Foreign institutional Investors, Monetary Policy, and Reaching for Yield *

Ahmed Ahmed
amaahmed@uchicago.edu

Boris Hofmann
boris.hofmann@bis.org

Martin Schmitz
martin.schmitz@ecb.europa.eu

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Abstract

This paper uses a unique security-level data set to demonstrate that foreign institutional investors shift their U.S. corporate bond portfolios toward bonds with higher credit spreads when U.S. monetary policy tightens, which reflects institutional factors related to nominal return targets and foreign exchange hedging. Foreign institutional investors in low-yielding jurisdictions are unable to meet their return target by only investing in their home bond market. To close this return gap, they increase their exposure to the higher yielding USD-denominated bonds. However, due to regulatory requirements and internal risk management, they hedge against the foreign exchange risk. To take advantage of the yield differential, they invest in long-term USD bonds while hedging the foreign exchange risk through short-term swaps on rolling basis. This makes the shape of the USD yield curve the key factor for the hedged return on their USD-denominated bonds, especially given the persistent premium to access the USD in the swap market since 2008. When U.S. monetary policy tightens, the USD yield curve flattens, erasing all the yield differential once the cost of hedging is applied. As a result, to improve returns on USD-denominated bonds, foreign institutional investors need to take more credit risk. This behavior has meaningful effects on corporate bond prices and issuances.

Keywords: FX hedging channel, pension funds, life insurance, corporate issuance, credit spreads.

JEL Classification: E43, E44, E58, G11, G12, G15, G22, G23.

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1 Introduction

The U.S. corporate bond market is the largest corporate bond market in the world. It accounts for more than 26% of the global corporate bonds and has become a crucial financing channel for firms in the U.S. (see International Capital Market Association August 2020 report). Since the 2008 financial crisis and against the backdrop of the prolonged period of low interest rates in many advanced economies (mainly the euro area and East Asia), foreign investors have funneled unprecedented amounts of funds into the U.S. corporate bond market. These foreign investors' holdings accounted for around 30% of the total outstanding amounts of corporate bonds in 2020, and the U.S. dollar value of these holdings doubled to over 4.5 trillion U.S. dollars between 2009 and 2020 (Figure 1). At the end of June 2020, 95% of these holdings were by private foreign investors (see Treasury International Capital System 2020 SHL Annual Survey). This makes private foreign investors the largest holders of U.S. corporate bonds. Given their dominance, it is important to understand their investment behavior and the effects of their institutional trading on prices in the U.S. corporate bond market.

We examine the determinants of reaching for yield in foreign institutional investors' holdings of U.S. nonfinancial corporate (NFC) corporate bonds from 2016 to 2020 and the implications for bond prices and issuance. Foreign institutional investors have been a driving factor for the large cross-border investment in the U.S. corporate bond market. Reaching for yield in our definition means tilting portfolios toward bonds with higher spreads relative to Treasury yields with the same maturity. More specifically, we examine how U.S. monetary policy affects risk-taking in foreign institutional investors' corporate bond portfolios by analyzing the extent to which foreign institutional investors shift the composition of their U.S. corporate bond holdings in response to changes in U.S. monetary policy.

Recent papers have illustrated reaching for yield among the two largest domestic institutional investors in the U.S. corporate bond market, i.e., insurance companies (Becker and Ivashina (2015) and Ozdagli and Wang (2020)) and mutual funds (Choi and Kronlund (2017)). Although the underlying mechanisms differ, a common theme in these studies is that institutional investors are especially prone to shift toward riskier bonds to generate higher returns when interest rates are low. However, past research has not focused on the reaching for yield behaviour by foreign investors in response to U.S. monetary policy. Studying the behaviour of these investors is important to fill this gap and to evaluate the full impact of U.S. monetary policy on credit conditions. Other papers have focused on the effect of unconventional monetary policies, namely the asset purchases programs of the Federal Reserve and the European Central Bank, on investors' bond portfolio rebalancing (Carpenter et al. (2015), Domanski et al. (2017), Fidora et al. (2020) and Koijen et al. (2021)). However, there has yet to be a study of the effects of conventional monetary policy on cross-border bond investments.

As such, we take a different perspective and study the reaching for yield of foreign institutional investors in response to U.S. conventional monetary policy. We find that as U.S. monetary policy tightens, foreign institutional investors tilt their U.S. corporate bond portfolios toward bonds with higher credit spreads and that such behaviour has price implications. Why would foreign institutional investors tilt their portfolios toward bonds with higher credit spreads when the U.S. monetary policy tightens? It is in line with efforts by foreign institutional investors in low-yielding jurisdictions to close their return gap by investing in higher yielding USD-denominated (USD) bonds. However, due to regulatory requirements and internal risk management, they hedge most of their U.S. dollar exposure.

Although using a longer-term cross-currency basis swap (or outright forward) contract broadly matches the maturity of the USD bonds, and hence fixes the basis for the term of the swap, foreign institutional investors hedge against the foreign exchange risk using short term FX swap (or outright forward) contracts that are renewed or "rolled over" at each FX contract maturity date until reaching the maturity of the respective USD bonds. They do so for two reasons. First, to take advantage of the yield differential between the higher yielding U.S. dollar and their low yielding currency. Second, short term swaps are the most liquid market for FX hedging, and so trading costs tend to be lower using these instruments compared to more tailored longer-term swaps. As a result, foreign institutional investors follow a "hedge short and invest long" strategy. In other words, they invest in long-term bonds, but hedge the currency through short-term swaps on a rolling basis.

The textbook cost of currency hedging is set only by the difference between the monetary policy rates in the U.S. and the foreign investor's home jurisdiction. However, in the post-great financial crisis environment, deviations of the cross-currency basis from zero are not uncommon (Borio et al. (2016), Du et al. (2018) and Avdjiev et al. (2019)). This introduces a premium to acquire the U.S. dollar in the swap market. For jurisdictions with large gross foreign asset positions (such as the euro area and East Asia), the premium is usually positive, increasing the cost for foreign investors acquiring USD bonds in an FX-hedged manner. This eliminates *more* than the short-term yield advantage of USD bonds over foreign institutional investors' jurisdictions' domestic bonds, amplifying the importance of the shape of the U.S. dollar yield curve for foreign investors. This makes the term spread on the USD bonds the key factor for their hedged return on their USD bonds investments. Given that the nominal term spread tends to get compressed during monetary policy tightening (Adrian et al. (2013), Hanson and Stein (2015), Crump et al. (2016), Nakamura and Steinsson (2018), and Kliem and Meyer-Gohde (2021)), foreign institutional investors need to increase their portfolio credit risk by investing in bonds with higher credit risk to improve the returns on the USD bonds, while leaving the FX hedge ratio unchanged.

To illustrate the currency hedging and term spread implications, we develop a mean-variance optimization framework where foreign institutional investors hedge their currency exposure and have a minimum required nominal return on their bond portfolio. The other key friction is that the premium (cross-currency basis) that foreign investors need to pay on top of the monetary policy interest rate differential between the U.S. and their home jurisdiction is persistently positive. The model predicts that foreign institutional investors who face a high FX hedging ratio and cannot achieve their required nominal return through investing in their home sovereign bond market reach for more yield when the U.S. monetary policy tightens. In addition, foreign institutional investors increase their allocation to the U.S. corporate bond market when the U.S. term spread widens or their home jurisdiction term and corporate spreads compress.

To test the model's predictions, we estimate a demand system for U.S. NFC bonds using euro area institutional investors as a representative of foreign institutional investors. Euro area institutional investors are particularly useful in studying the investment behaviour of foreign investors in response to U.S. monetary policy for two reasons. The first reason is the large size of euro area institutional investors' bond portfolio: at the end of 2020, euro area institutional investors held €688 billion in NFC bonds, accounting for 13% of the outstanding market reported in the U.S. Flow of Funds account. Second, the availability of detailed security-level data capturing all their bond holdings across the world at the sectoral level on a quarterly basis allows us to accurately capture their portfolio rebalancing, which is the main interest of this paper.

We use euro area investors' detailed quarterly bond holdings data to analyze how portfolio allocations and demand of U.S. NFC bonds relate to changes in U.S. monetary policy. The data comes from the ECB Sectoral Securities Holdings Statistics (SSHS). SSHS offers a comprehensive, fully integrated, granular dataset of the security holdings of euro area residents worldwide at the sectoral level. We also use the security-level holdings data of U.S. domestic investors from eMAXX. eMAXX provides comprehensive coverage of bonds predominantly held by domestic insurance companies, mutual funds, and pension funds at the security level. We combine the holdings data with bond yields and characteristics from the ESCB's Centralised Securities Database (CSDB). Our paper is the first – to the best of our knowledge – to construct a dataset that includes U.S. corporate bond holdings of *both* domestic and foreign investors at the sectoral level. The sectors in our sample collectively hold roughly 50% of the total outstanding corporate bond amount.

To estimate the demand system, we follow Koijen and Yogo (2019) and Koijen et al. (2021). This approach models weights of mean-variance portfolio as a logit function of bond yields, bond characteristics, and latent demand that represents heterogeneous expectations or constraints that are not captured by the observed characteristics. In equilibrium, it recognizes that investors' portfolio weights across securities have to add up to their outstanding values. Following this approach, we estimate a demand system for NFC bonds, modeling portfolio weights as a logit function of credit spreads, U.S and euro area monetary policy rates, bond characteristics, macro-financial variables (including term spreads), and latent demand.

Given the euro area investors' large size, an endogeneity problem may arise because a shock to their demand can have an impact on bond yields. With our dataset at hand and the persistence of investors' corporate bond investment mandates (Bretscher et al. (2020)), we use other sectors' contemporaneous bond holdings as an instrument to isolate exogenous variation in credit spreads for a given sector. To identify the effect of monetary policy rates and term spreads on the portfolio rebalancing, we use monetary policy shocks as an external instrument constructed from high-frequency price adjustments in the 3-month Libor rates and 10-year bonds for the U.S. and the euro area around the FOMC and ECB announcements, following the lead of Kuttner (2001), Bernanke and Kuttner (2005), Gürkaynak et al. (2005) and Gertler and Karadi (2015).

Consistent with the model and in contrast with U.S. life insurers, euro area institutional investors have a demand function that is decreasing in credit spreads. However, they tilt their portfolios toward corporate bonds with higher credit spreads when the U.S. monetary policy rate increases. Euro area investors also rebalance their portfolios toward U.S. corporate bonds when the U.S. term spread increases, and when the euro area term and credit spreads decrease. This emphasizes the importance of investor heterogeneity and its role in how monetary policy is transmitted.

Having documented the reaching for yield behaviour of euro area investors, we investigate whether their reaching for yield has an impact on corporate bond prices. To address this question, we examine the returns of bonds associated with their reaching for yield from the WRDS Bond Returns database. We find that during quarters that witness monetary policy tightening, bonds purchased by euro area investors in a given quarter have monthly raw returns that are 12 basis points higher than bonds not purchased by any euro area investor, and abnormal return 22 points higher. Such a pattern in raw and abnormal returns quickly reverses and is absent in other quarters. Using euro area investors' flows to the corporate bond market, our estimate of 12 basis points mean price effect implies a price elasticity of -1.67, which is similar to the demand elasticity reported in Chang et al. (2014) which is -1.46 in the cross section of U.S. stocks. Furthermore, we show that euro area investors reaching for yield have an impact on the volume of BBB-rated corporate bonds issuance. Overall, the results provide evidence corroborating that the behaviour of euro area investors reaching for yield can impact the credit conditions in the U.S.

