolios with different maturity profiles. The link between monetary policy changes and maturity profiles of the underlying bond portfolio is grounded in the preferred-habitat model of Vayanos & Vila (2021), which shows that investors with maturity preferences influence the term structure of interest rates. In their framework, shocks, including monetary policy changes, are transmitted across maturities through risk-averse arbitrageurs. In this regard, we examine whether the maturity profiles of the securities in the bond funds' portfolios are associated with the fund's response to Fed and ECB monetary policy actions. This allows us to test whether monetary policy exerts asymmetric effects on credit risk profiles depending on bond maturities.

Our results confirm that accommodative monetary policy is associated with a shift of bond funds toward riskier portfolios. We find that a one percentage point reduction in the Fed's shadow rate is associated with a reduction of approximately one-fifth of a notch in the weighted average credit rating of the US and EA bond funds' portfolios. With a total reduction of about six percentage points in the shadow Fed funds rate between 2019 and 2022, our findings imply a decline of 0.45 of a notch in the weighted average credit rating of bonds held by bond funds. This effect is relatively stronger for longer-term holdings: for portfolios of 10-year bonds, the weighted average rating falls by 0.6 of a notch. Results for the ECB closely mirror those for the Fed, though the effect is much less pronounced. Importantly, we find that Fed policy exerts a strong global influence: US monetary easing leads to risk-taking not only among US funds but also among euro-area funds. ECB policy also transmits to both EA and US bond funds, but with more muted effects compared to the Fed. Finally, we explore heterogeneity across fund types - by investment strategy, leverage positions, size and more. Our findings suggest that both the Fed and the ECB affect risk-taking across the whole spectrum of funds, with the effects being stronger for active funds, institutional funds and funds with long-duration portfolios.

Our study builds on the literature that identifies risk-taking as a distinct transmission mechanism of monetary policy (Borio & Zhu 2012) as well as on research showing that global financial conditions are shaped primarily by US monetary policy (Miranda-Agrippino & Rey 2020). The risk-taking channel posits that monetary policy affects investor risk perceptions and attitudes, thereby affecting capital flows and portfolio allocations. As shown by Bauer et al. (2015), unexpected monetary easing can increase investor risk appetite and encourage greater risk-taking in financial markets. Hau & Lai (2016) further show that this channel operates through the reallocation of investment fund portfolios. In Europe, Giuzio et al. (2021) find that expansionary ECB shocks lead to inflows into riskier segments of the fund market, particularly from lower-risk bond funds to higher-risk equity funds. However, whether portfolio allocations *within* funds become riskier following expansionary monetary policy remains an open question. Addressing this gap is important for understanding whether portfolio managers incorporate monetary policy signals in their risk-taking decisions. While existing studies on NBFIs have focused on fund flows and the search-for-yield behaviour amid abundant shareholder inflows, the connection between monetary policy and the risk-taking behaviour of funds remains relatively unexplored. Most of the literature relies on flow-level data rather than actual portfolio holdings, with only a few exemptions. We bridge that gap by directly examining how monetary policy influences the composition of fund portfolios - specifically their credit-risk exposure and maturity-structure - using granular security-level data of mutual fund holdings.

Our main contribution is to provide evidence for a market-based risk-taking channel of global monetary policy transmission. In particular, we show that monetary policy affects risk taking in the NBFI sector not only through fund flows from less risky to more risky funds, as already demonstrated in the extant literature, but also because it leads to more risk taking within funds. In doing so we find that the Fed's monetary policy has a significant impact on the risk level of investment funds' portfolios, while ECB policy has a weaker impact. Moreover, we demonstrate that overall monetary policy impacts are uneven across the term structure, with longer-maturity bonds displaying greater sensitivity. Finally, we disentangle the effects of different monetary policy tools: asset purchase programs and other forms of UMPs exert stronger influence on the longer holdings of bond funds portfolios than do interest-rate policies.

As market-based financing continues to surpass traditional banking channels, policymakers must broaden their focus to include the behaviour of investment funds. Evidence of a market-based risk-taking channel indicates that monetary policy not only shapes credit conditions through conventional banking mechanisms but also reshapes investor preferences, portfolio allocations and risk profiles. The asymmetric impact of quantitative easing on longer-duration bonds highlights the importance of monitoring duration risk within fund portfolios. During periods of prolonged monetary accommodation, central banks should weigh the trade-offs between stimulating economic activity and encouraging risk-taking in financial markets. Furthermore, the global transmission of monetary policy underscores the need for international coordination and enhanced macroprudential oversight.

The rest of the paper is structured as follows. Section 2 describes the data and variables, detailing the methodology used to measure portfolio-level credit risk. Section 3 presents results from a fixed-effects setup. Section 4 introduces the baseline model and reports findings, while Section 5 estimates the baseline setup in the face of fund heterogeneities. Finally, Section 6 concludes with a discussion on the implications for financial stability and the design of monetary policy.

2 Data and variables

2.1 Fund-level portfolio holdings and security-level data

We use security-level portfolio holdings data from open-end regulated investment funds in the US and the euro area that invest mainly in bonds (*i.e.,* bond funds).[1] Our sample spans 2018:Q1-2023:Q4 at quarterly frequency and is sourced from LSEG's Lipper for Investment Management database. In total, the initial sample of funds covers more than 7,500 US bond funds and 17,500 euro-area bond funds, with an average total asset fund value (AFV) of about USD 7.4 trillion across time. After applying the filters described in the Appendix, we end up with slightly more than 5,000 bond funds from the US and the euro-area.[2]

To put things in perspective, in 2023:Q4 bond funds globally held approximately USD 13 trillion in net assets (International Investment Funds Association 2024). Of this, US and euro area bond funds accounted for USD 7.5 trillion and around USD 4.4 trillion, respectively. As shown in the right-hand side of Figure 2, for the same period, our sample covers US bond funds with AFV exceeding USD 6.2 trillion and euro-area bond funds with AFV of approximately USD 2 trillion. Thus, our dataset captures about 69% of the total US and euro-area bond fund sector in terms of AFV, making it highly representative of the global market. Coverage remains consistently high across all quarters (Figure 3), ranging between 65% and 70% of the global bond funds market.

[Insert Figure 2 here]

[Insert Figure 3 here]

[1] According to the International Investment Funds Association, bond funds are mutual funds that invest mainly in bonds. In our sample, the average portfolio consists of about 81% bonds (government, corporate-financial and corporate-non financial), bills and cash or cash-like instruments; about 16% securitizations (mainly in US funds); and about 2.9% other assets (mainly loans and equities).

[2] The reduction in the number of funds, mainly from the euro area, reflects the exclusion of small funds with total net asset value below USD 250 million).

At the fund-level, we collect variables from Lipper, including market value (in USD), number of shares, index-tracking status, and other key characteristics, detailed in the Online Appendix. Additionally, we gather information on the net asset fund value and its composition – such as cash holdings, bonds, derivatives, etc. More importantly, we obtain detailed information on the composition of each fund's portfolio at the end of each quarter, at the security level identified by the securities' ISINs or CUSIPs. For each security, Lipper provides book and market values, the number of shares held, as well as a self-reported risk profile.

To examine risk-taking, our analysis relies crucially on detailed information about the risk profile of each funds' portfolio. A key challenge in this context is the limited reliability of self-reported risk profile variables commonly provided in databases of funds' portfolio data. As shown by Chen et al. (2021), these risk classifications reported by funds about their portfolios often diverge substantially from classifications based on actual credit ratings of the underlying securities. Relying on such self-reported risk classifications of holdings may therefore introduce inaccuracies, especially when the objective is to assess funds' risk-taking behaviour, as in this paper. To mitigate this concern, we construct an independent, security-level measure of portfolio risk. we combine Lipper's information regarding security-level holdings and amounts for each fund at the end of each quarter with security characteristics from LSEG-Datastream, using ISINs/CUSIPs as unique identifiers. This allows us to map each security held by a fund to its externally sourced credit rating and other attributes. We then aggregate these security-level risk parameters to the fund level, ensuring that our measure of portfolio risk reflects the actual composition and credit quality of the securities held.

Specifically, we collect credit ratings data from the three major rating agencies – Fitch, Moody's and S&P – and use the first best long-term issuer rating as a proxy for security-level credit risk. We also gather sectoral information for each issuing entity to classify funds' holdings into government bonds, financial bonds (mainly bank-issued) and non-financial corporate bonds. Additionally security-level data include issuance and maturity dates, allowing us to construct variables pertaining to the duration of the funds' holdings (e.g. the share of holdings with 1-3 years-to-maturity). We furher classify bonds into plain vanilla, synthetic and securitized instruments, excluding derivatives and bonds linked to derivatives, to ensure that our results are not confounded by idiosyncratic features that may render assets held by funds not entirely comparable to each other.

2.2 Time-varying risk-taking variable at the fund level

Depending on their type, funds invest in a range of asset classes, including equities, bonds, shares of real-estate investment trusts (REITs), derivatives, cash, and other. We focus exclusively on bond funds whose total value of portfolio holdings is at least/approximately 90% allocated to fixed-income securities in both the US and the euro area.[3]

To measure risk-taking behavior, it is important to distinguish between changes in portfolio composition that reflect genuine investment decisions and those that arise mechanically from price fluctuations. For example, if a fund reduces its holdings after a downgraded bond and increases its holdings of another bond with equivalent credit quality, its overall risk profile remains unchanged. By contrast, if the fund retains the downgraded bond, this constitutes a decision that increases portfolio risk. To ensure our measure reflects such choices and to rule out changes in a security's relative importance in a given fund's portfolio that arise solely from market-price fluctuations, we calculate portfolio weights using book values (BV), rather than market values. This approach ensures that changes in weights reflect actual adjustments in holdings rather than valuation effects.

Formally, to capture the relative importance of each bond within a fund's portfolio, we compute the weight of bond i, relative to other bonds in the same portfolio, at time t as follows:

$$w_{i,t} = \frac{BV_{i,t}}{\sum_{i=1}^{k} BV_{i,t}}. \tag{1}$$

This weighting approach eliminates a key source of endogeneity. Rating changes often trigger price movements that would mechanically alter market-value weights, even when the actual underlying investment holding remains unchanged. By calculating weights based on book values, we ensure that changes grouped in the risk classes of the underlying bonds reflect deliberate risk-taking decisions, including the choice to retain a position on a bond after its rating changed. Furthermore, in this regard, we mitigate other spurious signals that could arise from excessive price volatility in a given bond price.

We employ credit ratings as the basis for classifying bond holdings of funds into risk categories. This classification is a crucial step in constructing our time-varying risk-taking variable at the fund level. Credit ratings are well established determinants of the performance and the asset allocation of bond funds (Cici & Gibson 2012, Baghai et al. 2024). Using the mapping in Table 1, we convert alphanumeric ratings into numerical values to construct the variable $c_{i,t}$, which captures the rating of each bond i at each point in time t, allowing us to track rating transitions over time. Downgrades correspond to an increase in the value of c_i, such that $c_{i,t+1} > c_{i,t}$, while upgrades correspond to a

[3]Note that for US funds, the fixed-income portion includes mortgage-backed securities and other securitized loans, which account for roughly 10% of total portfolio value. Thus, even when restricting to non-securitized fixed-income holdings (*i.e.,* bonds), our dataset captures approximately 80–85% of US bond fund portfolios before additional filters. For a detailed discussion of the technical procedures regarding the construction of the dataset, see the Online Appendix.

decrease in the value of c_i, such that $c_{i,t+1} < c_{i,t}$.

[Insert Table 1 here]

Aggregating the holdings of a given fund across rating categories, allows us to assess the fund's overall portfolio risk profile in terms of credit ratings. The weighted-average credit rating of fund j's portfolio is given by:

$$w^c_{j,t} = \sum_{i=1}^{k} w_{i,t} \cdot c_{i,t} \tag{2}$$

According to equation (2), the weighted-average credit rating of fund j's portfolio at time t is the sum of the ratings of its k individual holdings, each weighted by its share in the portfolio. This measure serves as a proxy for the credit quality of the portfolio at time t with higher values of $w^c_{j,t}$ suggesting lower credit quality (higher risk). Changes in $w^c_{j,t}$ may arise over time from two sources: (i) changes in the credit quality of individual bonds, such as downgrades or upgrades (rating transitions of existing holdings), (ii) adjustments in the composition of the fund's holdings which alter the weights (rebalancing across securities). Both mechanisms reflect meaningful shifts in the credit quality of the portfolio, either through changes in the risk profile of assets already held or through re-balancing across assets with varying levels of credit risk.

2.3 Monetary policy variables

The main objective of the paper is to examine how bond fund managers respond to monetary policy, with a focus on the implications for risk-taking. Our analysis accounts for the overall stance of monetary policy implemented by the Fed and the ECB and further distinguishes between conventional interest-rate policies and unconventional monetary policy (UMP) measures. Figure 4 shows the monetary policy variables we use to assess their effects on funds' risk-taking behavior. We employ the shadow rates developed by Wu & Xia (2016), which are particularly useful because they incorporate both conventional and unconventional monetary policy measures, even when the policy rate is constrained by the zero lower bound, thereby providing a unified measure of accommodation across regimes.