Overall, our results highlight an important channel for the transmission of monetary policy that is relevant for practitioners and policy makers but has been overlooked by the academic literature.

These findings match the February 2018 Schroders' report on global corporate bond market, which states that "investors should not be fooled into thinking that markets with higher yields in local terms offer higher return prospects. Currency hedging will neutralize much of this advantage, rendering comparisons of yields between domestic and overseas markets less meaningful."[1]

The rest of the paper proceeds as follows. In Section 2, we discuss the institutional settings of foreign investors and explain how the institutional features of currency hedging could lead them to engage in reaching for yield as the U.S. monetary policy rate increases. Section 3 presents the conceptual framework. Section 4 describes the data. Section 5 develops the empirical predictions that follow from the conceptual framework. It connects changes in holdings directly to changes in credit spreads and U.S. monetary policy rate. Section 6 investigates the effects of reaching for yield on corporate bond prices and issuance. Section 7, the conclusion, discusses broader implications.

2 Institutional Background

2.1 Global developments

Over the last two decades, the euro area and East Asian countries have been running large current account surpluses. By definition, a current account surplus can be mirrored by foreign investors drawing down previously purchased domestic assets, central banks intervening in FX markets and accumulating foreign currency reserves, or private institutions increasing their ownership of foreign assets. In the late 1990s and in the case of East Asian countries, the current account surplus was mainly mirrored by central bank intervention in FX markets and foreign currency reserves accumulation, primarily in U.S. dollar assets. However, over the last two decades, as central bank FX activity became limited, the role of institutional investors, namely insurance companies and pension funds, became the main vehicle mediating current account surpluses into overseas security markets, primarily the U.S. market. Institutional investors can invest in overseas security markets either

[1] "Breaking down borders in corporate bond markets" is available on Schroders' website.

through direct holdings or through domestic investment funds. Figure 2 shows the accumulation of current account surpluses, FX reserves, and foreign assets ownership by several types of institutional investors, over the last two decades. These figures piece together evidence that a driving factor for large cross-border investment and the associated impact on credit conditions in the United States may have been the "Global Institutional Investors Glut" rather than the "Global Savings Glut" or the "Global Banking Glut" coined by Bernanke (2005) and Shin (2012), respectively.

2.2 Institutional Investors in the Euro Area

European insurance companies and pension funds (ICPFs) constitute a large segment of the investor base both in their jurisdictions and globally. According to statistics from the European Central Bank, by the end of 2020, their assets exceeded € 12.2 trillion, or almost 12% of global bond markets outstanding amount[2]. Direct holdings of debt securities represent the main asset item on their balance sheets and account for more than 35% of their total financial assets, with the debt securities of U.S. issuers accounting for more than 7.7% of their direct holdings of debt securities.

ICPFs face reaching for yield incentives to generate higher returns especially when interest rates are low. The liabilities of life insurance companies and pension funds consist of promised fixed investment returns or fixed benefit promises that they have to meet, creating incentives to invest in higher-yielding bonds. In addition, their fixed-rate liabilities are long dated for several years or decades into the future. As a result, life insurers and pension funds typically have a negative duration gap, with liabilities of longer duration, and thus of more interest-rate sensitivity, than their assets. Figure 3 estimates the duration mismatches between assets and liabilities for the nine countries (including Germany and France) with the largest life insurance sectors worldwide. It estimates the duration mismatch between assets and liabilities for German and French life insurers to be 10 and 6.5 years, respectively.

The duration mismatch depends on the level of interest rates and increases when rates fall (neg-

[2] According to SIFMA total global bond outstanding is $123.5 trillion as of 2020.

ative convexity). At times of low interest, this provides an incentive for ICPFs to "reach for duration" as well by investing in bonds with longer maturity. To better match the duration of their liabilities, insurance companies and pension funds are among the largest investors in the euro area bond markets: By the end of 2013, in notional amounts, almost 46.5% of their direct bond holdings were held in the form of euro area government domestic debt securities. By the end of 2020, this share decreased slightly to 45.4%, which accounts for 22% of the outstanding domestic government debt securities.

Nevertheless, ICPFs have been facing pressure to achieve guaranteed returns because of persistently low and declining yields on fixed-income instruments, partly driven by the accommodative ECB policies that led to term spread compression. Figure 3 estimates the gap between life insurance guaranteed returns and domestic 10-year sovereign bond yields for German and French life insurers to be 3.2% and 0.3%, respectively.

To boost returns, ICPFs can also invest in euro area corporate bonds. However, the domestic corporate bond market is relatively small (Figure 4). After the European sovereign debt crisis in 2012, banks dramatically reduced outstanding debt securities. This large decrease was not compensated by an equivalent increase in outstanding debt securities of other financial and non-financial firms (Koijen et al. (2021)). Furthermore, the ECB's unconventional monetary policies came with a credit spread compression, which reduced the yield attractiveness of euro area corporate bonds. It also led to fewer corporate bonds being available for sale. Figure 5 shows the total amount outstanding of euro area bonds by issuer type and the share of the total euro area bonds held by the Eurosystem (i.e. the ECB together with the euro area national central banks). By the end of 2020, 20% of all euro area bonds were held by the Eurosystem. In particular, by the end of 2020, the Eurosystem held 27% of investment grade non-financial corporate bonds in the euro area. European investors have been already facing credit-risk limit saturations on major European corporate issuers (Dauphine' et al. (2021)). Figure 6 shows the gap between life insurance guaranteed returns and the overall investment returns for EA life insurers. Many euro area countries face challenges to make investment returns in excess of guaranteed returns issued in the past as a result of the low yield environment.

The share of ICPFs' direct bond holdings allocated to debt issued by Monetary Financial Institutions (MFIs) declined from around 18.2% at the end of 2013 to 11.8% at the end of 2020. The shares of bonds issued by other financial institutions and non-financial corporations were stable around 8.5% and 9.5%, respectively. Geographically, by the end of 2013, close to 86% of the ICPFs' direct bond holdings were held in euro area debt securities, exhibiting a strong "euro area bias". However this figure declined to 79% at the end of 2020. Much of the increase in non-euro area debt allocation is reflected in an increase in exposure to the U.S. dollar denominated bonds. The share of U.S. dollar denominated bonds went up from 3.9% of direct bond holdings at the end of 2013 to 9% at the end 2020. This translates to an increase in holdings of magnitude of € 216 billion. Figure 7 shows the bond purchases by euro area ICPFs by issuer type from end of 2013 to end of 2020.

2.2.1 Indirect Holdings: Investment Funds

ICPFs can also invest in foreign bonds through euro area investment funds. At the end of 2020, ICPFs owned around € 4 trillion in investment fund shares, or more than 25% of euro area investment fund assets. A significant portion of this amount is invested in foreign bonds. Precise figures on ICPFs' indirect holdings of U.S. NFC bonds are not readily available, but Carvalho and Schmitz (2021) presents an analysis that looks through the holdings of investment fund shares to estimate euro area investors' full exposures to global debt securities by sector in the aftermath of COVID-19 crisis. Although investment funds do not face the same contractual and regulatory environment as ICPFs, demand for subsistence yields during low-interest-rate times from end-investors (such as ICPFs) forces them to have nominal return targets (Breuer et al. (2019) and Bundesbank (2020)) which have an effect similar to fixed-rate liabilities (Choi and Kronlund (2017)). This creates an incentive for investment funds to reach for yield during times of low interest rates by investing in higher yielding bonds, resembling the behaviour of ICPFs.

Euro area investment funds also invest significantly in debt securities, accounting for around 37% of their total assets. In contrast to direct holdings of ICPFs, investments in debt markets are geographically more widely distributed. At the end of 2013, debt securities of non-euro area issuers accounted for more than 41% of their total debt securities holdings. However, as a result of the ECB unconventional monetary policies, the share of debt securities of non-euro area issuers went up to 55% at the end of 2020. Much of the increase in the non-euro area debt allocation is tied to the increase in their exposure to U.S. dollar denominated bonds. The share of the U.S. dollar denominated bonds went up from 17.4% of their bond holdings at the end of 2013 to 26% at the end 2020. This translates to an increase in holdings of magnitude of € 753 billion. Figure 8 shows the bond purchases by euro area investment funds by issuer type from the end of 2013 to the end of 2020.

2.3 U.S. Nonfinancial Corporate Bond Market

Corporate debt substantially increased after the 2008-09 global financial crisis (GFC), amounting to more than half of U.S. GDP in 2020. The rise in corporate debt was concentrated in nonfinancial corporate debt and was mainly created in the form of bonds exhibiting the substitution of firms from bank debt to capital market debt. Between 2008 and 2020, outstanding nonfinancial corporate bonds rose from $ 3 trillion to $ 6.6 trillion. Issuance activity has been widespread. The share of debt in the 'BBB' category rose from 28% of the outstanding nonfinancial corporate bonds to 46% over the same period, and from 36% of the investment grade bonds to 52% (Figure 9).

Since the 2008 global financial crisis and against the backdrop of the prolonged period of low interest rates in the euro area, European institutional investors have been funneling large funds in the U.S. nonfinancial corporate bond market. Hence they are becoming key players in this market and are influencing credit conditions in the U.S. Euro area investors' holdings of U.S. nonfinancial corporate bonds rose from $ 335 billion at the end of 2013 to more than $ 820 billion at the end of 2020, in market value. This translates to an increase from 8% of the amount outstanding to 12.7% (Figure 10). Although the increase seems to be driven mainly by investment funds and, to a smaller extent, by ICPFs' direct holdings, the estimates developed by Carvalho and Schmitz (2021) provide some key facts. First, ICPFs hold a significant share of euro area investment fund shares and the ICPFs' share of euro area investment fund holdings of U.S. NFC bonds (and non-euro area bonds in general) has been increasing sharply since the implementation of the ECB quantitative easing in 2015. Second, ICPFs' indirect holdings of U.S. NFC bonds (via euro area investment funds) have more than doubled since 2015. Third, ICPFs' indirect holdings of U.S. NFC bonds are larger than its direct holdings.

The U.S. corporate bond market is the largest bond market globally. It offers European ICPFs four attractive features (Dauphine' et al. (2021)). First, it offers diversification opportunities in terms of issuers. For example, at the end of 2020, the U.S. investment grade credit universe accounted for over 700 U.S.-domiciled issuers, of which about 600 have never issued in Euros. Second, it offers diversification opportunities in terms of sectors. Relative to the euro area, U.S. credit markets feature relatively higher weights of the energy and technology sectors at the expense of financial institutions. Third, it offers accessible exposure to longer maturities, either through the corporate or agency bond markets. For example, bonds with maturities of ten years and above account for 39% of the U.S. corporate bond universe, in contrast to being only 10% in the Euro universe. Fourth, the U.S. corporate bond market offers attractive spread pick-up especially on intermediate- and long-dated maturities. Figure 11 shows the excess returns of U.S. 10-year sovereign bonds over 10-year German Bunds and of U.S. investment-grade corporate Bonds over euro area investment-grade corporate bonds.