[Insert Figure 4 here]

To understand why subtracting the effective policy rate from the shadow rate isolates the impact of the balance sheet policies, it is important to recall the mechanics underlying the construction of shadow rates. As shown in Wu & Xia (2016), shadow rates are derived from the pricing of interest-rate futures contracts, which embed expectations about the full spectrum of monetary policy actions, including those implemented when the policy rate is at or near the zero-lower bound. When the effective policy rate is deducted from the respective shadow rate, the resulting residual reflects the component attributable to unconventional monetary policy tools, such as large-scale asset purchases. This decomposition allows us to disentangle the effects due to the interest rate setting by the Fed and the ECB from those stemming from non-standard policy interventions.

Ultimately, the risk-taking channel of monetary policy hinges on investor choices, which are shaped by expectations about the future state of the economy. However, two challenges arise in this context. First, the process through which investors form their expectations is inherently unobservable. Second, monetary policy is endogenously related to contemporaneous economic and market conditions. To address these challenges, and following the approach of Koijen & Yogo (2019) and Koijen et al. (2021), we employ instrumental variables that capture expectations about monetary policy and the resulting reaction by markets. Specifically, we use monetary policy shocks derived from monetary policy statements of the Fed and the ECB, as constructed byJarociński & Karadi (2020)).

3 Fixed-effects setup

Figure 5 shows that during periods of accommodative monetary policy by the Fed, bond funds tend to increase their risk taking, whereas during tightening phases they reduce it. This pattern suggests that funds tend to take on more risk during accommodative periods, and conversely, are more inclined to offload risk position when policy tightens.

[Insert Figure 5 here]

To investigate the relationship between bond funds' risk-taking behavior and monetary policy, we first employ a simple fixed-effects specification:

$$w^c_{j,t} = \alpha_j + c_t + \beta_1 \cdot MP_t + \beta_2 \cdot Maturity_{j,t} + \beta_3 \cdot MP_t \cdot Maturity_{j,t} + \Gamma \cdot X_{j,t} + \epsilon_{j,t} \qquad (3)$$

where α_j denotes fund-level fixed effects to control for time-invariant heterogeneity, while c_t captures either macroeconomic controls (lagged inflation and growth rate) in the baseline specification or time fixed effects in an alternative specification. When time-fixed effects are included, the average cross-sectional effects of monetary policy as well as macroeconomic variables are absorbed. Standard errors are clustered at the fund-level, and a covid dummy (2020:Q1-2020:Q3) is included in the baseline specification.

The monetary policy variable, MP_t captures either pure monetary policy shocks from Jarociński & Karadi (2020) (*JK MP*) or policy rates. We rely on shadow rates from Wu & Xia (2016) (*sh.rate*) which incorporate monetary policy actions below the zero-lower bound in rate-equivalent terms. To disentangle effects stemming from interest-rate policies (*int.rate*) from those stemming from unconventional monetary policies (*UMP*) we also employ effective policy rates - Fed funds rates (EFFR) and deposit facility rates (DFR) for the ECB - and take the difference between shadow rates (SFFR and SDFR respectively) and effective rates to capture effects from UMPs. The coefficient β_1 captures whether funds shift toward safer or riskier assets when policy tightens or eases. A negative sign indicates that higher rates or positive policy shocks reduce risk-taking, while lower rates encourage it. In line with Figure 4 and Figure 5, we expect monetary tightening (positive values of MP shocks or rates variables) to be associated with lower risk taking. As a result, we anticipate a negative coefficient of β_1.

The maturity variable $Maturity_{j,t}$ measures the median remaining time to maturity of the securities in fund j's bond portfolio at each point in time t. Previous research has shown that funds' demand for bonds is influenced on the margin, *inter alia*, by the maturity profile of the securities held in their portfolios (Moneta 2015, Converse & Malucci 2023, Nenova 2025). Interacting monetary policy with maturity allows us to estimate how the elasticity of risk-taking to monetary policy varies across bonds' maturity profiles. For example, an increase in the base rate may have larger effects on longer-term bonds, diminishing demand for riskier bonds by sharply increasing the duration risk for the fund. As such, we reflect term-structure properties of the relationship between monetary policy and fund risk-taking, drawing from previous literature on the heterogeneity of monetary policy transmission with respect to the maturity profile of the underlying assets (Drechsler et al. 2021, Gürkaynak et al. 2022, Jungherr et al. 2024). A negative and significant β_3 would suggest that monetary policy exerts a stronger risk-taking effect on longer-maturity bond portfolios.

The control vector $X_{j,t}$ includes fund-level and fund-asset control variables captuting funds' portfolio allocation, liquidity, sensitivity to interest rates, and returns. For portfolio allocation, we use the share of fund holdings in government bonds (*Gvt bonds*), financial corporate bonds (*Corp-Fin*), non-financial corporate bonds (*Corp-NFC*), and cash (*Cash*). Government bond holdings are typically associated with risk aversion (Giuzio et al. 2021, Graziano & Habib 2024) and thus, we expect them to be associated with reduced risk taking. We proxy funds' liquidity position using cash holdings as a share of total asset value. Prior literature shows that increased liquidity boosts risk taking (e.g.Kacperczyk & Schnabl (2023) and Macchiavelli & Zhou (2022)). At the same time, a positive association of cash holding with funds' risk taking, may reflect a certain degree of caution from funds with riskier portfolios in order to meet unexpected investor redemptions (see, Jiang et al. (2021)).

Table 2 reports the fixed-effect regression estimates of the impact of monetary policy on bond funds' portfolio risk-taking, with Panel A presenting results for the Fed and Panel B for the ECB. Across specifications, the estimates consistently reveal a negative and statistically significant relationship. This pattern holds for both central banks and across all monetary policy measures. Specifically, increases in the shadow rate or the effective policy rate are associated with reductions in $w^{c}_{j,t}$, implying that tighter monetary policy dampens risk-taking. Importantly, the interaction terms between monetary policy and portfolio maturity are also negative and significant, indicating that the effect of monetary policy is stronger for funds with longer-maturity holdings. This suggests that duration risk amplifies the sensitivity of portfolios to monetary conditions. Taken together, the results corroborate the evidence in Figure 4 and confirm that accommodative monetary policy is associated with increased risk-taking.

[Insert Table 2 here]

Table 2 also reports results on the relationship between risk-taking, portfolio allocation and performance. In particular, we find that government bond holdings have a robust negative relationship with funds' weighted average risk. This implies that on average funds with larger government bond exposures tend to hold portfolios with lower risk. In contrast, higher holdings of corporate bonds, both from the financial and non-financial sectors, are associated with riskier portfolios. These results are consistent with the flight to safety argument (Graziano & Habib 2024, Giuzio et al. 2021) and corroborate previous empirical evidence that corporate bond holdings increase during search-for-yield times (Becker & Ivashina 2015, Choi & Kromlund 2018, Ahmed & Hofmann 2023). Finally, funds with higher cash holdings tend to have riskier portfolios; cash may be driving the risk taking by funds higher, in line with Macchiavelli & Zhou (2022) and Kacperczyk & Schnabl (2023), or the positive result may be corroborating the findings of Jiang et al. (2021), suggesting that funds with riskier holdings tend to hold larger amounts of cash in order to be able to meet unexpected investor redemptions.

4 Instrumental-variables setup

4.1 The baseline model

The results from the fixed-effects regressions indicate a statistically significant association between monetary policy and funds' risk taking behavior. However, these estimates may suffer from endogeneity bias. In particular, both risk-taking and monetary policy may simultaneously respond to expectations about future economic activity. To address these concerns, we employ an instrumental-variables (IV) approach based on two-stage least-squares (2SLS). In the first stage, we estimate the following regression:

$$MP_t = \alpha_j + c_t + b_1 Z_t + b_2 MP_{t-1} + b_3 Maturity_{j,t} + b_4(Z_t \times Maturity_{j,t}) \\ + b_5(MP_{t-1} \times Maturity_{j,t}) + \Gamma X_{j,t} + u_t \quad (4)$$

where MP_t denotes the monetary policy variable, Z_t is the instrument, $Maturity_{j,t}$ is the median maturity of fund j's portfolio, and $X_{j,t}$ is the vector of portfolio controls. We use the pure monetary policy shocks of Jarociński & Karadi (2020) as our main instrument. These shocks are strongly correlated with monetary policy stance but, by construction, do not directly affect bond funds' risk-taking. The inclusion of lagged policy rates accounts for inertia in rate-setting, while macro controls or time fixed effects, c_t, absorb aggregate conditions.

In the second stage, we use the fitted values from the first-stage estimation, $MP(Z)$, in the following IV regression:

$$w^c_{j,t} = \alpha_j + c_t + \beta_1 \cdot MP(Z) + \beta_2 \cdot Maturity_{j,t} + \beta_3 \cdot MP(Z) \cdot Maturity_{j,t} + \Gamma \cdot X_{j,t} + u_{j,t} \quad (5)$$

where $w^c_{j,t}$ is the weighted-average credit rating of fund j's portfolio at time t, with higher values indicating lower credit quality (higher risk). The coefficients have the following interpretation: β_1 captures the effect of monetary policy on risk-taking; β_2 captures the baseline maturity effect; and β_3 measures how this effect varies with portfolio maturity, reflecting duration risk.

We estimate three variants of this IV setup: (i) using shadow rates, which capture overall monetary policy stance, (ii) using effective policy rates (Fed funds rate or ECB deposit facility rate), which isolate conventional interest-rate policies, and (iii) using the difference between shadow (SFFR and SDFR respectively) and effective rates, which captures unconventional monetary policies

(UMPs). Each variant is estimated for the Fed and the ECB separately. Our baseline specification includes macro controls and fund-level fixed effects, while an alternative specification adds time fixed effects to absorb common shocks.[4]

Empirical estimates of equations (4)-(5) are reported in Table 3, Panel A for the Fed and Panel B for the ECB.[5] The first-stage regressions confirm that monetary policy shocks are strongly correlated with policy rates. The second-stage regressions, reported in the lower part of each panel, indicate that shadow rates exert a statistically significant effect on risk taking of bond funds. For the Fed both the level and the interaction term with the maturity of the portfolio are significant at the 1% level. For the ECB, only the maturity interaction is significant, also at the 1% level. In both cases, the coefficients are negative, implying that risk taking decreases (increases) when shadow rates increase (decrease), with stronger effects for funds holding larger positions in longer-dated bonds.

[Insert Table 3 here]

The economic magnitudes, as shown also in Figure 6, are substantial. For the Fed, a one percentage point (p.p.) reduction in the shadow rate increases risk-taking by about 0.055 notches on average across all funds, with an additional 0.013 notches for each year of remaining portfolio maturity. Thus, a median bond fund with a weighted-average maturity of six years experiences an increase of roughly 0.13 notches per 1 p.p. reduction. Between 2019:Q1 and 2021:Q1, the Fed reduced the shadow rate by about 4.4 p.p., implying a cumulative increase in risk-taking of funds of about 0.24 notches across the board plus an additional 0.34 notches for the median-tenored (six-year) bond portfolio. Hence, these estimates suggest that Fed's monetary easing during this period led to a median rating reduction of about half a notch. For longer-dated portfolios, the effects are even more pronounced: for a hypothetical portfolio consisting of 10-year bonds, the estimated additional risk-taking corresponds to about 0.81 notch.

For the ECB, the effects are more muted and work primarily through the interaction of the shadow rate with portfolio maturity. Specifically, we find that each 1 p.p. reduction in the ECB's shadow rate is associated with a 0.004 notch increase in risk-taking for each year of remaining maturity. Thus, a median bond fund with a weighted-average maturity of six years would experience an increase in risk-taking of about 0.025 notches per 1 p.p. reduction in the ECB's shadow rate.

[4]All regressions control for the share of fund holdings in government bonds (*Gvt bonds*), financial corporate bonds (*Corp-Fin*), non-financial corporate bonds (*Corp-NFC*), and cash (*Cash*). We also control for the weighted average maturity of the bond portfolio (*Maturity*), lagged one period ((*Returns(t-1)*) and contemporaneous fund financial returns (*Returns*).

[5]For reasons of brevity, we suppress the estimates for the control variables; these are very similar to the ones reported in Table 2 and are available upon request.

For comparison, if the ECB had reduced its shadow rate by the same magnitude as the Fed, the implied increase in risk-taking for the median-tenored portfolio would be about 0.1 notches. In this regard, these findings suggest that ECB monetary policy exerts a statistically significant but considerably weaker effect on bond funds' risk-taking relative to the Fed. This is consistent with previous literature (e.g. Miranda-Agrippino & Rey (2020)), which emphasizes that the Fed exerts a strong effect on the global financial system and affects European financial markets more strongly than the ECB affects US markets (e.g., Ca'Zorzi et al. (2023)).