2.4 FX Hedging and Reaching for Yield

Although the U.S. sovereign debt market appears very appealing to foreign institutional investors, especially those with investment mandate constraints like life insurers and pension funds, there is the cost of hedging against the currency risk to consider. It is perceived that the European institutional investors hedge almost 100% of their exposure to foreign currency bonds (Borio et al. (2016) and Dauphine' et al. (2021)). There are two reasons that they hedge most of their FX exposure. The first is domestic regulation requirements. The EU's Solvency II directive, which came into effect in January 2016, stipulates that European insurers face 25% solvency capital charge applicable in the event of currency mismatches between insurance companies' assets and liabilities. The second is internal risk management practices. Taking FX risk would prove to be very risky without benefit. The losses incurred as a result of any depreciation in the U.S. dollar would likely outweigh any yield gains from the reduction in hedging cost. This concern is likely to materialise given the volatility of the FX market. Meese and Rogoff (1983) and Perold and Schulman (1988) suggested that short-term currency movements follow a random walk, representing a source of uncompensated risk. This would suggest that, by itself, an investment in unhedged foreign bond provides little value to investors, in light of the exchange rate volatility.

An FX hedge could be constructed either with a cross-currency basis swap or outright forward contracts. Although using a longer-term cross-currency swap (or outright forward) contract broadly matches the maturity of the USD bonds, and hence fixes the basis for the term of the swap, foreign institutional investors hedge against the foreign exchange risk using short term FX swap (or outright forward) contracts that are renewed or "rolled over" at each FX contract maturity date until reaching the maturity of the respective USD bonds. They do so for two reasons. First, to take advantage of the yield differential between the higher yielding USD and their low yielding currency. This is mainly determined by the shape of the USD yield curve. Second, short term swaps are the most liquid market for FX hedging, and so trading costs tend to be lower using these instruments compared to more tailored longer-term swaps. According to the BIS Triennial Central Bank Survey 2019, FX swaps (forward contracts) with maturity of six months or less made up 98% (95%) of their respective turnover. As a result, foreign institutional investors follow a "hedge short and invest long" strategy. In other words, they invest in long-term bonds, but hedge the currency through short-term swaps on a rolling basis.

In a textbook setting, FX cross-currency basis swap would be set only by USD-EUR interest rate differentials, giving rise to the academically revered no-arbitrage condition. However, in the post-great financial crisis environment, deviations of the cross-currency basis from zero are not uncommon (Borio et al. (2016), Du et al. (2018) and Avdjiev et al. (2019)). For jurisdictions with large cumulative current account surpluses over the past decade (such as the euro area and Far East Asia) and subsequently increasing gross foreign asset positions, the cross-currency basis is usually negative, increasing the cost for domestic investors acquiring U.S. dollar denominated assets in an FX-hedged manner. The EUR-USD swap rate in a cross-currency basis (CCB) contract with a tenor of three months is formalized as follows:

$$\text{EUR/USD Swap}_{3\text{month}} = \text{USD LIBOR}_{3\text{month}} - \text{EUR LIBOR}_{3\text{month}} - \text{CCB}_{3\text{month}}, \tag{1}$$

Equation 1 shows that the swap rate depends on the divergence of monetary policy rates in the U.S. and euro area directly through interest rate differentials. As a consequence, when the U.S. monetary policy is tightened, the cost increases for a euro area investor to hedge a USD-denominated long-term bond, erasing the entire increase in the U.S. short term rate. Thus, assuming hedging the full FX exposure, the hedged return on the U.S. Treasury bond is:

$$\text{Hedged Return} = \text{USD Term Spread} + \text{EUR LIBOR}_{3\text{month}} + \text{CCB}_{3\text{month}} \tag{2}$$

Equation 2 shows that the hedged return on the U.S. Treasury bond pins down to the sum of the term spread on the Treasury bond (the difference between long-term and short-term interest rates), the Euribor, and the cross currency basis. Given that both Euribor (Figure 17) and cross currency basis (Figure 12) have been negative since the ECB quantitative easing program in 2015, the term spread becomes the key factor for the hedged return for euro area investors. Empirical literature (Adrian et al. (2013), Hanson and Stein (2015), Crump et al. (2016), Nakamura and Steinsson (2018), and Kliem and Meyer-Gohde (2021)) documents that during recent monetary policy rate hike cycles, the nominal term spread tends to get compressed. This research shows that that the term spread tends to decline in monetary policy rate hike cycles even though it may initially rise modestly upon impact in some rate hike cycles such as 1994 and 1999. This contrasts with the 2004 and 2015 tightening cycles when the term spread dropped steadily in the face of hiking monetary policy rate. Although these rate hike cycles had boosted interest rates on the short end, they had not caused long-term rates to lift, and the term spread stayed close to historic lows and turned negative.

Figure 13 plots the coefficient of correlation between federal funds rates and term spread (based on the yield on the 10-year Treasury bond minus the yield on the 3-month Treasury bill) based on rolling regression with 20 quarters window. The coefficient has been persistently negative stabilizing around -0.43 from 2010. This means that U.S. monetary policy tightening potentially erases the entire yield differential for euro area investors as the USD yield curve flattens and term spread gets compressed. The hedged returns on the U.S. Treasury bonds turned negative for a prolonged period after the ECB quantitative easing program and the FED's monetary policy tightening in 2015. Even with yields at multi-year highs, Treasuries were returning less than their pricier German peers when euro area investors account for the steep hedging costs. Figure (14) shows the returns on the 10-years German Bund, and 10-years U.S. Treasury bond on unhedged and hedged (using a rolling 3-month FX swap) basis. The situation was not much different for A-rated U.S. corporate bonds. The hedged returns on AAA-rated corporate bonds for euro area investors were negative during some quarters in 2018 and 2019. The only segment in the U.S. investment grade corporate bond market that was yielding a positive hedged return for euro area investors during this period was the BBB-rated corporate bonds. Figure 15 shows the unhedged and hedged (using a rolling 3-month FX swap) U.S. corporate bonds yield curve for a euro area investor.

As a result, for euro area investors to improve their returns on their USD bonds, they need to reach more for yield in the USD bond market by taking extra credit risk through buying USD corporate, agencies or emerging market economies issued bonds. In other words, when U.S. monetary policy tightens, foreign institutional investors reach more for yield in clear contrast to the U.S. institutional investors who reach more for yield when U.S. monetary policy loosens. This shows significant heterogeneity in response to monetary policy between domestic and foreign institutional investors.

3 Conceptual Framework

This section sketches a two-period portfolio optimization model. The institutional investor pursues a total return objective of y_L which can be the rate of return on liabilities in the case of ICPFs or minimum nominal required return in the case of investment funds. At time 0, the investor chooses a global bond portfolio to achieve such return objective. To describe the portfolio re-balancing problem which arises due to the FX hedging, we solely consider bonds issued in the euro area and the U.S. At time 0, the investor's investment opportunity set consists of the following four bonds with the same maturity:

1. Euro area riskless sovereign bond with expected return $y_e + T_e$ and allocated weight w_1

2. Euro area corporate bond with expected return of $y_e + T_e + C_e$, volatility of σ_e^2 and allocated weight w_2

3. U.S Treasury riskless bond with expected return of $y_\$ + T_\$^*$ and allocated weight w_3

4. U.S corporate bond with expected return of $y_\$ + T_\$^* + C_\$$, volatility of $\sigma_\$^2$ and allocated weight w_4

Where y_e is the current short term interest rate in the euro area and $y_\$$ is the current short term interest rate in the U.S. The term spreads in the Euro-Area and the U.S. are given by T_e and $T_\$^*$, respectively. C_e is the yield spread of the euro area corporate bond over the euro area sovereign bond with the same maturity. Similarly, $C_\$$ is the yield spread of the U.S. corporate bond over the U.S. Treasury bond with the same maturity. Given the sensitivity of the term spread to the monetary policy, we model the term spread as $T_\$^* = T_\$ - \rho y_\$$, where $\rho > 0$ to capture the negative impact of monetary policy tightening on the term spread. Finally, the short-term rates and corporate spreads are assumed to be independent of one another.

FX Hedging: The euro area investor decides to currency hedge ϕ of the U.S. bonds, where $\phi \in [0,1]$. He uses a 3-month cross-currency basis swap to facilitate this hedging. The cost of hedging is $H(y_\$, y_e) = y_\$ - y_e - Z$, where $Z < 0$ to capture the persistent negative cross currency basis reflecting the premium that euro area investors need to pay in order to access the U.S. dollar in the swap market. Finally, the investor will face FX fluctuation for the 1 - ϕ of the U.S. bonds that are not hedged. The expected return of the currency movement is F with associated risk of σ_f^2

The euro area investor has mean-variance preferences over the return on bonds, but faces the cost of FX hedging. Thus, the investor chooses its bond portfolio such that:

$$
\begin{aligned}
\min_{w_1, w_2, w_3, w_4} \quad & w_2^2 \sigma_e^2 + w_4^2 \sigma_\$^2 + (1-\phi)^2 (1-w_1-w_2)^2 \sigma_f^2 \\
\text{s.t.} \quad & \textstyle\sum_{i=1}^4 w_i \, r_i + \phi(1-w_H) H(y_\$, y_e) + (1-\phi)(1-w_H) F \geq y_L \\
\text{s.t.} \quad & \textstyle\sum_{i=1}^4 w_i = 1
\end{aligned} \tag{3}
$$

where r_i is the expected return on the respective bond. We assume short selling is allowed for simplicity. The allocation problem in Equation (2) involves constrained minimization of the portfolio variance over the bonds weights. The first-order condition yields the following solution for the optimal weight of the U.S. corporate bond, w_4^*:

$$
w_4^* = \left(\frac{R_G}{C_\$}\right) \cdot \frac{\left(\frac{C_\$}{\sigma_\$}\right)^2}{\left(\frac{D}{(1-\phi)\sigma_F}\right)^2 + \left(\frac{C_e}{\sigma_e}\right)^2 + \left(\frac{C_\$}{\sigma_\$}\right)^2} \tag{4}
$$

where R_G is the gap between the targeted nominal return and domestic sovereign bond yield and D is the spread of investing in the domestic sovereign bond over the U.S. Treasury bond with ϕ of the FX exposure is hedged. In other words, it is the expected return on a portfolio which involves longing the euro area sovereign bond, shorting the U.S. Treasury bond and hedging ϕ of the FX exposure. For simplicity we will call D the return on the "hedged portfolio". Formally, R_G and D are defined as follows:

$$
R_G = y_L - y_e - T_e \tag{5}
$$

$$
D = y_e + T_e - [y_\$ + T_\${}^* + (1-\phi)F - \phi H(y_\$, y_e)] \tag{6}
$$

Figure 16 shows that D has been positive during the U.S. monetary policy tightening cycle that started at the very end of 2015, assuming an FX hedge ratio (ϕ) of 100%. Equation 3 implies that the optimal demand for the U.S. corporate bond is the product of two terms. The first term is the ratio of the return gap to the credit spread of the U.S. corporate bond. This captures how much investment in the U.S. corporate bond is needed to close the return gap. This is driven by the minimum return target. The second term is the risk-adjusted returns square of the U.S. corporate bond relative to the sum of the risk-adjusted returns square of other risky assets; the U.S. corporate bond, euro area corporate bond and the "hedged" portfolio. This is driven by the mean-variance optimization. We now move on to characterize the change in demand.