[Insert Figure 6 here]

4.2 Disentangling the effects of different monetary policy tools

Columns (3)-(6) of Table 3 report the estimated effects of conventional interest-rate policies (*int.rates*) and unconventional monetary policies (*UMP*), respectively, on bond funds' risk- taking. Both tools exert statistically significant negative effects on the weighted average credit rating of bond fund portfolios. In other words, a cut in policy rates or an equivalent easing through UMPs is associated with an increase in risk-taking by funds.

In particular, for the Fed, a hypothetical 1 p.p. reduction in the effective fed funds rate (EFFR) raises the weighted-average risk score about 0.06 notches, operating only through the maturity-specific component. Over 2019:Q3 and 2020:Q1, the EFFR fell by 2.4 p.p. (followed by a period in which the EFFR remained near zero until 2022:Q1), implying a rise in the weighted-average risk score of 0.14 notches. For longer-dated portfolios, the effect is amplified: a hypothetical portfolio of 10-year bonds, the same reduction corresponds to an increase in risk-taking of about 0.09 notches.

Unconventional monetary policies generate even stronger effects on the median-tenored portfolio, and these effects become even more pronounced for longer-dated bond holdings. Specifically, a hypothetical 1 p.p. reduction in the shadow rate attributable to UMPs raises the weighted-average risk score by about 0.16 notches - 0.06 across-the-board plus 0.10 for the median maturity fund.[6] These results suggest that the Fed's large-scale asset purchases (LSAPs), which targeted longer-duration securities, elevated the prices of these assets and induced bond funds to engage in yield-seeking by increasing their exposure to longer-term, riskier bonds. Moreover, for longer-dated portfolios UMPs have a much stronger risk-taking effect. For example, for a hypothetical portfolio with an average maturity of 10 years, a 1 p.p. reduction corresponds to an increase in risk-taking of about 0.1 notches, whereas the same reduction implemented through UMPs corresponds to about 0.24 notches. Taking into account that the Fed's UMP over 2019:Q3-2021:Q4 were equivalent to

[6] This is calculated as: a 1 p.p. reduction in the shadow rate due to UMPs multiplied by 6 years (the median tenor of the funds' portfolios in our sample) times the estimated coefficient of -0.018.

a 2 p.p. reduction in the EFFR, our estimates suggest that UMPs contributed to an additional 0.34 of a notch rise in the weighted average risk score of bond funds. For a 10-year portfolio, the corresponding increase in risk-taking is about 0.48 notches.

These results suggest that Fed's UMPs have been much more effective in stimulating risk-taking in long-dated portfolios than conventional interest-rate policies. Additionally, these results highlight an important asymmetry across monetary policy phases: as interest-rate hikes were implemented after the asset-purchase programs ended, these hikes did not fully offset the earlier risk-taking effects by UMPs. This finding is consistent with Malliaropulos & Migiakis (2023), who show that LSAPs had strong and persistent effects on bond risk premia, particularly for lower-rated bonds.

Panel B of Table 3 reports estimates for the ECB. Disentangling the effects of overall monetary policy into interest-rate policies and UMPs shows that, relative to the Fed, the muted effects of ECB monetary policy on risk-taking is driven primarily by UMPs. The key difference between the two policy tools is that interest-rate policies affect risk-taking only through the maturity interaction term, whereas UMPs also exert a statistically significant cross-section average effect.

For the ECB, we find that UMPs are somewhat more effective than interest-rate policies in influencing funds' risk-taking. In particular, a 1 p.p reduction in policy rates is associated with a decrease of the average rating in the median-tenored bond funds portfolio of 0.05 of a notch, whereas an equivalent easing through UMPs corresponds to a 0.07 notches reduction. For a longer-tenored portfolios, such as those with an average maturity of 10 years, the results are quite larger: a 1 p.p cut implies a 0.09 of a notch, while interest-rate policies would result in a risk taking equal to 0.08 of a notch. During 2019:Q1-2020:Q4, the ECB's asset- purchases that resulted in a drop of the shadow rate by about 1.5 p.p. According to our estimates, this implies an increase in risk-taking of 0.10 notches for the median-tenored bond fund and of 0.14 of notches for portfolios with a 10-year average maturity.

4.3 Dynamic panel data model

To account for the persistence of the dependent variable, we estimate a dynamic panel data model using the Arellano–Bond (AB) estimator. In this specification, lagged levels of the policy variable and the dependent variable serve as instruments for the differenced equation, making it well-suited for our dataset with a large cross-section ($N > 5{,}000$ funds) and short time dimension ($T = 24$ quarters). The AB estimator controls for residual endogeneity between risk-taking and policy rates, while allowing for heterogeneity across funds and within-fund autocorrelation and heteroskedasticity.

We employ the Arellano-Bond estimator (AB estimator) for the following GMM dynamic panel data model:

$$\Delta w^c_{j,t} = \rho \cdot \Delta w^c_{j,t-1} + \beta_1 \cdot \Delta MP(Z)_t + \beta_2 \cdot (\Delta MP(Z)_t \times Maturity_{j,t}) + \beta_3 \cdot Maturity_{j,t} + \Gamma \cdot \Delta X_{j,t} + u_{j,t} \quad (6)$$

In the above setup, $\rho \cdot \Delta w^c_{j,t-1}$ captures persistence of the risk-score variable. All other variables are the same as in the IV setup. The vector of instrumental variables is

$$\mathcal{Z}_t = \left\{ MP_{t-1},\, MP_{t-2},\, MP_{t-1} \times Maturity_{j,t-1}, MP_{t-2} \times Maturity_{j,t-2}, JK_{t-1}, JK_{t-2}, w^c_{j,t-2},\, w^c_{j,t-3} \right\}$$

Table 4 reports the results.[7]Across all specifications, the lagged dependent variable is highly significant, confirming persistence in portfolio risk scores. Monetary policy variables remain significant and carry the expected negative signs, in line with the IV results.

For the Federal Reserve (Panel A), shadow rates exert significant effects both across the board and through the maturity interaction: a 1 p.p. reduction in the shadow rate increases risk-taking by about 0.011 notches on average, plus 0.007 notches for each year of portfolio maturity. Effective policy rates affect risk-taking only through the maturity interaction, while the level effect is insignificant. Unconventional monetary policies (UMP) have the strongest impact: a 1 p.p. reduction in the shadow rate equivalent to UMPs increases risk-taking by 0.050 notches across the board, plus 0.024 notches per year of maturity. For a median-tenored portfolio (6 years), this corresponds to about 0.19 notches, while for a 10-year portfolio the effect rises to 0.29 notches. These magnitudes confirm that UMPs were particularly powerful in stimulating risk-taking in longer-dated portfolios.

For the ECB (Panel B), the effects are weaker and more maturity-specific. Shadow rates show a weakly significant positive level effect, but the maturity interaction is negative and significant implying that risk-taking increases only for longer-dated portfolios when rates decline. Effective policy rates are insignificant, both at the level and in interaction. UMPs exert no significant across-the-board effect, but the maturity interaction is significant, again pointing to tenor-specific transmission. For a median-tenored portfolio, a 1 p.p. reduction in the shadow rate through UMPs increases risk-taking by about 0.02 notches, while for a 10-year portfolio the effect is about 0.03 notches.

Economically, our results confirm the notion that the Fed's monetary policies affect bond funds risk-taking more strongly than the ECB's. The reduction of the shadow FFR explains a weighted-

[7]All regressions control for the share of fund holdings in government bonds (*Gvt bonds*), financial corporate bonds (*Corp-Fin*), non-financial corporate bonds (*Corp-NFC*) and cash (*Cash*). We also control for the weighted-average maturity of the bond portfolio (*Maturity*), lagged one period fund returns ((*Returns(t-1)*) and contemporaneous fund returns (*Returns*).

average risk score that is about 0.52 notche higher than before.[8] For longer-term portfolios, the impact is larger reaching around 0.80 of a notch for a portfolio of 10-year bonds. These magnitudes highlight the persistence and strength of Fed transmission channels, particularly when portfolio duration is long. For the ECB, the dynamic panel estimates yield results very similar to the 2SLS setup. A shadow rate reduction of about 1.8 p.p. is associated with an increase of 0.05 notches in the risk score of the median-tenored portfolio.

Overall, the dynamic panel results confirm the robustness of our findings: Fed monetary policies exert stronger and broader effects on bond funds' risk-taking, particularly through UMPs, while ECB policies operate mainly through maturity-specific channels and with smaller magnitudes.

[Insert Table 4 here]

5 Heterogeneity of funds

In this section, we examine whether the documented risk-taking effects of monetary policy on funds' bond portfolio holdings vary systematically across funds with different characteristics, such as domicile (US vs. EU), asset-value size (smallest 20% funds, largest 20% funds, and those between the first and fourth quintile), investment strategy (active vs. passive), leverage status (leveraged vs. unleveraged) and investor classification (institutional vs. non-institutional).[9] The results are presented in Table 5; Panel A reports results for the Fed and Panel B for the ECB.[10]

The analysis presented in Table 5 confirms that the observed risk-taking effects of monetary policy are representative of the full sample and are not driven by a narrow subset of funds. Across all find categories, statistically significant effects operate in the anticipated direction: a fall in rates is associated with an increase in risk-taking.

In particular, we find that Fed's monetary policy affects risk-taking in the expected direction for both US and euro-area funds, although the tenor-specific effect is statistically significant only for US domiciled funds. ECB monetary policy also affects both US and euro-area funds, but again only US funds exhibit a significant tenor-specific response. Moreover, the size of the Fed's tenor-specific

[8] The 'equilibrium' effects from the 4.4 p.p. reduction in the shadow FFR are calculated as follows: $\frac{-0.011 \times 4.4\% - 0.007 \times 6 years \times 4.4\%}{0.528} \approx 0.52$ of a notch.

[9] We have also used other variables, such as 12-month bill rates and results are very similar. The results are available upon request.

[10] All regressions control for the share of fund holdings in government bonds (*Gvt bonds*), financial corporate bonds (*Corp-Fin*), non-financial corporate bonds (*Corp-NFC*), and cash (*Cash*). We also control for the weighted-average maturity of the bond portfolio (*Maturity*), lagged one period fund returns ((*Returns(t-1)*) and contemporaneous fund returns (*Returns*).

coefficients for US funds is about three times larger than the ECB's. Overall, our findings suggest that the Fed's monetary policy has stronger effects on the risk-taking of euro-area funds than the ECB's, driven primarily by the level effect rather than the tenor-specific component..

Turning to the fund size, both Fed and ECB policies affect the entire spectrum of funds, regardless of their size. Nevertheless, the effects of Fed policy on the longer-term positions of smaller funds' are more than twice as strong as those for funds of median or large size. A similar result holds for ECB policies, although the difference in risk-taking between small and large funds is more modest.

Monetary policies by both the Fed and the ECB also affect funds that employ active investment strategies more strongly than those following passive strategies. Again, however, the effects of Fed policy are larger than those of the ECB. Importantly, this finding suggests that our results are not driven mechanically by rating changes in passive funds, as would be the case if the results reflected index-linked rebalancing around downgrades or upgrades.

Finally, some differences emerge across leveraged and non-leveraged funds. In particular, Fed shadow rate changes affect both leveraged and non-leveraged funds, whereas ECB monetary policy effects are concentrated in leveraged funds, where the impact is stronger.

[Insert Table 5 here]

6 Conclusions

We examine the effects of monetary policy on bond funds' risk taking using security-level portfolio data from 2018:Q4 to 2023:Q4. Our main variable measures the risk score of each fund's bond portfolio. Our findings provide clear evidence of a market-based risk-taking channel of monetary policy transmission. Monetary easing leads bond funds to increase the risk of their portfolios, with the effect being stronger for longer-maturity holdings. This term-structure pattern suggests that monetary policy does not affect risk-taking uniformly across the maturity structure but instead amplifies duration risk in financial markets. Quantitatively, we find that the Fed's monetary easing between 2020:Q1 and 2021:Q3 lowered the median rating of bond funds by about 0.45 of a notch, with the effect rising to about 0.6 of a notch for longer-term portfolios. ECB policies also increas risk taking, but to a much weaker degree.

Three policy implications follow from these findings. First, the stronger cross-border transmission of Fed shocks compared to ECB shocks reflects the structural composition of euro-area bond funds. With safe assetsscarce and domestic safe assets are in relative short supply, these funds hold a higher proportion of US securities, making their portfolios more directly exposed to US monetary policy. This underscores the global dominance of US monetary policy and highlights the vulnerability of euro-area financial markets to external shocks. In this regard, the increase in the supply of European safe assets could strengthen the transmission of ECB monetary policy through bond funds.