Implication 1: The effect of U.S. monetary policy on risk taking: Assuming a positive return gap ($R_G > 0$), a positive credit spread on the U.S. corporate bond ($C_\$ > 0$), and a positive yield on the "hedged portfolio" (D > 0), when the FX hedging ratio is low ($0 < \phi < 1-\rho$), the higher U.S. monetary policy rate leads to an increase in the attractiveness of the U.S. bonds for the euro area investor, including corporate bonds ($\frac{\partial w^*_{C_\$}}{\partial y_\$} > 0$), all else being equal.

When the FX hedging ratio is high ($\phi > 1-\rho$), the higher U.S. monetary policy rate leads the euro area investor to be discouraged from investing in the U.S. corporate bonds ($\frac{\partial w^*_{C_\$}}{\partial y_\$} < 0$). We prove this in Appendix. All else being equal, the higher the U.S. monetary policy rate, the more compressed the term spread will get, potentially erasing all the yield differential. This is a direct result of the term spread compression parameter (ρ).

Implication 2: Dynamics between U.S. monetary policy and risk taking: For investors fulfilling the conditions[3] for implication 1, if the risk-adjusted return of the U.S. corporate bond is high enough relative to the sum of the risk-adjusted return of the euro area corporate bond and the "hedge" portfolio, the higher U.S. monetary policy rate will lead to stronger demand of U.S. corporate bonds with higher credit spreads. In other words, the higher the cost of hedging, the more risk taking in the U.S. corporate bond market by the euro area investor ($\frac{\partial^2 w^*_{C_\$}}{\partial C_\$ \partial y_\$} > 0$). We prove this in Appendix. All else being equal, the higher the U.S. monetary policy rate, the more compressed the term spread will get, potentially erasing all the yield differential. As a result, to improve their returns to close the return

[3] The four conditions are: (1) positive return gap ($R_G > 0$), (2) positive expected return on the "hedged" portfolio ($D > 0$), (3) a positive credit spread on the U.S. corporate bond ($C_\$ > 0$), and (4) high required FX hedge ratio ($\phi > 1-\rho$).

gap, euro area investors take more credit risk.

Implication 3: Effect of the slope of the yield curve: Steepening of the U.S. yield curve (higher U.S.term spread $T^*_\$$) leads to an increase in the attractiveness of the U.S. bonds for the euro area investor, including corporate bonds, all else being equal. On the other hand, steepening of the euro area yield curve (higher euro area term spread T_e) leads to decrease in the demand of the U.S. bonds, including corporate bonds, all else being equal.

3.1 Testable Predictions

This gives the following predictions that will be tested using detailed securities holding data for major euro area institutional investors in the U.S. corporate debt market. The exact empirical methodology and measurement of "reaching for yield" are described in the next Section.

Prediction 1: Euro area investors' U.S. corporate bond holdings are decreasing in the U.S. policy (cost of hedging).

Prediction 2: Euro area investors' U.S. corporate bond holdings are increasing in the U.S. bonds' credit spread in response to higher U.S. monetary policy (cost of hedging).

Prediction 3: Euro area investors' U.S. corporate bond holdings are increasing in the U.S. term spread, and decreasing in the euro area term and credit spreads.

4 Data

For euro area investors, we use data on security-level portfolio holdings of all 19 euro area countries from the ESCB Sectoral Securities Holding Statistics (SSHS). The data are collected by national central banks from financial investors and custodians. The dataset covers debt securities, listed shares as well as investment fund shares, all of which are in most cases identified with a unique International

Securities Identification Number (ISIN). The data are collected on a quarterly basis since 2014Q1 and we use releases until 2020Q4.

The SHSS data consist of directly and indirectly reported securities. A financial institution resident in the euro area is obliged to report securities that it holds as its own investment ("direct reporting") as well as securities that it holds in custody ("indirect reporting"). Investors in the SHSS are defined by their country of domicile and sector. We follow Koijen et al. (2021) and aggregate the data to five sectors on the euro area level: monetary financial institutions (MFI) excluding monetary authorities, insurance companies and pension funds (ICPF), other financial institutions (OFI - including important intermediaries such as mutual funds which represent the largest subgroup of this sector and hedge funds), households (HH) and "others" which include non-financial corporations and general government.

For U.S. domestic institutional investors, we use detailed investors' bond holdings data from eMaxx Thomason Reuters to test the above predictions. eMAXX has been used in several papers (Becker and Ivashina (2015) and Bodnaruk and Rossi (2016)), but is still a relatively new source in international finance literature. It covers the holdings of insurance companies, mutual funds, pension funds and investment management companies.

Using the ISIN for every security, SHSS and eMAXX data are merged with individual asset characteristics obtained from the ESCB's Centralised Securities Database (CSDB) which contains information on more than six million debt and equity securities issued globally (Rousová and Caloca (2018) and Fidora et al. (2020)). Therefore, one can use information at the security-level to retrieve information related to bond yields, maturity and liquidity. In addition, we use the Wharton Research Data Services (WRDS) Bond Database to track all the corporate bonds traded over time along with their monthly returns. It provides comprehensive coverage of all traded corporate bond issues, sourced from TRACE Standard and TRACE Enhanced. We use the yield curve constructed by Gürkaynak et al. (2007) to calculate bonds' credit spread by subtracting the yield of the corresponding Treasury security with the same maturity from the yield of the corporate bond. We also use Bloomberg to retrieve euro area corporate option adjusted spread index.

Table 1 reports the summary statistics of the portfolio information for euro area ICPFs and investment funds, and U.S. life insurance companies. It also reports the summary statistics of bonds' average monthly return in a given quarter. Euro area investors tend to hold bonds with higher credit spreads than U.S. investors. The average credit spread for euro area investors around 3.8 %, with a standard deviation of 2.2%. On the other hand, the average credit spread of U.S. life insurers is half the average credit spread for the euro area investors with a smaller standard deviation. U.S. life insurers tend to hold bonds with slightly higher time to maturity compared to other investors. Euro area investors also tend to hold bonds with larger amount outstanding than the U.S. life insurers.

5 Empirical methodology for changes in holdings

In our empirical analysis we focus on the holdings of U.S. NFC bonds by euro area ICPFs and investment funds. The share of these two sectors constitutes 93% of euro area private investor holdings of U.S. NFC bonds and 78% of euro area private investor holdings of all U.S. bonds. We use the notional values in all our analyses such that market prices are not driving the results. Thus these values accurately capture new investments and portfolio shifts reflecting active choices by investors, which is the main focus of this paper.

Our analysis spans from 2016:Q1 to 2020:Q4. We choose this period for three reasons. First, the data quality of SSHS is best during this period. Second, it is a period that has witnessed a full monetary policy tightening-loosening cycle in the U.S. Figure 17 shows that the 3-month Libor rate gradually started to increase from the very end of 2015 to early 2019, and decreased thereafter, reaching 22 bps in 2020:Q4. On the other hand, the euro area monetary policy rate was relatively stable in the negative territory. During this period, euro area institutional investors were already facing a negative return gap as the result of the term and credit spread compression on the back of ECB unconventional monetary policies. Third, the EU's Solvency II directive came into effect in January 2016, pushing euro area insurers to hedge their currency exposures.

5.1 Reaching for Yield at the Extensive Margin

We start with studying whether the incentives of euro area investors to invest in higher-yield bonds in the U.S. is related to the U.S. monetary policy rate. We define the reaching for yield at the extensive margin to be the difference between the weight of U.S. dollar denominated non-Treasury bonds and the weight of dollar denominated Treasury bonds in the bond portfolio. We conjecture that euro area investors who are attempting to achieve a minimum nominal yield due to their liability structure, like ICPFs, increase their reaching for yield when the U.S. monetary policy increases. They do so by investing more in U.S. dollar denominated non-Treasury bonds as compared to dollar denominated Treasury bonds. To test this hypothesis, we run the following regression:

$$\mathrm{W}_t^{NT} - \mathrm{W}_t^{T} = Post_t + \beta\, y_t^{\$} + \epsilon_t \tag{7}$$

where W_t^{NT} is the weight of U.S. dollar denominated non-Treasury bonds in the euro area investor's global bond portfolio, W_t^T is the weight of U.S. dollar denominated Treasury bonds in the euro area investor's global bond portfolio, and $y_t^{\$}$ is the 3-month U.S. dollar Libor rate. To capture the impact of the Federal Reserve Secondary Market Corporate Credit Facility (SMCCF), which was created in the aftermath of the COVID-19 crisis and spurred risk taking, on euro area investors reaching for yield, we include a regression dummy $Post_t$ which is equal to one for quarters starting from 2020:Q2. Table 2 reports the results of the regression characterized in Equation 7. Columns 1 & 2 report that a one percent increase in the 3-month U.S. dollar Libor is associated with a 0.44 and 0.75 percentage point increase in the difference between the weight of U.S. non-Treasury bonds and the weight of Treasury bonds in the bond portfolio for euro area ICPFS and investment funds, respectively. These results imply that when the U.S. monetary policy tightens, euro area investors tilt their portfolios toward non-Treasury dollar denominated bonds.

Euro area investors may be titling their portfolios toward non-Treasury dollar denominated bonds to add duration risk and not to add credit risk. To isolate lengthen the bond portfolio duration channel, we run the following regression:

$$\mathrm{W}^{NT}_{m,t} - \mathrm{W}^{T}_{m,t} = \alpha_m + Post_t + \beta\, y^{\$}_t + \epsilon_{m,t} \tag{8}$$

where $W^{NT}_{m,t}$ is the weight of U.S. dollar denominated non-Treasury bonds in the euro area investor's global bond portfolio with maturity of m years, and $W^{T}_{m,t}$ is the weight of U.S. dollar denominated Treasury bonds in the euro area investor's global bond portfolio with maturity of m years. We also include maturity-bin fixed effects α_m, where m is 0, 1, 2, ..., 30 years. Columns 3 & 4 of Table 2 report that for a given maturity, a one percent increase in the 3-month U.S. dollar Libor is associated with an 0.02 and 0.018 percentage point increase in the difference between the weight of U.S. non-Treasury bonds and the weight of Treasury bonds in the global bond portfolio of euro area ICPFS and investment funds, respectively. These results imply that when the U.S. monetary policy tightens, euro area investors tilt their portfolios toward non-Treasury dollar denominated bonds to add credit risk.

5.2 Reaching for Yield in the NFC Corporate Bond Market

Next, we study whether the incentives of euro area investors to invest in higher-yield bonds *relative* to the market is related to the level of U.S. monetary policy rate. To measure this empirically, we compare the average credit spreads of euro investors' non-financial corporate bond holdings with the average credit spread of the aggregate non-financial corporate bond portfolio (Choi and Kronlund (2017)) and Ozdagli and Wang (2020)) in the WRDS Bond Returns database. We define the relative reaching for yield (RRFY) of the euro investors at date t as the average credit spread of the euro investors' bond portfolio relative to the average credit spread of all outstanding non-financial corporate bonds in the market:

$$RRFY_t = \frac{\sum_i H_{i,t} CS_{i,t}}{\sum_i H_{i,t}} - \frac{\sum_j V_{j,t} CS_{j,t}}{\sum_j V_{j,t}} \tag{9}$$

where $CS_{i,t}$ is the credit spread of bond i defined as yield spread measured as the yield-to-maturity of bond i over the Treasury yield of similar maturity, $H_{i,t}$ is the amount of bond i held by the euro area investors, and $V_{j,t}$ is the total amount of bond j outstanding in the market. Comparing the relative credit spread of euro area investors' portfolio to the market allows us to control for unobservable factors that drive variation in the market credit spreads. We focus on the average credit spread rather than the average total yield to disentangle the effect of euro area investors' reaching for yield by increasing their holdings of bonds with greater credit risk (Becker and Ivashina (2015)) from reaching for yield by lengthening the bond portfolio's duration and adding more duration risk (Ozdagli and Wang (2020)). The main advantage of our approach is that it cancels out any bias, as our RFY measure is defined as deviations of average bonds' credit spread from the average credit spread of other bonds.

Figure 18 plots our RRFY measure versus the 3-month U.S. dollar Libor rate for euro area investors by sector (ICPFs and investment funds). A one percentage point increase in the U.S. dollar rate is associated with a 28 and 33 point increase in the excess credit spreads on NFC bond portfolios of euro ICPFs and investment funds, respectively. These results imply that when monetary policy tightens in the U.S., euro area investors tilt their portfolios toward relatively cheaper (higher-yielding) NFC bonds.

5.3 A demand system for NFC bonds

We next turn to the main test of the empirical predictions derived from our theoretical framework. To bring the predictions of the model to the data, we estimate a demand system for NFC bonds to relate portfolio rebalancing to corporate credit spreads and U.S. monetary policy changes using the asset demand system developed by Koijen and Yogo (2019). This system tests how bond holdings evolve as the U.S. monetary policy rate changes over time. We conjecture that investors with a long-term investment objective due to their liability structure (ICPF) or their attempt to achieve a minimum nominal yield (investment funds) increase their reaching for yield when the monetary policy increases. We define reaching for yield as taking on more risk by acquiring higher yielding bonds, i.e., bonds with higher credit spreads.

For demand curves estimation, we extend the euro area investors' holdings data with the U.S. domestic life insurers' holdings to obtain a larger coverage of U.S. nonfinancial corporate bond holders. Domestic life insurers, who are the largest domestic holders of U.S. corporate bonds, share the same business model as euro area insurance companies and pension funds, making them a suitable placebo. To be comparable with the euro area investors, we aggregate their holdings at the sectoral level.

Formally, investor i's investment in U.S. NFC bond n is denoted by $H_{it}(n)$, and the investment in the outside asset is denoted by $H_{it}(0)$. The portfolio weight in the framework of Koijen and Yogo (2019) is then defined as:

$$w_{i,t}(n) = \frac{H_{it}(n)}{H_{it}(0) + \sum_{n=1}^{n=N} H_{it}(n)} = \frac{\delta_{it}(n)}{1 + \sum_{n=1}^{n=N} \delta_{it}(n)} \tag{10}$$

where $\delta_{i,t}(n) = \frac{H_{it}(n)}{H_{it}(0)}$. The portfolio weight in the outside assets is $w_{i,t}(n) = 1 - \sum_{n=1}^{n=N} w_{it}(n)$. Koijen and Yogo (2019) shows that for investors with mean-variance preferences over returns, returns which are assumed to follow a factor model, and both expected returns and factor loadings which are assumed to be affine in a set of characteristics, we can write the portfolio weight in Equation 10 as a logit function of the credit spread, U.S. monetary policy rate, bond characteristics, and financial macroeconomic variables $X_t(n)$. Koijen et al. (2021) show that we can characterize euro area investors' demand as follows:

$$\log(\mathrm{H}_{i,t}(n)) = \beta_{1,i}\,\mathrm{CS}_{i,t}(n) + \beta_{2,i}\,y_t^{\$} + \beta_{3,i}\,\mathrm{CS}_{i,t}(n)\cdot\,y_t^{\$} + \beta_{4,i}\,y_t^{e} + \beta_{5,i}^{'}\,\mathrm{X}_t(n) + \epsilon_{i,t}(n) \tag{11}$$

where the credit spread $CS_t(n)$ is bond n's risk measure defined as yield spread measured as the yield-to-maturity spread over the Treasury yield of similar maturity. $y_t^{\$}$ and y_t^{e} are the 3-month U.S. dollar and euro Libor rates, respectively. To account for the last component of the cost of currency hedging beside the U.S. dollar and euro libor rates, we include the euro-dollar cross currency basis.

The component of demand that is not captured by prices, characteristics, and time-invariant characteristics, $\epsilon_{i,t}(n)$, is referred to as latent demand.

To control for time-invariant issuer characteristics, all regressions include issuer fixed effects. We also include controls for remaining time to maturity and total amount outstanding as key time-varying bond characteristics that drive demand for bonds. Investors aiming to match their liabilities or trying to achieve certain nominal yields might have a preference for certain maturities. Total amount outstanding is a measure of liquidity that potentially leads to higher or lower demand for certain bonds. To control for alternative investments to U.S. corporate bonds both in the U.S. and the EA, we include the U.S. and euro area term spreads calculated as the 10-year constant maturity minus 3-month Libor rates on the dollar and euro, respectively. As a proxy for the euro area Investment Grade corporate spreads, we use the euro area Corporate Option Adjusted Spreads index.

We capture persistent unobserved characteristics through the lagged investor i's holdings of bond n in the prior quarter t. By conditioning on initial holdings, our identification comes from time-series variation within a bond during a certain quarter. Although time fixed effects would be the most general specification, they would preclude the use of time-series variation to estimate the effect of the change in the U.S. monetary policy and the cost of hedging on the U.S. corporate bond holdings. Finally, we cluster standard errors by issuer because some companies have several traded issues over our sample.

Our main variable of interest is the interaction between the security's credit spread measure and the U.S. dollar Libor rate, CS_{it} x $y_t^{\$}$. So our key coefficient is β_3 which determines the search-for-yield effects through the credit-risk channel. A positive coefficient ($\beta_3 > 0$) would suggest that the higher U.S. monetary policy rate, the more investment is shifted toward riskier U.S. corporate bonds. In other words, this interaction captures whether the euro area investors' propensity to invest in U.S. NFC bonds with a different credit spread is affected by the U.S. monetary policy. That is, we test if euro area investors' allocations across different categories of riskiness vary positively with the U.S. monetary policy. We then interpret a positive coefficient as evidence of a search-for-yield motive since it implies that U.S. monetary policy tightening increases investment in U.S. corporate bonds with higher credit spreads. On the other side, for domestic investors, a negative coefficient ($\beta_3 < 0$) would suggest that the higher the monetary policy rate, the more investment is shifted toward safer U.S. corporate bonds.

5.3.1 Instrumental Variable Approach

In order to obtain consistent estimates of the parameters in Equation 11 using OLS, one has to assume that characteristics and prices (spreads and swap rate) are exogenous to latent demand. We can't assume this exogeniety for three reasons. First, the corporate bond market is dominated by a few key players. And so the investors included in this study cannot be assumed to be atomistic with demand shocks of non-negligible price impact. Second, correlated demand shocks could have price impact in the aggregate, which rules out any factor structure in latent demand. Third, there is a possibility that economic activity fluctuates in response to exogenous non-financial factors, and the swap rate simply reflects these changes in real activity. Consequently, bond specific credit spreads, U.S. and euro area Libor rates and term spreads, and the index of euro area corporate spreads are allowed to be jointly endogenous with latent demand. That is, a correlated positive demand shock to euro area investors can have an impact on credit and term spreads. Equation 11 is therefore estimated by fitting a dynamic panel data model using GMM with an instrumental variable approach.

To identify NFC bonds credit spreads, we construct an instrument based on Koijen and Yogo (2019)'s framework applied to corporate bonds in Bretscher et al. (2020). We use other investors' contemporaneous portfolio holdings as an instrument to isolate exogenous variation in credit spreads. In contrast to their paper, we define the investment holdings of an investor at the sectoral level instead of the fund level. We do so because the euro area investors' holdings are at the sectoral level. To construct this instrument, we extend the holdings of euro area investors and domestic life insurers with the holdings of domestic investment management firms, mutual funds, pension funds, and non-life insurance companies using eMaxx bond holdings.

In estimating sector i's bond demand, the instrument for credit spread of bond n is:

$$\hat{CS}_{i,t}(n) = log\left(\sum_{j\neq i} A_{j,t}\,\frac{\mathbb{1}_{j,t}(n)}{1+\sum_i \mathbb{1}_{j,t}(n)}\right) \tag{12}$$

where $A_{j,t}$ is the total holdings of sector j at time t and $\mathbb{1}_{j,t}(n)$ equals one if sector j at time t has positive holdings of bond n. This instrument depends only on the holdings of other sectors, which are exogenous under our identifying assumptions. The instrument can be interpreted as the counterfactual credit spread if other sectors were to hold an equal-weighted portfolio within their investment universe. For example, the life insurance sector holds an equal-weighted portfolio of NFC bonds, the mutual funds sector holds an equal-weighted portfolio of NFC bonds, and so on. In constructing the instrument for the EA ICPFs (investment funds), we drop the holdings of EA investment funds (ICPFs) from the other sector's holdings universe. We do so because the EA ICPFs own more than 25% (33%) of the bonds held by EA bonds (mixed) investment funds holdings. This makes the holdings of one sector not exogenous to the other.

Following Romer and Romer (2004), we use surprises in the three month U.S. Dollar and Euro LIBOR rates as an instruments to identify the impact of U.S. and euro area monetary policy on portfolio adjustment of euro area investors. Similar to papers that employ intraday measures of monetary policy surprises (e.g., Kuttner (2001), Bernanke and Kuttner (2005), Gürkaynak et al. (2005) and Gertler and Karadi (2015)), surprises in the LIBOR rates are measured within a tight window of 30 minutes of the FOMC and ECB announcements to ensure that the surprises in LIBOR rates solely reflect news about the FOMC and ECB decisions. Similarly, we use the cumulative surprises in the 10-year Treasury and euro area bonds around the FOMC and ECB announcements as the instruments for U.S. and euro area term spreads. To identify the euro area credit spreads index, we use the natural logarithm of ECB bond holdings of non-public sector bonds. These bonds are purchased under the ECB asset purchases programmes that started in 2009, namely asset-backed securities, corporate, and covered bond (1, 2 and 3) purchase programmes. All the variables have a first-stage t-statistic that is well above the critical value of 4.05 for rejecting the null of weak instruments at the 5 percent level (Stock and Yogo (2005)).

In order to quantify the strength of our instruments, we run a first-stage regression of the endogenous independent variable onto its instrument among other instrumental variables, swap basis, the lagged investor holdings of the bond in the prior quarter t-1, and other bond characteristics contained in the vector X_t. We estimate the first-stage regression for each sector. Formally, the first stage regression of the credit spreads is characterized as follows:

$$\mathrm{CS}_{i,t}(n) = \beta_{1,i}\hat{CS}_{i,t}(n) + \beta_{2,i}\ \hat{y}_t^{\$} + \beta_{3,i}\hat{CS}_{i,t}(n) \cdot\ \hat{y}_t^{\$} + \beta_{4,i}\ \hat{y}_t^{e} + \beta_{5,i}^{'}\hat{X}_t(n) + \epsilon_{i,t}(n) \tag{13}$$

where $CS_{i,t}(n)$ is the credit spread of bond n, $\hat{CS}_{i,t}(n)$ is the instrument for credit spread of bond n for investor i defined in Equation 12, $\hat{y}_t^{\$}$ is the instrument for the USD libor rate, $\hat{y}_t^{e}$ is the instrument for the euro libor rate, $\hat{X}_t(n)$ includes the instruments for the USD term spread, euro area term spread and euro area credit spreads index. It also includes the swap basis, the lagged investor holdings of the bond n in the prior quarter t-1, remaining time to maturity and total amount outstanding of bond n. Figure 19 reports t-statistic of the first stage of the credit spreads across our three sectors of interest. That is, all sectors have a first-stage t-statistic above the 4.05 (lower bound in the Figure) for rejecting the null of weak instruments at the 5 percent level (Stock and Yogo (2005)). For all other four endogenous variables, we run the first stage regression in Equation 13. The first-stage t-statistic is well above this critical value for all the four endogenous variables across our three sectors of interest, implying the weak instruments problem does not exist.