Second, the finding that expansionary monetary policy induces greater risk-taking among funds with longer-maturity holdings is consistent with portfolio rebalancing toward higher-yielding corporate bonds, which tend to carry greater credit risk. The duration channel thus amplifies the risk-taking effect, suggesting that monitoring maturity structures is crucial for macroprudential oversight.

Finally, the finding that for longer-term bond positions, the risk-taking channel is more pronounced for unconventional monetary policies than for interest-rate policies reflects two mechanisms: (i) asset purchases directly affect bond funds through portfolio rebalancing, intensifying the hunt-for-yield effect; and (ii) unconventional measures typically occur in low-rate environments, which further encourage risk-taking. Together, these dynamics imply that unconventional monetary policy has disproportionate effects on non-bank financial intermediaries.

In sum, our evidence shows that monetary policy affects risk-taking not only through traditional banking channels but also via investment funds, which are now central actors in global financial markets. Policymakers must therefore broaden their monitoring frameworks to include the behavior of bond funds, weigh the trade-offs between accommodation and financial stability, and recognize the asymmetric global influence of US monetary policy.

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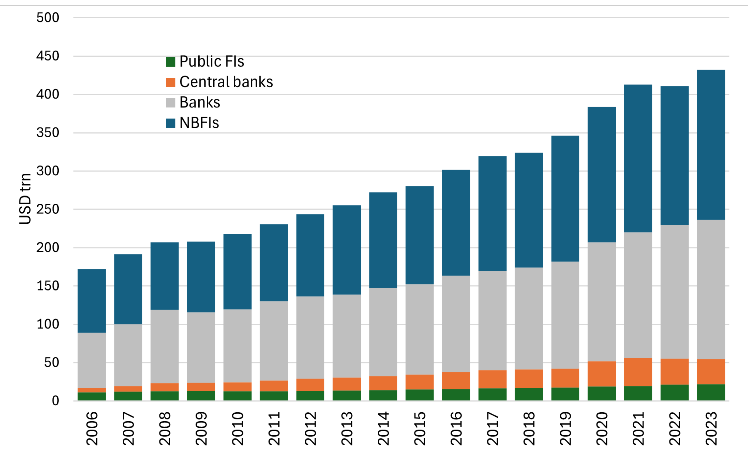
Figures and Tables

Figure 1 Global financial assets: Holdings by NBFIs and other sectors

The figure shows the total value of financial assets across G20 countries from 2006 to 2023, in trillion USD. Panel A presents the breakdown of asset holdings by sector – Non-bank financial intermediaries (NBFIs), banks, central banks and public financial institutions. Panel B provides a detailed breakdown of the NBFI sector's total assets to entities according to the Financial Stability Board classification into five functions: (a) investment funds (bond funds, equity funds, mixed funds, money market funds etc), (b) entities providing loans that depend on short-term funding, (c) entities intermediating in financial markets (e.g. broker-dealer), (d) entities facilitating credit creation and (e) entities intermediating in securitization transactions. The data source is the Financial Stability Board.

Panel A: Total value of financial assets per holding sector



Panel B: Breakdown of the NBFI sector per total asset value

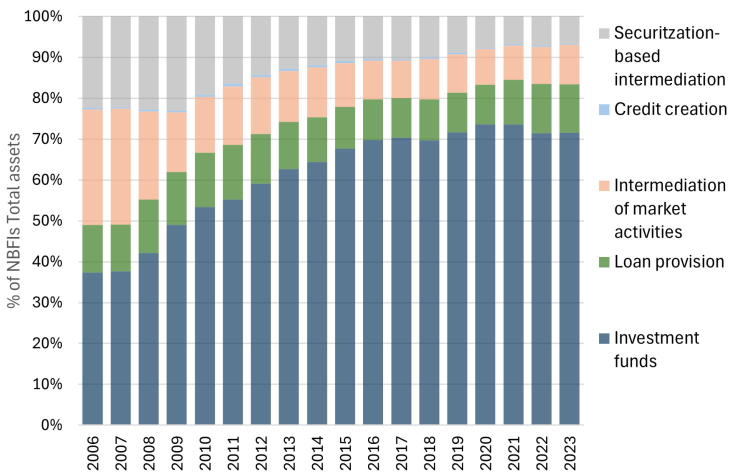


Figure 2 Active versus passive funds by domicile

The figure presents the distribution of funds by domicile and portfolio management style – active versus passive – based on Lipper classification at the end of the sample period (2023:Q4). The left panel shows the number of US and euro-area domiciled funds categorized as active (grey) or passive (blue). The right panel shows the corresponding aggregate fund asset value (AFV), in trillion USD.

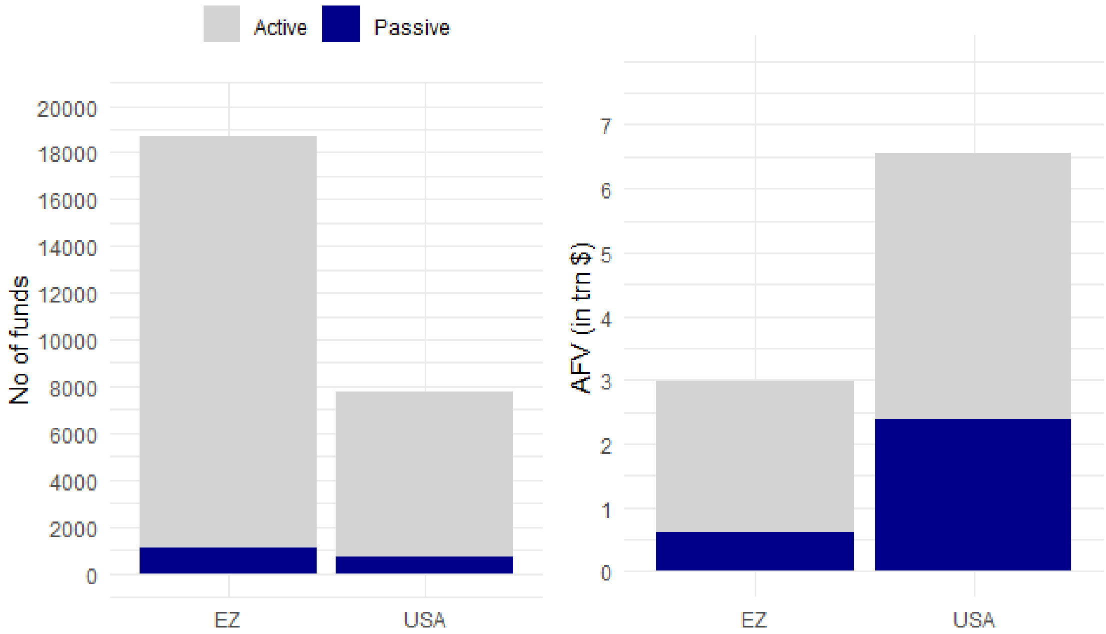


Figure 3 Dataset coverage relative to global bond-fund market

The figure shows the USD market value of US and euro-area domiciled funds that invest primarily in fixed-income securities, expressed as a percentage of the global market capitalization of regulated open-end bond funds. Data are reported by the International Investment Funds Association (IIFA).

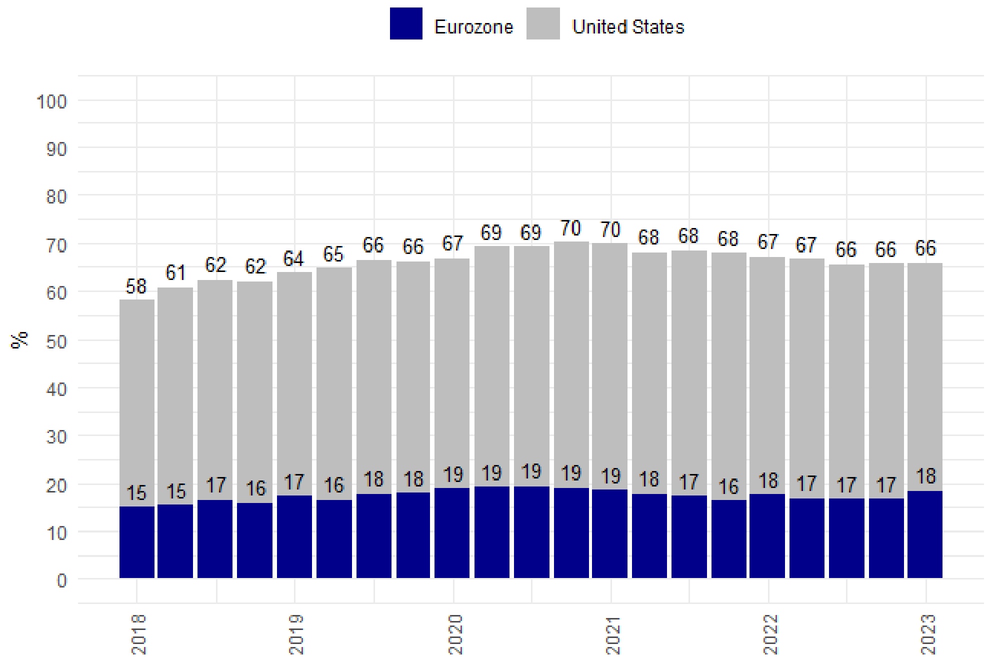
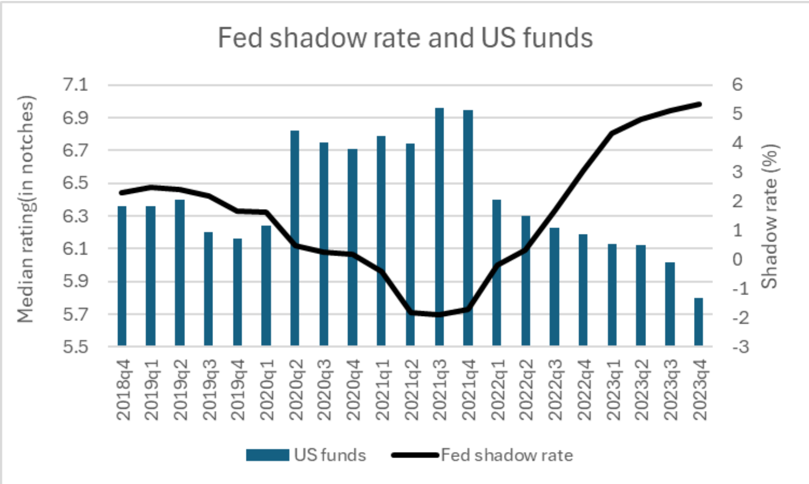


Figure 4 Funds' risk taking and shadow rates

Panel A shows the median weighted-average credit rating $w_{j,t}^{c}$ of US bond funds (blue bars) alongside the Fed shadow rate (black line) from Wu & Xia (2016). Panel B presents the same for euro-area bond funds (orange bars) and the ECB shadow rate. The sample period is 2018:Q1 to 2023:Q4.

Panel A



Panel B

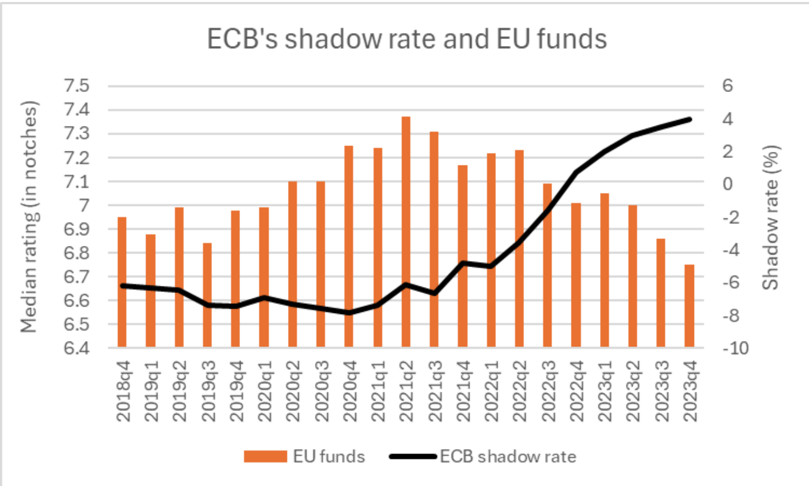


Figure 5 Risk-taking across monetary policy phases

The figure shows kernel density estimates of the weighted average credit rating ($w^c_{j,t+1}$) for US and euro-area bond funds across periods of monetary easing (blue line) and tightening (red line), based on Fed policy actions. Rightward shifts in the density indicate higher values of $w^c_{j,t+1}$, corresponding to increased portfolio risk.

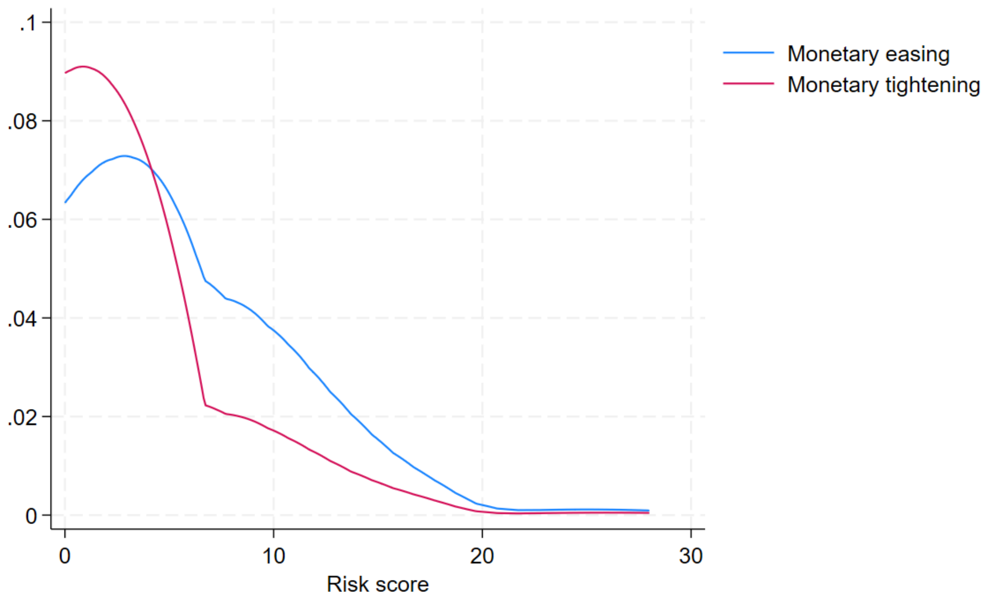
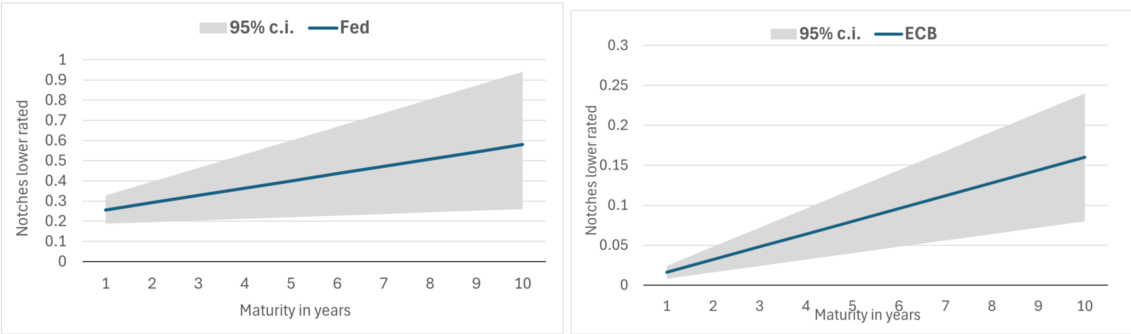


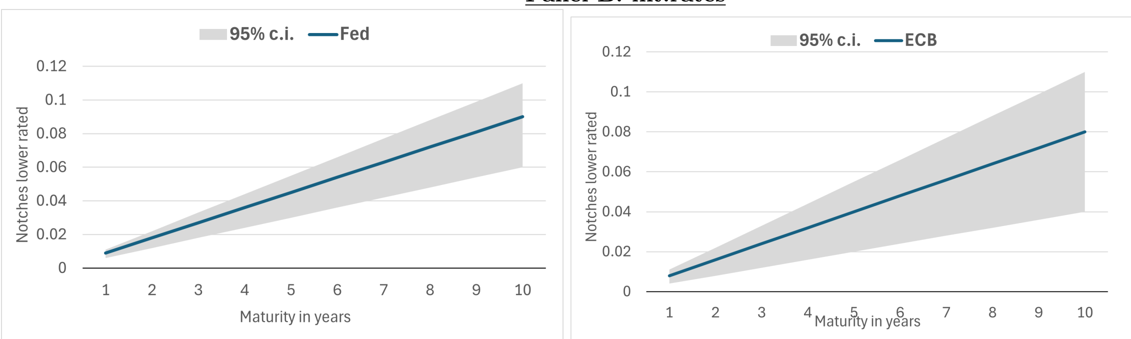
Figure 6 Effects of monetary policy on bond fund risk-taking

The figure shows the estimated effects of monetary easing by the Federal Reserve (left panels) and the ECB (right panels) on the weighted average credit rating of bond fund portfolios, based on IV estimates from Table 3. Blue lines represent point estimates; shaded areas indicate 95% confidence intervals. Panel A uses shadow rates, Panel B uses effective Fed funds rate (EFFR) and deposit facility rate (DFR) for the ECB, and Panel C captures unconventional monetary policy (UMP)

Panel A: sh.rates



Panel B: int.rates



Panel C: UMP

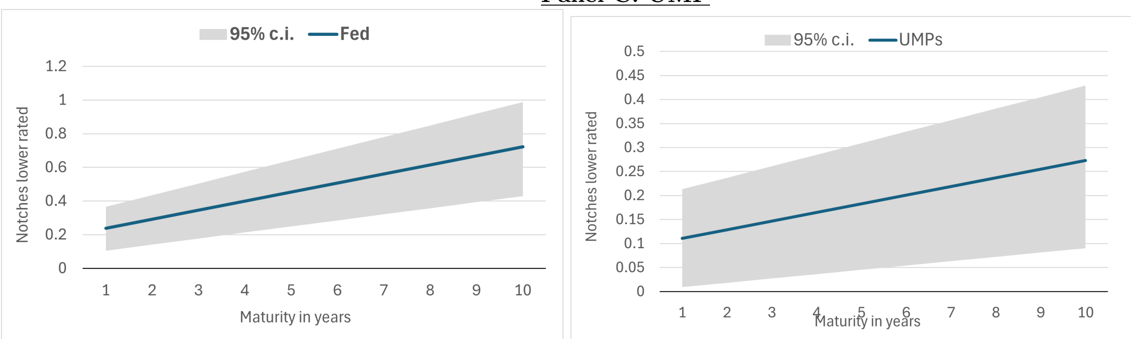


Table 1 Transformation of credit ratings to risk scores

The table maps alphanumeric credit ratings from S&P, Fitch, and Moody's into numerical values used to construct the variable $c_{i,t}$, which captures the credit risk of each bond at time t. Rating transitions are reflected as changes in $c_{i,t}$ relative to $c_{i,t-1}$.

Rating	$c_{i,t}$	**Rating**	$c_{i,t}$
AAA/Aaa	1	BB+/Ba1	11
AA+/Aa1	2	BB/Ba2	12
AA/Aa2	3	BB-/Ba3	13
AA-/Aa3	4	B+/B1	14
A+/A1	5	B/B2	15
A/A2	6	B-/B3	16
A-/A3	7	CCC+/Caa1	17
BBB+/Baa1	8	CCC/Caa2	18
BBB/Baa2	9	CCC-/Caa3	19
BBB-/Baa3	10	CC/Ca	20
		C	21
		Lower/NR	22

Table 2 Fixed-effects estimates of monetary policy effects on bond fund risk-taking

The table reports coefficient estimates and robust standard errors (in parentheses) for the estimated effects of monetary policy on the risk level of bond fund portfolios domiciled in US and the euro area. The dependent variable is the weighted average credit rating ($w^c_{j,t}$) of fund j's portfolio at time t. In all specification we include fund fixed effects. Columns (1), (3), (5) and (7) include macroeconomic controls (lagged inflation π_{t-1} and lagged growth g_{t-1}) and a covid dummy (2020:Q1–2020:Q3). Columns (2), (4), (6) and (8) include time fixed effects. Monetary policy is captured in (1)-(2) by Jarociński & Karadi (2020) shocks (*JK MP*), in (3)-(4) by Wu & Xia (2016) shadow rates (*sh. rate*), in (5)-(6) by effective policy rates (*int.rate*) and in (7)-(8) by the difference between shadow and effective rates (*UMP*). Panel A reports results for the US Federal Reserve monetary policy and Panel B for the European Central Bank. Standard errors are clustered at the fund level. Asterisks (***, **, and *) denote statistical significance (at the 1%, 5%, and 10% levels, respectively).

Panel A: Federal Reserve

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
JK MP	0.620**							
	(0.256)							
JK MP× *Maturity*	-0.227***	-0.205***						
	(0.033)	(0.029)						
sh.rate			-0.052***					
			(0.021)					
sh.rate× *Maturity*			-0.013***	-0.018***				
			(0.002)	(0.002)				
int.rate					-0.010***			
					(0.010)			
int.rate× *Maturity*					-0.008***	-0.008***		
					(0.001)	(0.001)		
UMP							-0.134***	
							(0.010)	
UMP× *Maturity*							-0.049***	-0.054***
							(0.002)	(0.018)
π_{t-1}	-0.035***		-0.013***		-0.019***		-0.024***	
	(0.005)		(0.004)		(0.004)		(0.005)	
g_{t-1}	0.002***		-0.001***		$7.42\times10^{-4**}$		0.001***	
	(3.42×10^{-4})		(3.29×10^{-4})		(3.26×10^{-4})		(3.49×10^{-4})	
Maturity	-0.033***	-0.033***	-0.038***	-0.037***	-0.018**	-0.016**	-0.043***	-0.043***
	(0.008)	(0.007)	(0.008)	(0.007)	(0.008)	(0.008)	(0.008)	(0.009)
Gvt bonds	-0.018***	-0.021***	-0.019***	-0.021***	-0.019***	-0.021***	-0.023***	-0.025***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Corp-Fin	0.020***	0.018***	0.019***	0.017***	0.019***	0.017***	0.017***	0.015**
	(0.006)	(0.005)	(0.006)	(0.005)	(0.006)	(0.005)	(0.006)	(0.005)
Corp-NFC	0.067***	0.058***	0.063***	0.059***	0.064***	0.059***	0.059***	0.053***
	(0.005)	(0.004)	(0.005)	(0.004)	(0.005)	(0.004)	(0.005)	(0.005)
Cash	0.032***	0.026***	0.029**	0.026***	0.029***	0.026***	0.026***	0.021***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Returns	-0.005	-0.016*	-0.016	-0.015*	-0.013	-0.017*	-0.025**	-0.030***
	(0.009)	(0.009)	(0.013)	(0.009)	(0.012)	(0.009)	(0.010)	(0.008)
Returns_{t-1}	0.004	-0.003	-0.009	-0.004	-0.009	-0.006	-0.017***	-0.020***
	(0.006)	(0.005)	(0.006)	(0.005)	(0.006)	(0.006)	(0.005)	(0.008)
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	No	Yes	No	Yes	No	Yes
Covid dummy	Yes	No	Yes	No	Yes	No	Yes	No
Clustered s.e.	Fund	Fund	Fund	Fund	Fund	Fund	Fund	Fund
N	5,084	5,084	5,084	5,084	5,084	5,084	5,084	5,084
Obs.	82,214	82,214	82,214	82,214	82,214	82,214	82,214	82,214
Adj. R-squared	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89

Panel B: European Central Bank

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
JK MP	0.789***							
	(0.168)							
JK MP× *Maturity*	-0.088***	-0.088***						
	(0.019)	(0.019)						
sh.rate			0.001					
			(0.007)					
sh.rate× *Maturity*			-0.004***	-0.004***				
			(7.71×10^{-4})	(7.44×10^{-4})				
int.rate					0.033**			
					(0.015)			
int.rate× *Maturity*					-0.008***	-0.009***		
					(0.002)	(0.002)		
UMP							2.92×10^{-4}	
							(0.009)	
UMP× *Maturity*							-0.006***	-0.006***
							(0.001)	(0.001)
π_{t-1}	-0.057***		-0.019***		-0.019***		-0.024***	
	(0.005)		(0.005)		(0.004)		(0.005)	
g_{t-1}	0.006***		0.004***		7.42×10^{-4}**		0.001***	
	(0.001)		(0.001)		(3.26×10^{-4})		(3.49×10^{-4})	
Maturity	-0.035***	-0.034***	-0.047***	-0.437***	-0.030***	-0.029***	-0.056***	-0.056***
	(0.008)	(0.007)	(0.008)	(0.007)	(0.008)	(0.007)	(0.008)	(0.008)
Gvt bonds	-0.018***	-0.020***	-0.019***	-0.021***	-0.019***	-0.021***	-0.019***	-0.021***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Corp-Fin	0.020***	0.018***	0.019***	0.017***	0.019***	0.017***	0.019***	0.017**
	(0.006)	(0.005)	(0.006)	(0.005)	(0.006)	(0.005)	(0.006)	(0.005)
Corp-NFC	0.065***	0.058***	0.064***	0.059***	0.064***	0.059***	0.064***	0.059***
	(0.005)	(0.004)	(0.005)	(0.004)	(0.005)	(0.004)	(0.005)	(0.004)
Cash	0.030***	0.026***	0.029**	0.026***	0.029***	0.026***	0.029***	0.026***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Returns	-0.012	-0.015*	-0.018	-0.015*	-0.015	-0.017*	-0.018	-0.018*
	(0.011)	(0.009)	(0.013)	(0.009)	(0.012)	(0.009)	(0.014)	(0.010)
Returns_{t-1}	-0.008	-0.004	-0.010	-0.004	-0.009	-0.005	-0.010	-0.005
	(0.005)	(0.005)	(0.006)	(0.005)	(0.006)	(0.006)	(0.006)	(0.005)
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	No	Yes	No	Yes	No	Yes
Covid dummy	Yes	No	Yes	No	Yes	No	Yes	No
Clustered s.e.	Fund	Fund	Fund	Fund	Fund	Fund	Fund	Fund
N	5,084	5,084	5,084	5,084	5,084	5,084	5,084	5,084
Obs.	82,214	82,214	82,214	82,214	82,214	82,214	82,214	82,214
Adj. R-squared	0.88	0.89	0.89	0.89	0.89	0.88	0.89	0.89