5.3.2 Results

Table 3 reports the estimated demand for the U.S. NFC bonds characterized in Equation 11. Columns 1 & 2 report the estimated demand for euro area investors and column 3 reports the estimated demand for U.S. domestic investors. Columns 1 & 2 report the impact of U.S. monetary policy on the degree to which euro area investors rebalance their bond portfolio toward riskier U.S. corporate bonds. The demand of a given bond by euro area ICPFs and investment funds is positively related to our key interaction term, the product of the credit spread on that bond and the U.S dollar Libor. This means that the higher the U.S. monetary policy rate, the larger the holdings of euro area institutional investors of higher-yielding U.S. bonds. Although we cannot reject equality, the coefficient on the bond's credit spread has a negative sign, suggesting that euro area investors are not inclined toward reaching for yield, in general. This is consistent with euro area investors taking a more cautious approach to corporate bonds. The coefficient on the U.S dollar Libor also has a negative sign which means the higher the U.S. monetary policy rate, the less attractive U.S. corporate bonds, as the monetary policy eliminates the yield advantage of the bond.

Column 3 reports the impact of U.S. monetary policy on the degree to which U.S. life insurance companies rebalance their bond portfolio toward riskier U.S. corporate bonds. In contrast with euro area investors, domestic investors have a positive coefficient on the credit spread, which means that their demand is increasing in the credit spread, and there is reaching for yield. However, they have a negative coefficient on the interaction between the 3-month U.S. LIBOR and the credit spread, which means that their reaching for yield is decreasing in the U.S. monetary policy rate. In other words, the domestic investors decrease their reaching for yield when the U.S. monetary policy is tightened. This results in heterogeneity in the effect of U.S. monetary policy on NFC bond holdings across institutional investors with different residencies.

The coefficient on the Euribor for euro area investors is positive which means that the euro area investors' demand for U.S. bonds (including corporate bonds) increases when the cost of currency hedging decreases. The coefficients on the euro area term spread and corporate credit spreads are negative which means that the euro area investors' demand for U.S. bonds (including corporate bonds) is higher when the investment opportunities deteriorate in the euro area. In contrast to domestic lifers and their inherent need to match long-term liabilities with long-term bonds, euro area institutional investors hold U.S. corporate bonds with shorter maturity. This is likely driven by "search for yield" by taking extra credit risk at shorter maturities as the result of the term premia compression during monetary tightening.

Domestic life insurers are more persistent in their NFC bond portfolio than euro area investors. Their holdings in the prior quarter $t-1$ have a higher coefficient, closer to one. This is consistent with euro area investors having a larger propensity to sell U.S. corporate bonds because of a change in the FX currency hedging cost or in times of market stress. Finally, euro area investors have a preference for bonds with a larger amount outstanding compared with domestic life insurance companies, implying a preference for more liquid bonds. This is consistent with domestic life insurers holding the least liquid bonds if they can get compensated for doing so due to their long-term liability structure (Becker and Ivashina (2015)). This makes sense especially given they do not face the same dynamic FX hedging cost as their euro area counterparts.

5.3.3 Robustness Check

The main theme of our identification strategy explained in Section 5.3.1 is that the instrument for the credit spread at the bond level exploits variation in the investment universe across investors and in the size of potential investors across bonds. Given that our holdings data is at the sectoral level, one concern is that bonds with small issue outstanding may have a small exogenous component of demand as the holdings of this bond may be dominated by one sector and not included in the investment universe of others. As a robustness check, we estimate the specification in Equation 11 for different levels of issue outstanding. Figure 20 reports our key interaction term at different levels of bond issue outstanding across our three sectors of interest. Across our three sectors of interest, the interaction coefficient is overall decreasing in absolute value for higher levels of issue outstanding. For the euro area investors, the coefficient is relatively stable in terms of economic and statistical significance. For domestic life insurers, the economic significant of the interaction coefficient is steadily decreasing for higher levels of bonds issue outstanding. This is likely driven by the least liquid bonds being dominantly held by domestic life insurers. These bonds have small issue outstanding and hence small exogenous component of demand.

As an alternative approach to characterize our demand system, we will combine the three components of the hedging costs $y_t^{\$}$, y_t^e and swap basis into one variable, which we call the swap rate. Formally, we characterize our demand system as follows:

$$\log(\mathrm{H}_{i,t}(n)) = \beta_{1,i}\,\mathrm{CS}_{i,t}(n) + \beta_{2,i}\,\mathrm{Swap}_t + \beta_{3,i}\,\mathrm{CS}_{i,t}(n)\cdot\mathrm{Swap}_t + \beta_{4,i}^{'}\mathrm{X}_{i,t}(n) + \epsilon_{i,t}(n) \tag{14}$$

where Swap_t is the 3-month euro-dollar swap rate. We identify the impact of cost of currency hedging on portfolio adjustment of euro area investors using the cumulative difference in surprises between the three month U.S. Dollar and Euro LIBOR rates as an instrument for the 3-month swap rate. The minimum first-stage t-statistic for the swap rate across our three sectors of interest is 67.92, implying a strong instrument.

Table 4 reports the estimated demand for the U.S. NFC bonds characterized in Equation 14. Columns 1 & 2 report the impact of cost of currency hedging on the degree to which euro area investors rebalance their bond portfolio toward riskier U.S. corporate bonds. Euro area ICPF and investment funds sectors' demand of a given bond is positively related to our key interaction term, the product of the credit spread on that bond and the swap rate. This means that the higher the swap rate, the larger the holdings of euro area institutional investors' of higher-yielding U.S. bonds. Similar to the results from the estimated demand system in Equation 11, the coefficient on the bond's credit spread have negative signs. The coefficient on the swap rate is negative which implies the higher cost of hedging, the less the attractiveness of U.S. corporate bonds, as the yield advantage gets eliminated. Column 3 reports the impact of U.S. monetary policy on the degree to which U.S. life insurance companies rebalance their bond portfolio toward riskier U.S. corporate bonds. As expected, the coefficient on the interaction term has no statistical or economic significance. This can be explained by domestic life insurers holding the majority of their bond portfolio in the domestic (corporate) bond market. Therefore, the euro-dollar swap rate is irrelevant.

The coefficient on the U.S. term spread for the euro area ICPFs is positive, which means that euro area investors' demand for U.S. bonds (including corporate bonds) is higher when investment opportunities improve in the U.S. On the other hand, and similar to the estimated demand system in Equation 11, the coefficients on the euro area term spread is negative, which means that euro area investors' demand for U.S. bonds (including corporate bonds) is higher when investment opportunities deteriorate in the euro area.

6 Implications of Reaching for Yield

In the previous sections, we have documented that euro area investors tend to reach for yield by rebalancing their portfolios toward corporate bonds with higher yield spread following U.S. monetary policy tightening. In this section, we investigate whether reaching for yield on the part of euro area investors can have implications for bond prices. We hypothesize that U.S. monetary policy tightening compresses the term spread, erasing the yield on Treasury bonds that euro area investors can earn on a hedged basis, which spurs an increase in their demand for corporate bonds with high yield spreads, thereby creating an upward price pressure in the valuations of corporate bonds.

To test the hypothesis regarding the price pressure exerted by euro area investors' reaching for yield behaviour, we examine the path of bond abnormal returns around euro area investors' purchases. We run the following regression using a framework similar to Chodorow-Reich et al. (2020):

$$Abret_{i,t+h} = \alpha\, EAbuy_{i,t} + \beta\, EAbuy_{i,t} \cdot y_t^{\$} + \gamma\, \mathrm{X}_{i,t} + \epsilon_{i,t} \tag{15}$$

where $EAbuy_{i,t}$ is an indicator variable which equals one if euro area institutional investors in aggregate buy bond i in quarter t and $y_t^{\$}$ is the three month U.S. dollar Libor instrumented with the monetary policy shocks to LIBOR rates. To adjust for risk, the average of monthly abnormal return of bond i in quarter t, denoted as $Abret_{i,t}$, is calculated as its raw return minus the return on the benchmark portfolio to which it belongs. Using the characteristics-based procedure in Bessembinder et al. (2008) at a more granular level, the portfolio benchmarks are created based on remaining time-to-maturity and bond credit rating. At the end of every quarter, bonds are first segmented into 31 time-to-maturity groups (0, 1, 2 and up to 30 years) and then 11 credit rating groups (AAA, AA, A, BBB, ..., D and not rated). This gives a total of 341 groups of bonds. For each group, the equal-weighted return is computed and used as the benchmark portfolio return. Following Chodorow-Reich et al. (2020), we include in the control set $X_{i,t}$ the time fixed effects, coupon rate and squared coupon rate of the bond, and the change of the yield on a maturity-matched treasury .

The coefficients of interest are α on the variable EAbuy and β on the interaction term $EAbuy$ x $y_t^{\$}$.

While the coefficient α measures the difference in abnormal returns between bonds bought by euro area investors and those that are not during a certain quarter, the coefficient β captures the additional difference in abnormal returns as a result of the U.S. monetary policy tightening. When the U.S. monetary policy is tightened, corporate bonds purchased by euro area investors are likely to be under price pressure. Therefore, if reaching for yield creates upward price pressure, then the coefficient on the interaction term $EAbuy\ x\ \ y_t^{\$}$ should be positive.

The results are displayed in Raw Qtr = 0 of Table 5. Notice that bonds purchased by euro area investors during quarters with monetary policy tightening exhibit striking positive abnormal returns, as evidence by the positive and significant coefficient on the interaction term $EAsbuy$x $y_t^{\$}$. In particular, as a result of a one percent increase in the 3-month U.S. dollar Libor rate, the difference in the monthly abnormal returns between bonds bought by euro area investors and those that are not increases by 22 basis points on a monthly basis.

To differentiate euro area investors bringing information into prices from exerting price pressure, following Coval and Stafford (2007), we look for evidence of price reversals through extending the time horizon of the dependent variable Abret in Equation 15 from t - 4 to t + 4. The results are presented in Table 5. The coefficients on the interaction term $EAsbuy$x $y_t^{\$}$ are plotted in Figure 21 which shows an upside-down V shape price pattern centering around Qrt 0 of euro area investors' buying, indicating that the returns reverse over the quarter that follows. To put all results above into a difference-in-difference perspective: During quarters with high U.S. dollar Libor rates, there is upward price pressure from euro area investors buying of corporate bonds. Hence, the results demonstrate that the price pressure is generated by EA purchases associated with reaching for yield as the U.S. monetary policy rate increases and term spread get compressed.