Table 3 Instrumental variables model

The table reports coefficient estimates and robust standard errors (in parentheses) from two-stage least-squares instrumental-variables (2SLS IV) regressions for the estimated effects of monetary policy on the risk level of bond fund portfolios domiciled in the US and the euro area. The dependent variable is the weighted average credit rating ($w^c_{j,t}$) of fund j's portfolio at time t. In all specifications we include fund fixed effects. Columns with macro controls include lagged inflation (π_{t-1}), lagged growth (g_{t-1}), and a COVID dummy (2020:Q1–2020:Q3), while adjacent columns include time fixed effects. Monetary policy is captured by Wu & Xia (2016) shadow rates ($sh.rate$), effective policy rates ($int.rate$), and the difference between shadow and effective rates (UMP), each instrumented with Jarociński & Karadi (2020) pure monetary policy shocks. Panel A reports results for the US Federal Reserve and Panel B for the European Central Bank. At the bottom of each panel, we report under-identification (Kleibergen–Paap X^2), weak-identification (Kleibergen–Paap F-statistic), and Hansen J-test statistics. Asterisks (***, **, and *) denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Federal Reserve

First stage

	sh.rate	sh.rate×$Mat.$	sh.rate×$Mat.$	int.rate	int.rate×$Mat.$	int.rate×$Mat.$	UMP	UMP×$Mat.$	UMP×$Mat.$
JK MP	1.834***	-1.878***		-0.223***	-35.039***	-	2.405***	-2.098	
	(0.013)	(0.291)		(0.016)	(0.635)		(0.012)	(0.283)	
JK MP×$Maturity$	-0.003***	2.588***	2.651***	4.13×10^{-4}	2.909*	3.909*	-0.003***	2.622***	2.651*
	(0.001)	(0.039)	(0.033)	(2.98×10^{-4})	(2.069)	(2.069)	(0.001)	(0.038)	(1.436)
sh.rate$_{t-1}$	0.977***	0.171***							
	(1.65×10^{-4})	(0.005)							
sh.rate$_{t-1}\times Maturity$	-0.002***	0.724***	0.764***						
	(5.99×10^{-5})	(0.003)	(0.004)						
int.rate$_{t-1}$				0.990***	-0.004				
				(5.97×10^{-4})	(0.053)				
int.rate$_{t-1}\times Maturity$				7.03×10^{-5}	0.993***	0.992***			
				(4.96×10^{-5})	(0.006)	(0.039)			
UMP$_{t-1}$							0.786***	-0.277***	
							(6.65×10^{-4})	(0.034)	
UMP$_{t-1}\times Maturity$							-1.36×10^{-5}	0.764***	0.764***
							(1.36×10^{-4})	(0.004)	(0.128)

Second stage

	sh.rate	sh.rate	int.rate	int.rate	UMP	UMP
sh.rate	-0.055***					
	(0.005)					
sh.rate×$Maturity$	-0.013***	-0.018***				
	(0.002)	(0.003)				
int.rate			-0.011			
			(0.009)			
int.rate×$Maturity$			-0.009***	-0.009***		
			(0.001)	(0.002)		
UMP					-0.061***	
					(0.019)	
UMP×$Maturity$					-0.018***	-0.018**
					(0.003)	(0.007)
Fixed effects and macro controls						
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	No	Yes	No	Yes
π_{t-1}	Yes	No	Yes	No	Yes	No
g_{t-1}	Yes	No	Yes	No	Yes	No
Covid dummy	Yes	Yes	Yes	Yes	Yes	Yes
Fund and fund-asset controls						
Maturity	Yes	Yes	Yes	Yes	Yes	Yes
Gvt bonds	Yes	Yes	Yes	Yes	Yes	Yes
Corp-Fin	Yes	Yes	Yes	Yes	Yes	Yes
Corp-NFC	Yes	Yes	Yes	Yes	Yes	Yes
Cash	Yes	Yes	Yes	Yes	Yes	Yes
Returns	Yes	Yes	Yes	Yes	Yes	Yes
Returns(t-1)	Yes	Yes	Yes	Yes	Yes	Yes
Clustered s.e.	Fund	Fund	Fund	Fund	Fund	Fund
N	5,084	5,084	5,084	5,084	5,084	5,084
Obs.	82,214	82,214	82,214	82,214	82,214	82,214
Adj. R^2	0.075	0.056	0.074	0.057	0.072	0.056
$X^2 stat$	3,038.41	35,661	606.10	603.54	471.63	496.53
F-stat	50,141	62,054	10,182.1	2,043.3	1,813.4	6,204.1
J-stat	103.29	-	168.23	-	72.63	-

Panel B: European Central Bank

First stage

	sh.rate	sh.rate×$Mat.$	sh.rate×$Mat.$	int.rate	int.rate×$Mat.$	int.rate×$Mat.$	UMP	UMP×$Mat.$	UMP×$Mat.$
JK MP	-1.491***	-20.799***		0.706***	-10.779***		2.405***	-14.114***	
	(0.031)	(2.695)		(0.009)	(0.392)		(2.511)	(0.032)	
JK MP×$Maturity$	0.007**	1.037	2.651***	-7.51×10^{-4}	1.913***	1.918	0.008***	0.072	-0.005
	(0.003)	(4.811)	(0.033)	(6.94×10^{-4})	(0.047)	(2.263)	(0.003)	(0.296)	(4.759)
sh.rate$_{t-1}$	0.797***	-1.687***							
	(0.001)	(0.092)							
sh.rate$_{t-1}$ × $Maturity$	-1.40×10−5	0.994***	0.994***						
	(3.7×10^{-5})	(0.011)	(0.043)						
int.rate$_{t-1}$				0.986***	1.306***				
				(3.14×10^{-4})	(0.037)				
int.rate$_{t-1}$×$Maturity$				-1.29×10^{-5}	1.139***	1.139***			
				(1.99×10^{-5})	(0.004)	(0.076)			
UMP$_{t-1}$							0.467***	-3.562***	
							(0.002)	(0.132)	
UMP$_{t-1}$ × $Maturity$							6.83×10^{-6}	0.882***	0.882***
							(5.76×10^{-5})	(0.014)	(0.056)

Second stage

	sh.rate	sh.rate	int.rate	int.rate	UMP	UMP
sh.rate	-0.001					
	(0.008)					
sh.rate×$Maturity$	-0.004***	-0.004***				
	(0.001)	(0.001)				
int.rate			0.020			
			(0.014)			
int.rate×$Maturity$			-0.008***	-0.008***		
			(0.002)	(0.002)		
UMP					-0.031**	
					(0.014)	
UMP×$Maturity$					-0.006***	-0.006***
					(0.001)	(0.001)
Fixed effects and macro controls						
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	No	Yes	No	Yes
π_{t-1}	Yes	No	Yes	No	Yes	No
g_{t-1}	Yes	No	Yes	No	Yes	No
Covid dummy	Yes	Yes	Yes	Yes	Yes	Yes
Fund and fund-asset controls						
Maturity	Yes	Yes	Yes	Yes	Yes	Yes
Gvt bonds	Yes	Yes	Yes	Yes	Yes	Yes
Corp-Fin	Yes	Yes	Yes	Yes	Yes	Yes
Corp-NFC	Yes	Yes	Yes	Yes	Yes	Yes
Cash	Yes	Yes	Yes	Yes	Yes	Yes
Returns	Yes	Yes	Yes	Yes	Yes	Yes
Returns(t-1)	Yes	Yes	Yes	Yes	Yes	Yes
Clustered s.e.	Fund	Fund	Fund	Fund	Fund	Fund
N	5,084	5,084	5,084	5,084	5,084	5,084
Obs.	82,214	82,214	82,214	82,214	82,214	82,214
Adj. R^2	0.075	0.058	0.073	0.056	0.075	0.058
$X^2 stat$	4,352.86	641.63	629.57	624.38	4,200.91	638.59
F-stat	50,141	3,189.6	2,345.6	6,503.5	2,404.1	1,409.3
J-stat	6.811	-	168.23	-	0.322	-

Table 4 Dynamic panel data model

The table reports coefficient estimates and robust standard errors (in parentheses) from dynamic panel GMM regressions for the estimated effects of monetary policy on the risk level of bond fund portfolios domiciled in the US and the euro area. The dependent variable is the weighted average credit rating ($w^c_{j,t}$) of fund j's portfolio at time t. Arellano–Bond estimators are employed, which include the dependent variable up to three lags and lags of the policy rates. Monetary-policy effects are captured in column (1) by Wu & Xia (2016) shadow rates (*sh.rate*), in (2) by effective policy rates (*int.rate*), and in (3) by the difference between shadow and effective rates (*UMP*). Panel A reports results for the US Federal Reserve and Panel B for the European Central Bank. Asterisks (***, **, and *) denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Federal Reserve

	sh.rate (1)	int. rate (2)	UMP (3)
$w^c_{j,t-1}$	0.528***	0.544***	0.537***
	(0.031)	(0.031)	(0.029)
sh.rate	-0.011***		
	(0.005)		
sh.rate×*Maturity*	-0.007***		
	(0.001)		
int.rate		-0.006	
		(0.006)	
int.rate×*Maturity*		-0.002**	
		(0.001)	
UMP			-0.050***
			(0.009)
UMP×*Maturity*			-0.024***
			(0.003)
Setup characteristics			
AB IV	Yes	Yes	Yes
Policy inertia IV	Yes	Yes	Yes
Maturity	Yes	Yes	Yes
Gvt bonds	Yes	Yes	Yes
Corp-Fin	Yes	Yes	Yes
Corp-NFC	Yes	Yes	Yes
Cash	Yes	Yes	Yes
Returns	Yes	Yes	Yes
Returns(t-1)	Yes	Yes	Yes
Covid dummy	Yes	Yes	Yes
π_{t-1}	Yes	Yes	Yes
g_{t-1}	Yes	Yes	Yes
Robust s.e.	Yes	Yes	Yes
N	5,084	5,084	5,084
Obs.	82,214	82,214	82,214

Panel B: European Central Bank

	sh.rate (1)	int. rate (2)	UMP (3)
$w^c_{j,t-1}$	0.528***	0.544***	0.537***
	(0.031)	(0.031)	(0.029)
sh.rate	0.010*		
	(0.006)		
sh.rate×*Maturity*	-0.001**		
	(4.21×10^{-4})		
int.rate		0.011	
		(0.008)	
int.rate×*Maturity*		2.41×10^{-4}	
		(0.001)	
UMP			0.009
			(0.007)
UMP×*Maturity*			-0.003***
			(6.36×10^{-4})
Setup characteristics			
AB IV	Yes	Yes	Yes
Policy inertia IV	Yes	Yes	Yes
Maturity	Yes	Yes	Yes
Gvt bonds	Yes	Yes	Yes
Corp-Fin	Yes	Yes	Yes
Corp-NFC	Yes	Yes	Yes
Cash	Yes	Yes	Yes
Returns	Yes	Yes	Yes
Returns(t-1)	Yes	Yes	Yes
Covid dummy	Yes	Yes	Yes
π_{t-1}	Yes	Yes	Yes
g_{t-1}	Yes	Yes	Yes
Robust s.e.	Yes	Yes	Yes
N	5,084	5,084	5,084
Obs.	82,214	82,214	82,214

Table 5 Bond funds' heterogeneity

The table reports coefficient estimates and robust standard errors (in parentheses) from two-stage least squares instrumental-variable (2SLS IV) regressions examining the heterogeneity of monetary-policy effects on bond-fund risk-taking. The dependent variable is the weighted-average credit rating ($w^c_{j,t}$) of fund j's portfolio at time t. All specifications include fund fixed effects, macroeconomic controls (lagged inflation π_{t-1} and lagged growth g_{t-1}), and a Covid dummy. Monetary-policy variables include Wu & Xia (2016) shadow rates (*sh.rate*), effective policy rates (*int.rate*), and the difference between shadow and effective rates (*UMP*), instrumented with Jarociński & Karadi (2020) monetary-policy shocks. PanelA reports results for the Federal Reserve and PanelB for the European Central Bank. Within each panel, funds are grouped by domicile, size, investment strategy, leverage status, and investor type. Asterisks (***, **, and *) denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Federal Reserve

	Domicile		Size			Strategy		Leveraged		Institutional	
	US	Euro-area	Smallest	Medium	Largest	Active	Passive	Yes	No	Yes	No
sh.rate	-0.081***	-0.043**	-0.077***	-0.057***	-0.051***	-0.065***	-0.011**	-0.054***	-0.054***	-0.052***	-0.059***
	(0.009)	(0.005)	(0.017)	(0.007)	(0.012)	(0.006)	(0.005)	(0.005)	(0.025)	(0.006)	(0.011)
sh.rate×Maturity	-0.014***	0.001	-0.027***	-0.011***	-0.008***	-0.014***	-0.001	-0.012***	-0.013***	-0.016***	-0.005
	(0.003)	(0.002)	(0.006)	(0.003)	(0.002)	(0.002)	(0.001)	(0.002)	(0.006)	(0.003)	(0.003)
IV: MP shocks	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
IV: sh.rate$_{t-1}$	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clustered s.e.	Fund	Fund	Fund	Fund	Fund	Fund	Fund	Fund	Fund	Fund	Fund
Fund-asset controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fund controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Covid dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
π_{t-1}	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
g_{t-1}	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	2,734	2,341	1,587	4,317	642	4,322	753	486	4961	1,406	3,669
Obs.	46,015	35,821	15,087	47,907	18,605	69,453	12,383	3,947	77,657	21,710	60,126
Adj. R-squared	0.079	0.122	0.083	0.069	0.122	0.077	0.296	0.108	0.077	0.149	0.065

Panel B: European Central Bank

	Domicile		Size			Strategy		Leveraged		Institutional	
	US	Euro-area	Smallest	Medium	Largest	Active	Passive	Yes	No	Yes	No
sh.rate	0.013	-0.037***	0.031	0.002	-0.021**	0.001	-0.011**	-0.003	0.024	-0.026***	0.012
	(0.011)	(0.007)	(0.019)	(0.011)	(0.010)	(0.009)	(0.006)	(0.008)	(0.029)	(0.009)	(0.010)
sh.rate×Maturity	-0.005***	4.09×10^{-4}	-0.006***	-0.004***	-0.002**	-0.004***	-4.55×10^{-4}	-0.003***	-0.002*	-0.001	-0.005***
	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(3.84×10^{-4})	(0.001)	(0.001)	(0.003)	(0.001)
IV: MP shocks	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
IV: sh.rate$_{t-1}$	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clustered s.e.	Fund	Fund	Fund	Fund	Fund	Fund	Fund	Fund	Fund	Fund	Fund
Fund-asset controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fund controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Covid dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
π_{t-1}	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
g_{t-1}	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	2,734	2,341	1,587	4,317	642	4,322	753	486	4961	1,406	3,669
Obs.	46,015	35,821	15,087	47,907	18,605	69,453	12,383	3,947	77,657	21,710	60,126
Adj. R-squared	0.081	0.122	0.083	0.071	0.116	0.077	0.296	0.099	0.078	0.144	0.065

Appendix

The micro-data

Our dataset spans the period from 2018:Q1 to 2023:Q4 and comprises primary investment funds that mainly invest in debt securities; henceforth '*bond funds*', in respect to the definitions of the International Investment Funds Association. [11] We exclude mixed, equity and alternative investments funds from our sample. The source of the fund-level data is Lipper for Investment Management and consists of investment fund characteristics at the fund-level including Net Asset Value (NAV), fund type, investment focus, and other features detailed in Table A1.

Table A1 Fund-level variables

Variable	Description
Lipper ID	Unique code provided by Lipper to identify a specific investment fund.
Name	Full name of the investment fund.
Fund Management Company	The name of the company responsible for managing all legal and financial aspects of the fund, including appointing the advisor, administrator, custodian, and other support companies. The fund management company is also responsible for managing the assets of the fund if no investment advisor is appointed.
Parent Company Name	The name of the ultimate parent company that has the day-to-day responsibility for investing and monitoring the fund's portfolio to meet its investment objectives.
Launch Date	Date the fund was launched.
Closed Date	Date the fund was reported as merged or liquidated.
Closed	Classification variable indicating whether the fund is closed.
Successor	Name of the surviving fund in merger.
Domicile	Jurisdiction in which the fund is legally incorporated.
Asset Type	Primary asset class: Bond, Currency/Money Market, Equity, Mixed/Multi Asset, Real Estate, or Other.
Fund Type	Broad characteristic that is hierarchically above *Asset Type* to categorize the fund, such as Mutual Fund, Exchange Traded Fund, Close-End Fund, Pension Fund, Insurance Fund or Hedge Fund.
Fund Status	Current status: Active, Liquidated, or Merged.
Aggregate Fund Value	Market value net of liabilities (in million $), aggregated across all share classes of the specific fund.

Continued on next page

[11] According to Lipper's classification, a primary fund refers to the main or representative share class of an investment fund, serving as the benchmark for its performance and characteristics. This differs from other share classes within the same fund, which may vary in fees, minimum investment requirements, or target investor groups, even though sharing identical underlying holdings and management.

Table A1 – Continued

Variable	Description
Index Tracking	Flag indicating whether the fund replicates a specific index, useful to identify passive vs. active investment strategies.
Fund of Funds	Flag indicating whether the fund invests in other mutual funds.
Exchange Traded Fund	Flag indicating whether the fund tracks the growth of a stock exchange index, usually an index of bonds or ordinary shares.
Government Bond	Flag indicating investment in government-issued bonds.
Corporate Bond	Flag indicating investment in bonds issued by a public company.

The fund-level database comprises approximately 76,886 bond-focused primary investment funds, spanning all types of investment funds provided by Lipper, including mutual funds, insurance funds, pension funds, investment trusts, hedge funds, Exchange Traded Funds (ETF), and closed-end funds. These funds represent an aggregate fund value (AFV) of $14.3 trillion as of Q4 2023.[12] Of this total, 21% are funds domiciled in the euro-area, while 46% are domiciled in the US.

A1 Description of the asset-level fund data

Our filtering process begins with the fund-level database, focusing on fixed income-oriented funds domiciled in the US as well as bond funds domiciled in the euro area with an aggregate fund value (AFV) exceeding $250 million. Euro area bond funds with AFV below this threshold represent a very small share of the total AFV of euro area funds, ranging between $156 and $207 billion during the period of interest – approximately 6%-7% of the total market value of euro area domiciled bond funds. Next, we exclude fund-of-funds to avoid double-counting of asset holdings. Then, we proceed identifying those funds' holdings by employing the asset-level database from Lipper for Investment Management. A detailed overview of the fund asset-level variables employed in this study is presented in Table A2 below.

[12]Aggregate Fund Value (AFV) refers to a fund's total market value net of liabilities at any historical date. A "fund" is defined as the entity through which investments are made via independently defined share classes. A fund may be sold through one or multiple share classes. On the other hand, Total Net Assets (TNA) represents the total funds under management, net of fees and expenses, for a specific fund share class.

Table A2 Asset-level variables

Variable	Description
Lipper ID	Unique fund identification code assigned by Lipper.
Date	Reporting date of the asset holding.
Currency	Base currency of the fund.
Current Weight	Proportion of the fund allocated to the specific asset.
ISIN	International Securities Identification Number.
CUSIP	Committee on Uniform Securities Identification Procedures code.
RIC	Reuters Instrument Code.
SEDOL	Stock Exchange Daily Official List identifier.
Market Value Held	Market value of the asset held, in \$.
Number of Shares	Number of shares for equities and face value in local currency times units for fixed income securities.

Figure 3 depicts the market value share of the funds covered by the asset-level database relative to the global market value of regulated open-end bond funds reported by the International Investment Fund Association (IIFA)[13] (see International Investment Funds Association (2024) link). Our dataset covers 60%-70% of the global bond fund market value for the period 2018-2023, accounting for over \$8.8 trillion of bond fund holdings out of a total of \$12.9 trillion as of 2023:Q4.[14]

A2 Fixed income securities database

From the asset-level fund holdings, we identify the unique security identifiers for all securities held by the funds in our sample over the period 2018-2023. We next construct a security-level database containing detailed characteristics of each instrument, along with historical credit ratings and foreign exchange rates. This database, compiled using data from LSEG, comprises information on each security's ultimate parent characteristics of the issuer, instrument type and classification, sectoral characteristics of the issuer, denomination value, issue and maturity date, rating history[15], pricing currency and its exchange rate against the US dollar. A detailed description of the asset variables used for the securities database is provided in Table A3

[13]Regulated open-end funds include mutual funds, exchange-traded funds, and institutional funds. Fund-of-funds are excluded from this classification.

[14]Bond funds represented 19% of the total worldwide regulated open-end fund assets as of 2023:Q4.

[15]We collect historical issuer long term credit ratings from S&P, Moodys, Fitch and DBRS.

Table A3 Variables for the securities database

Variable	Description
Instrument ID	Instrument identifier reported by the investment fund to Lipper.
Instrument Description	Security common name.
Country of Risk	Country where the issuer's majority of revenues, pricing currency, primary exchange, and company's or ultimate parent's headquarters are located.
Parent Name	Name of the ultimate parent company of the issuer.
Parent ID	Ten-digit identification code for the ultimate parent.
Parent Economic Sector	Refinitiv classification of the ultimate parent's economic sector.
Parent NAICS Sector	North America Industry Classification Sector of the ultimate parent.
Asset Category	Classification among 94 asset categories (e.g. bond, CLO, MBS, warrant etc).
Asset Type	Qualitative classification: Government, Supranational or Corporate.
Asset SubType	Qualitative classification: Domestic, Foreign, Eurobond and Global.
Issuer Economic Sector	Refinitiv classification of the issuer's economic sector.
Issuer NAICS Sector	North America Industry Classification Sector of the issuer.
Issuer Date	Date of security issuance.
Maturity Date	Date the fixed income security matures.
Currency	Pricing currency of the security.

Source: LSEG.

A3 Data cleaning

A3.1 First-pass data cleaning

We begin by merging the asset-level database with the supplementary database containing securities characteristics, exchange rates, and credit ratings. A primary issue encountered after merging the datasets is the absence of currency data for a subset of assets. These missing currency securities include fund shares, bonds, derivative instruments, loans, ordinary shares, ETFs, cash positions, fees, and taxes. On average, over the sample period, long positions with missing currency data represent $244 billion (11%) for euro area domiciled bond funds and $769 billion (12%) for US-domiciled funds. Short positions with missing currency data total $118 billion (94%) and $321 billion (96%) for euro area and US bond funds, respectively. The majority of short positions are linked to hedging instruments, such as futures, forward contracts, and options.

To address the missing currency issue, we hypothesize that we can impute assets likely issued in USD based on some metadata. Specifically, we impute assets whose ISIN identification starts with "US" or whose security description includes the name of a US state. For US domiciled bond funds, among those assets with missing currency in 2023 those meeting these criteria total $243 billion. The majority of these assets held in long positions by bond funds are bonds (\$141.8 billion), money market funds (\$41.8 billion), and assets with unidentified asset category (\$49.6 billion). Short positions in these assets are negligible in comparison to the full sample, totaling just \$2.6 billion. A deeper examination of the US bond assets reveals that they are largely municipal bonds issued by states, water and energy management authorities, state ports, airports, and bonds held by trusts. The issuers are predominantly concentrated in sectors such as transportation and warehousing, finance and insurance, utilities, and healthcare and social assistance. However, nearly 60% of the assets lack NAICs sector classifications.

Before removing entries from our sample, we follow a two-step imputation strategy. First, we impute the currency that is explicitly stated in cash holdings. For example, *"EUR Cash"* are assigned the euro exchange rate and similarly for other cash holdings. Then, we assign USD currency to US bond assets meeting two criteria: *(i)* ISIN starting with "US" or a US state name in the security description, and *(ii)* asset Category variable is "Bond" regardless of their parent or issuer sector classification based on the assumption that municipal bonds are issued in USD. This imputation strategy significantly reduces the missing currency assets by almost 22% for long holdings of bond funds domiciled in both geographical regions, and by 16% and 8% for shorted assets held by euro area and US domiciled funds, respectively.

Given our initial sample of bond fund security holdings, we proceed by removing all fund-related assets. Despite prior filtering of fund of funds set in the fund-level database, a substantial number of securities remain associated with fund shares. For the US-domiciled funds, these include of money market funds, open-end and closed-end funds, Exchange Traded Funds (ETF) primary bond ETFs, and other types of funds. Consequently, our first-pass filter for the asset-level database guarantees the exclusion of all fund-related securities even if they bypassed the initial fund-level screening.