As an alternative approach to using abnormal returns to evaluate the price pressure exerted by euro area investors, we use the average monthly raw return in a given quarter. This allows us to estimate the price elasticity. We run the following regression using a framework similar to Bretscher et al. (2020):

$$ret_{i,t+h} = \alpha_i + \alpha_t + \gamma\, EAbuy_{i,t} + \beta\, EAbuy_{i,t} \cdot y_t^{\$} + \epsilon_{i,t} \tag{16}$$

where $ret_{i,t}$ is the average of monthly abnormal return of bond i in quarter t. We include bond (α_i) and time fixed (α_t) effects. The results of the regression in Equation 16 are presented in Table 6. Similar to the results using the abnormal returns in Equation 15, with a one percent increase in the U.S. dollar Libor, the difference in average monthly raw returns between bonds bought by euro area investors and those that are not increases by 12 basis points. In addition, the coefficients on the interaction term $EAsbuy$x $y_t^{\$}$ which are plotted in Figure 22 show an upside-down V shape price pattern centering around Qrt 0 of euro area investors' buying indicates that the returns reverse over the quarter that follows.

To quantify the price pressure exerted by euro area investors, we follow Coval and Stafford (2007) and Lou (2012) and define it as the net purchases (sales) by euro area investors of a certain bond in a particular quarter scaled by the lagged bond amount outstanding from the prior quarter. Formally, $\%\Delta Demand_{i,t}$ is defined as follows:

$$\%\Delta Demand_{i,t} = -100 * \frac{\Delta Demand_{i,t}}{Outstanding_{i,t-1}} \tag{17}$$

The average price pressure exerted by euro area investors when they buy a U.S. corporate bond is 0.20 %. As defined in Equation (18) and to relate our results to the literature and to estimate price elasticity, we divide our measure of price pressure by the positive coefficient of the interaction term between EAbuy and the U.S. Libor rate of 0.12% which yields a price elasticity of -1.67. This is very similar to the demand elasticity reported in Chang et al. (2014) which is -1.46 in the cross section of U.S. stocks.

$$Elasticity = -\frac{1}{\%\,\Delta Demand / \Delta Return} \tag{18}$$

Finally, we investigate whether reaching for yield on part by euro area investors can have implications for corporate bond issuance. Similar to prices, we hypothesize that an increase in monetary policy rate spurs an increase in euro area investors' demand for corporate bonds, thereby facilitating larger issuance or even giving incentives for larger bond issuance by corporations. To test this hypothesis, we run the following regression similar to Todorov (2020) and Siani (2019):

$$log(\text{Issuance}_{i,t}) = \beta\, EAbuy_{i,t} \cdot y_t^{\$} + \gamma \text{X}_{i,t} + \epsilon_{i,t} \tag{19}$$

where $log(\text{Issuance}_{i,t})$ is the natural logarithm of the issuance amount of bond i issued in quarter t. We include in the control set $X_{i,t}$ the time and issuer fixed effects, coupon rate and squared coupon rate of the bond, and the maturity of the bond. SHSS does not distinguish between bonds acquired in the primary market or the secondary market, we consider euro area investors to have participated in the issuance of a bond if they purchased such bond in the same quarter when it was issued. The first column in Table 7 shows that the coefficient on the interaction term EAbuy x USD Libor is positive and statistically significant.

We next explore whether there are differences in effects by types of bonds. It could be that risk-taking by euro area investors is related to monetary policy tightening, but only within certain categories of corporate bonds. We divide the universe of bonds into various groups: AAA/AA/A-rated bonds, BBB-rated bonds, non-investment grade bonds and non-rated (NR) bonds. Among the rated groups, Table 7 shows that the estimated effect for the USD Libor interaction is only statistically significant within the set of BBB-rated bonds (column 3). We then test the same hypothesis using the total bond issuance at the firm level by running the following regression:

$$log(\text{Issuance}_{f,t}) = \beta\, Hold_{f,t} \cdot y_t^{\$} + \epsilon_{f,t} \tag{20}$$

where $log(\text{Issuance}_{f,t})$ is the natural logarithm of the total bond issuance amount of by firm f in quarter t and $Hold_{f,t}$ is an indicator variable which equals one if euro area institutional investors in aggregate hold at least one bond issued by firm f in quarter t. Similar to the results at the bond level, among the rated groups, Table 8 shows that the estimated effect for the USD Libor interaction is only statistically significant within the set of BBB-rated issuers (column 3). This shows that reaching for yield on the part of euro area institutional investors contributed to the rapid growth of the BBB bond market. Overall, this table suggests that euro area investors' risk taking increases in the U.S. corporate bond when the U.S. monetary policy tightens.

7 Conclusion

Using unique security-level holdings data for euro-area investors, we study the impact of currency hedging on bond portfolio rebalancing, reaching for yield, and bond prices. We find that euro area insurance companies, pension funds, and investment funds, which are among the largest players in the U.S. non-financial corporate (NFC) corporate bond market, shift their bond portfolios toward corporate bonds with higher credit spread as U.S. monetary policy tightens.

We estimate a demand system for U.S. NFC bonds using instrumental variables to relate portfolio rebalancing to credit spreads and the stance of U.S. monetary policy. Our results highlight significant heterogeneity between euro area institutional investors and domestic life insurers. In particular, while the former increase their holdings of corporate bonds with higher credit spreads when U.S. monetary policy is tightened, the latter reduce such holdings. This result highlights fundamentally different incarnations of reaching for yield behaviour between the two types of investors reflecting the effect of currency hedging implemented by foreign investors. We further find corroborating evidence that reaching for yield on the part of euro area investors can drive overpricing of corporate bonds when U.S. monetary policy tightens. It can also facilitate larger bond issuance or even give incentives for larger issuance by U.S. corporations, especially BBB-rated corporations.

The results point to a new amplifying mechanism that contributed to the crash of the U.S. corporate bond market in the wake of the COVID crisis in 2020. When a shock hits the economy, the Federal Reserve loosens monetary policy and the yield curve steepens. This induced euro area investors to re-balance their bond portfolio back to Treasury and safer corporate bonds as their hedged return increased. This in turn led to high selling pressure in the corporate bond market, especially in the market segment with the lowest credit quality.

More generally, our analysis suggests that inflows by foreign institutional investors from low-yielding jurisdictions have contributed to the easing of financial conditions in the corporate bond market and have probably been a major driving force of the build up of corporate debt in the U.S. over the past decade, especially by BBB-rated corporations. At the same time, they may have had a profound impact on the transmission of the Federal Reserve's monetary policy to domestic financial conditions. Previous papers have analyzed the risk-taking channel of monetary policy working through domestic banks and institutional investors. Our paper shows how U.S. monetary policy affects the portfolio allocation of foreign investors who reach for yield. The results suggest that the FX hedging channel of foreign investors works in the opposite direction of the classical risk-taking channel for domestic investors, thus potentially weakening the effectiveness of U.S. monetary policy.

The analysis of our paper suggests interesting avenues for future research. Our framework could be applied to also analyze the extent to which other foreign investors, especially large East Asian (Japan, Korea, Taiwan) institutional investors, shift the composition of their U.S. corporate bond holdings in response to changes in U.S. monetary policy. Breuer et al. (2019) shows that large East Asian life insurers added more than $0.4 trillion in new investments in U.S. dollar–denominated credit during 2013–18. Their combined share of the market rose from 8 percent in 2013 to 11 percent in 2018. East Asian investors are facing the same return gap challenge as euro area investors but at a larger scale, given the tiny size of their domestic corporate bond market (Figure 4). In addition, Japanese investors have been facing a return gap and hedged return challenges for a longer period of time period. Figure 23 shows that Japanese investors have been facing negative hedged returns on their Treasury bond investments already since before the 2008 financial crisis. However, the main challenge in performing this analysis remains the availability of security-level data at the holder sectoral-level, similar to the ECB SHSS.

Our framework could also be used to analyze the extent to which euro area and East Asian investors adjust their holdings of U.S. dollar denominated of emerging market economies (EMEs). Exploring this question could shed light on the impact of institutional investors' risk-taking on the financial stability challenges of EMEs. Such an analysis could be helpful to understand better the continued challenges of EMEs from capital flows highlighted in the recent debate about the design of

EME macro-financial stability frameworks.

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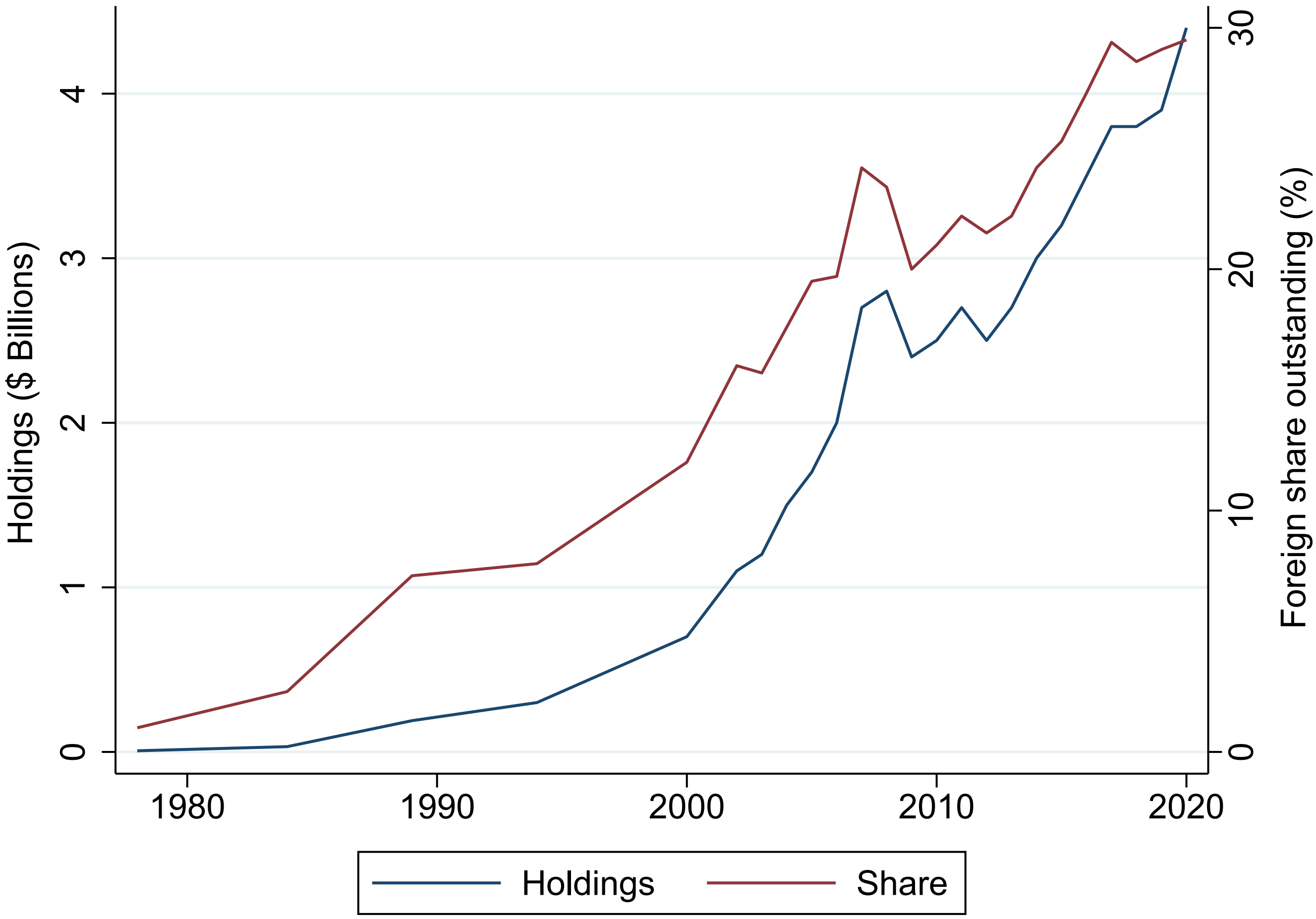
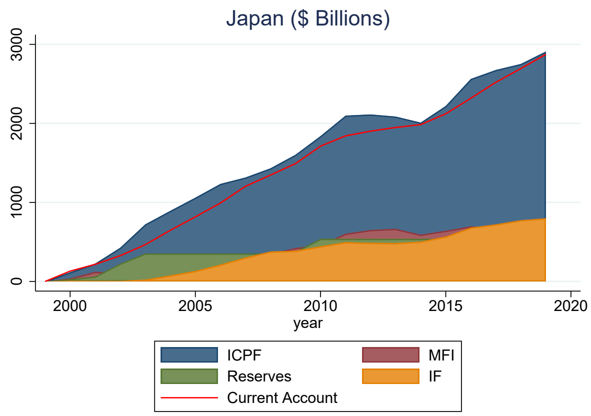
Figure 1: Foreign Holdings of U.S. Corporate Bonds