Fixed-income funds often hold a non-trivial but relatively small amounts of ordinary equity shares even when they are not classified as mixed or blend funds. However, the inclusion of equity-related holdings complicates comparisons of book values across fixed-income and equity. The book value of fixed income securities represents the holdings of funds stripped from the impact of price changes and it is central in our analysis. Yet, reporting conventions differ significantly between fixed income securities and ordinary equity shares. In particular, regarding bond-like assets which is the major focus of this study, funds report book value in local currency, calculated as the acquisition price multiplied by the number of bonds held. In contrast, for ordinary equity shares, funds report only the number of shares, without the acquisition price, making the book value of two security types uncomparable. To preserve consistency, we remove ordinary equity shares from the sample excluding preferred and preference shares that are reported in the same way as fixed income instruments. For similar reasons, we also exclude derivative instruments which mainly consist of bond futures, inflation, exchange rate and interest rate derivatives, forward contracts, and options. Finally, we remove equity-linked securities and administrative and management fee or tax entries which are frequently under-reported at the asset-level.

We then remove the remaining asset holdings with missing currency information, which are primarily associated with unidentified asset class securities. These entries are excluded from the sample, as their incomplete data prevents reliable computations. Following this comprehensive first-pass filtering, the dataset includes the following asset classes: Bonds, Asset Backed Securities including Collateralised Mortgage and Loan obligations (CMO, CLO), Loans, Commercial Paper, Certificate of Deposits, and Cash. For euro-area fund holdings, the filtering process reduces on average the initial sample's market value 10% and 79% for long and short positions, respectively. For US bond funds, the average reduction in the initial sample's market value equals 12% and 84% for long and short positions, respectively.

A3.2 Second-pass data cleaning

Following the removal of missing currency data and non-relevant asset classes holdings, we proceed to the analysis of each bond fund's holding comparing the market and book value. To identify misreported entries and market value outliers, we use the ratio of each security's market value over book value, adjusted for denomination currency. Thus, we first convert book values in USD by dividing each book value position with its denomination currency exchange rate relative to the US dollar. This adjustment ensures that each fund's portfolio weights are standardized across all assets in the sample, stripping out the impact of price and exchange rate changes. Next, we compute the divergence across all asset holdings between market and book values in US dollars to identify outliers. We remove a significant number of preference equity shares whose market value is greater than three times the 99th quantile of the ratio distribution. Similar, though less pronounced, upper tail outliers are found among bond securities, ABS and loans. The most extreme market to book ratios are observed in derivative assets that were not captured in the first-pass filter. We do not remove lower-tail outliers, as they typically reflect cases where the security has defaulted.

We continue the second-pass filtering by removing entries with inconsistencies between reported market and book value. For instance, a small number of entries with positive market value but negative book value primarily correspond to futures holdings that were not captured by the first-pass filter. We exclude these from the sample. Further, entries with non-zero market value and zero book value result in infinite market to book ratio. Although these are negligible relative to the total sample market value, they are removed to maintain consistency. Moreover, a non-trivial number of cash holdings exhibit implausible discrepancies between market and book values, unrelated to currency denomination. To correct this, we impute the book value in local currency using the formula Market Value $\times$ FX Rate and this adjustment is applied to both short or long cash positions.

As a final step, we eliminate duplicate entries arising from fund-level misreporting. These are identified as entries with identical security characteristics, identical market and book value, the same reporting date, and the same portfolio holdings within a fund. On average across quarters, these checks and removals result in a further reduction of the sample on average across quarters by $80 billion in long positions and $2.2 billion in short positions for euro area domiciled funds. For US domiciled funds, the respective reduction amounts to $34 billion in long positions and $1.5 billion in short positions.

A3.3 Third-pass data cleaning

In regards to government-related bond issuers, the three major players in the U.S. mortgage-backed securities market differ in their institutional structure. Ginnie Mae (GNMA) is a wholly owned government operation and its securities are backed by government-insured or government-guaranteed mortgage loans. Crucially, Ginnie Mae securities carry the full faith and credit of the U.S. government, making them equally safe investments to US Treasuries.[16]In contrast, Fannie Mae (Federal National Mortgage Association - FNMA) and Freddie Mac (Federal Home Loan Mortgage Corporation - FHLMC) are government-sponsored enterprises (GSEs). Although they also operate in the secondary mortgage market, their focus is primarily on conventional mortgages. Their securities are not government-backed and have a different regulatory structure.[17,18]

Considering the characteristics of non-rated securities in the sample, we assign the corresponding US Treasuries credit rating score to those securities issued by Ginnie Mae that lack a rating. Cash positions and certificates of deposits remain unrated but are excluded from the construction of the risk-taking variable. The same exclusion applies to other non-rated assets. The imputation of government-agency related security ratings has a minimal effect on the share of non-rated assets in the final sample. Specifically, the imputed ratings account for 0.2%-0.5% for assets held by euro area domiciled funds and for 1%-3% of assets held by US domiciled funds.

A3.3.1 Final filtered database of bond fund holdings

The final sample of bond fund holdings, following the application of the three-stage filtering process, averages across quarters to approximately $7,358 billion in long positions and $74 billion in short positions. These holdings form the basis in our analysis of the risk-taking channel for investment funds. By repeating the filtering procedure across all available quarters, we obtain Figure A1 and Figure A2, which illustrate the filtered market value in USD for the euro area and US domiciled funds. The reduction in market value due to the data cleaning remains relatively stable across the sample period. For the euro area domiciled funds, the filtered out market value ranges between $235 billion and $391 billion corresponding to 11%-16% of the initial market value. For the US domiciled funds, the respective figures range from $569 billion (10%) to $1,070 billion (15%). Figure A2 illustrates the composition of the final sample's aggregate market value by fund domicile. Euro area funds correspond to 23% - 28% of the total market value of the final asset-level fund holdings database. This share peaks in 2021:Q3, followed by a decline of three percentage points in subsequent quarters.

[16]Ginnie Mae in its official website states that *"Ginnie Mae is a self-financing, wholly owned U.S. Government corporation within the Department of Housing and Urban Development. It is the primary financing mechanism for all government-insured or government-guaranteed mortgage loans."*

[17]In Fannie May's official website it is explicitly stated that *"Fannie Mae's Single-Family and Multifamily businesses acquire mortgage loans for inclusion in Mortgage-Backed Securities (MBS). Such MBS are secured by a beneficial ownership interest in either a single mortgage loan or a pool of mortgage loans secured by residential properties and are guaranteed as to timely payment of principal and interest by Fannie Mae. The certificates and payments of principal and interest on the certificates are not guaranteed by the U.S. Government and do not constitute a debt or obligation of the United States or any of its agencies or instrumentalities other than Fannie Mae."*

[18]In Feddie Mac's official website it is explicitly stated that *"We guarantee the payment of interest and principal on the Securities as described in this Offering Circular. Principal and interest payments on the Securities are not guaranteed by, and are not debts or obligations of, the United States or any federal agency or instrumentality other than Freddie Mac. We alone are responsible for making payments on our guarantee."*

Figure A1 Funds' Filtered Market Value

Fund market value of the initial and final sample after applying the three-stage data cleaning filter process. Market value is expressed in billion USD. The graph on the left depicts the filtered market value of US-based bond funds while the right graph illustrates the corresponding case for EZ-domiciled funds.

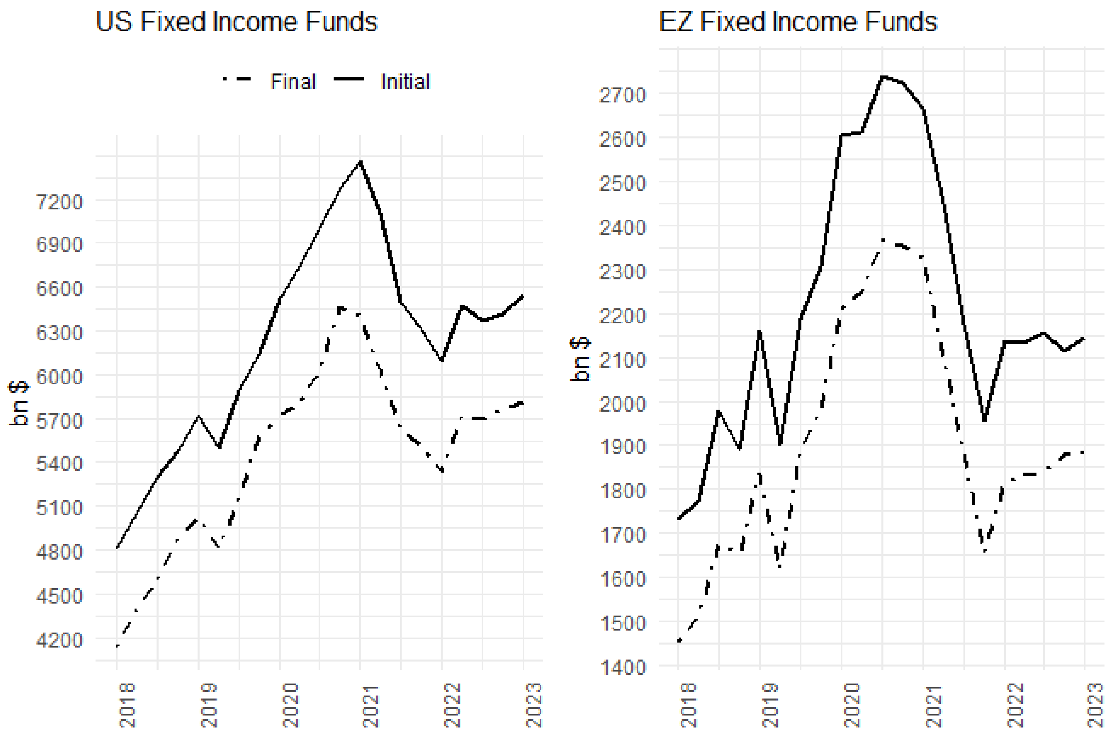
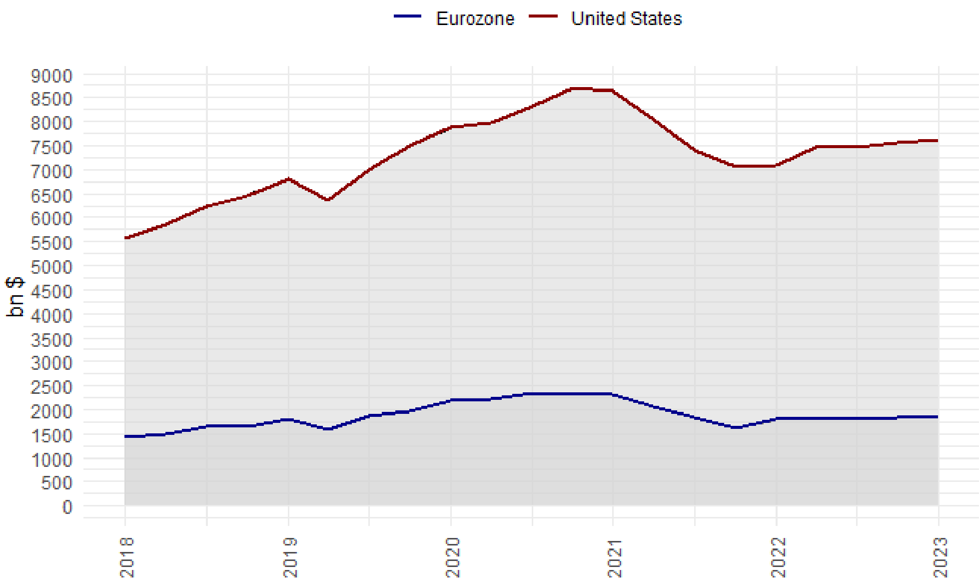


Figure A2 Asset-level fund market value by fund domicile

Fund market value in billion $ decomposed between US and EZ based bond funds. The area under the red and blue lines illustrates the final market value of US and EZ domiciled fund holdings respectively.



Acknowledgements
We would like to thank Loriana Pelizzon, Vasso Ioannidou, Hans Degryse, Jose Luis Peydro, Carlo Altavilla, Giulio Nicoletti and Ugo Albertazzi for their valuable comments on previous drafts of this paper. Special thanks are due to the coordinators of the ChaMP Network (the ESCB research network on monetary policy in a changing world) – Philipp Hartmann, Diana Bonfim, and Margherita Bottero – for their guidance. We extend our gratitude to all participants participants of the 4th workshop of ChaMP Workstream 1 (9 October 2024 Banco de Portugal, Lisbon Portugal), the 10th workshop of the Eurosystem MPC Task Force on Banking Analysis for Monetary Policy (21-22 October 2024 Osterreichische Nationalbank, Vienna Austria) and the 2025 Special NBFI ChaMP workshop (17 November 2025, SAFE House of Finance Goethe Univ., Frankfurt Germany.
The views expressed in this paper are those of the authors and do not necessarily reflect those of the European Central Bank, the Bank of Greece, or the Eurosystem.

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PDF ISBN 978-92-899-7713-5 ISSN 1725-2806 doi:10.2866/6206417 QB-01-26-073-EN-N