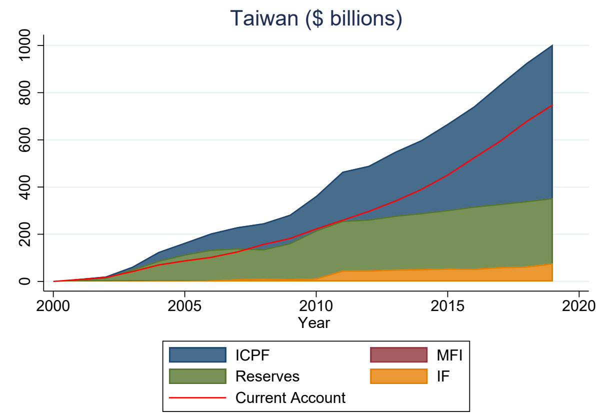


This figure reports the market value of U.S. corporate debt holdings by foreign investors and their share of the outstanding U.S. corporate bond market. The figure includes 1974, 1984, 1989, 1994, 2000, and then on an annual basis from 2002 to 2020. The data source is the Treasury International Capital System (TIC) SHL Annual Survey.

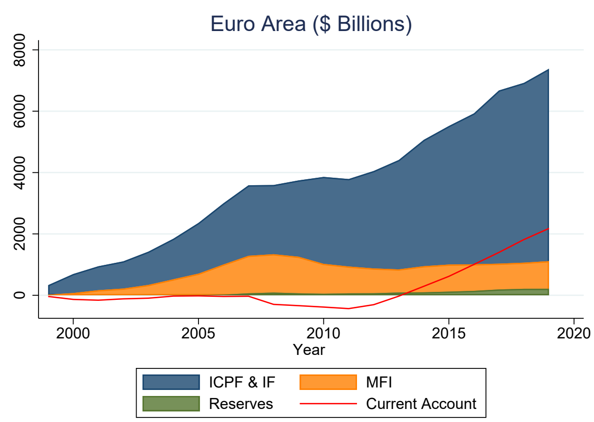
Figure 2: Accumulation of Foreign Assets



(a) Japan



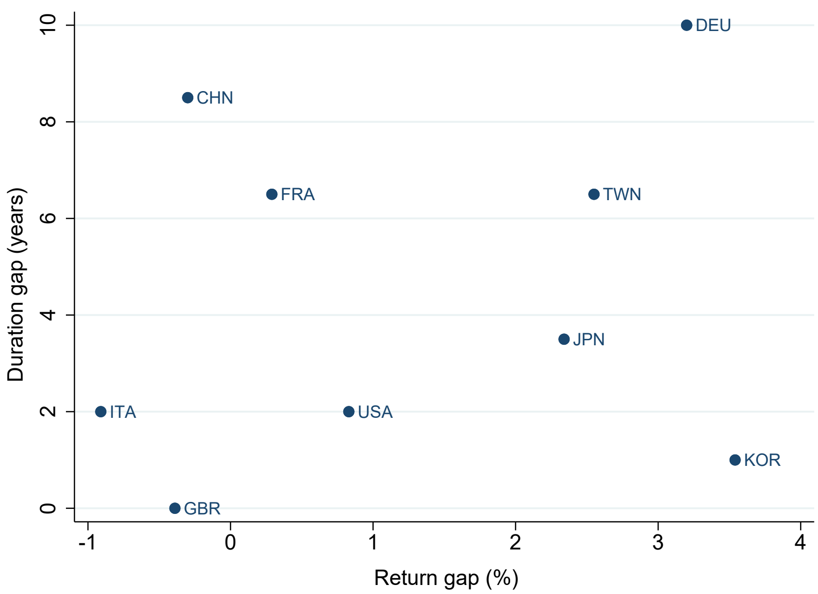
(b) Taiwan



(c) Euro Area

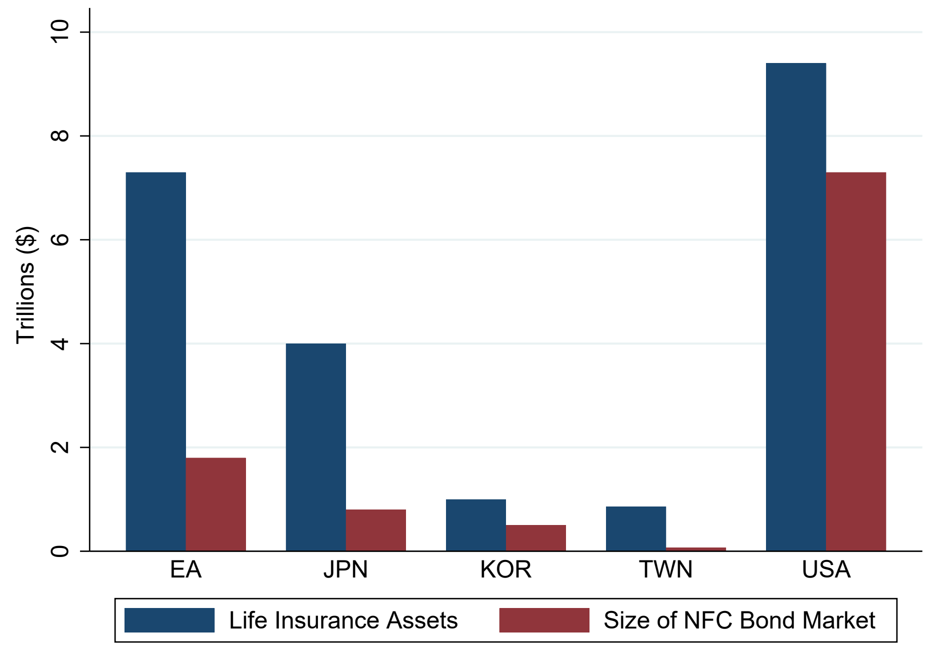
This figure reports the cumulative acquisitions of foreign assets by insurance companies and pension funds (ICPF), investment funds (IF), central banks (Reserves) and monetary financial institutions (MFI) in Japan, Taiwan, and the euro area from 2000 to 2019. For the euro area, the acquisitions of the insurance companies and pension funds are consolidated with the acquisitions of the investment funds. The data sources are Bank of Japan, the Central Bank of the Republic of China, and the European Central Bank.

Figure 3: Life Insurers: Guaranteed Return Spreads and Duration Mismatches



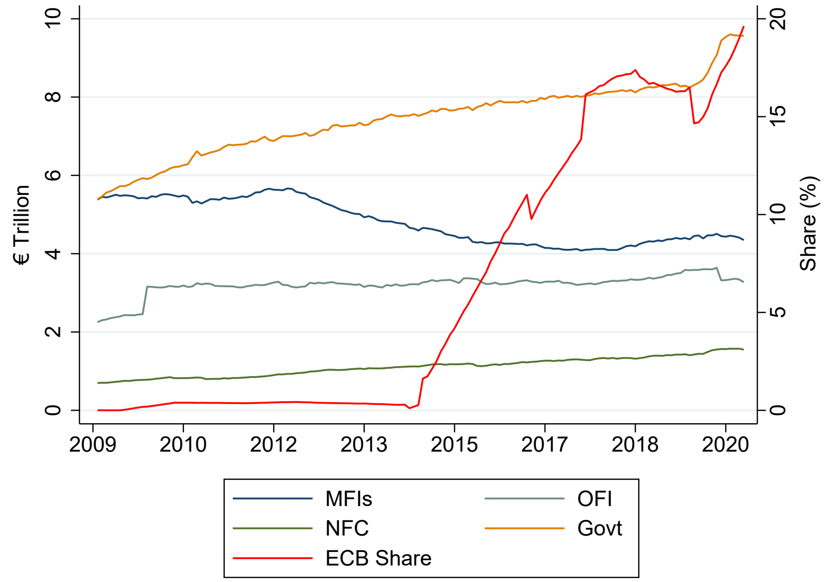
The figure plots the gap between the guaranteed returns and domestic sovereign 10-years bond yields, as well as duration mismatches between assets and liabilities for the nine jurisdictions with the largest life insurance sectors. The nine jurisdictions account for 73 percent of the world's life insurance premiums. Data labels use International Organization for Standardization (ISO) country codes. The data source is the October 2019 Global Financial Stability Report report by the International Monetary Fund.

Figure 4: Domestic Nonfinancial Corporate Bond Market and Life Insurance Industry Size



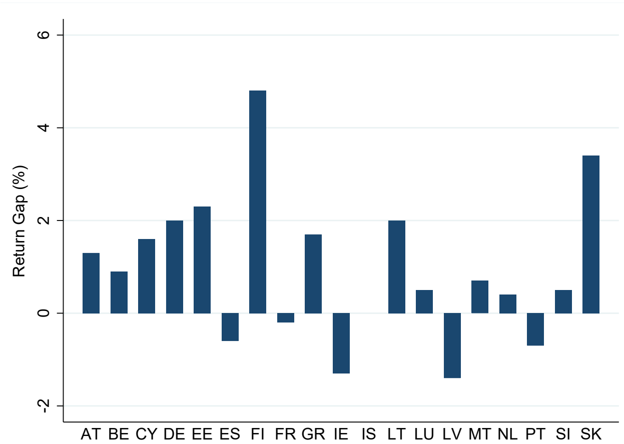
This figure plots the life insurance assets and the size of the domestic nonfinancial corporate bond market for the euro area, Japan, Koea , Taiwan and the United States at the end of 2020. The data source for the life insurance companies assets is the central bank of the jurisdiction. The data source for the outstanding nonfinancial corporate bond market is the debt securities statistics of the Bank For International Settlements.

Figure 5: Euro Area Bond Market



This figure reports the face value of debt outstanding for governments (GOVT), banks (MFI), nonbank financial firms (OFI), and nonfinancial (NFC) firms in the euro area from January 2009 to December 2020. It also reports the share of the European Central Bank holdings in the euro area bond market. It is calculated as the total euro area bonds held by the European Central Bank multiplied by the 100 divided by the total outstanding bonds in the euro area which is the sum of the debt outstanding for governments (GOVT), banks (MFI), nonbank financial firms (OFI), and nonfinancial (NFC) firms. The data source is the European Central Bank's Statistical Data Warehouse.

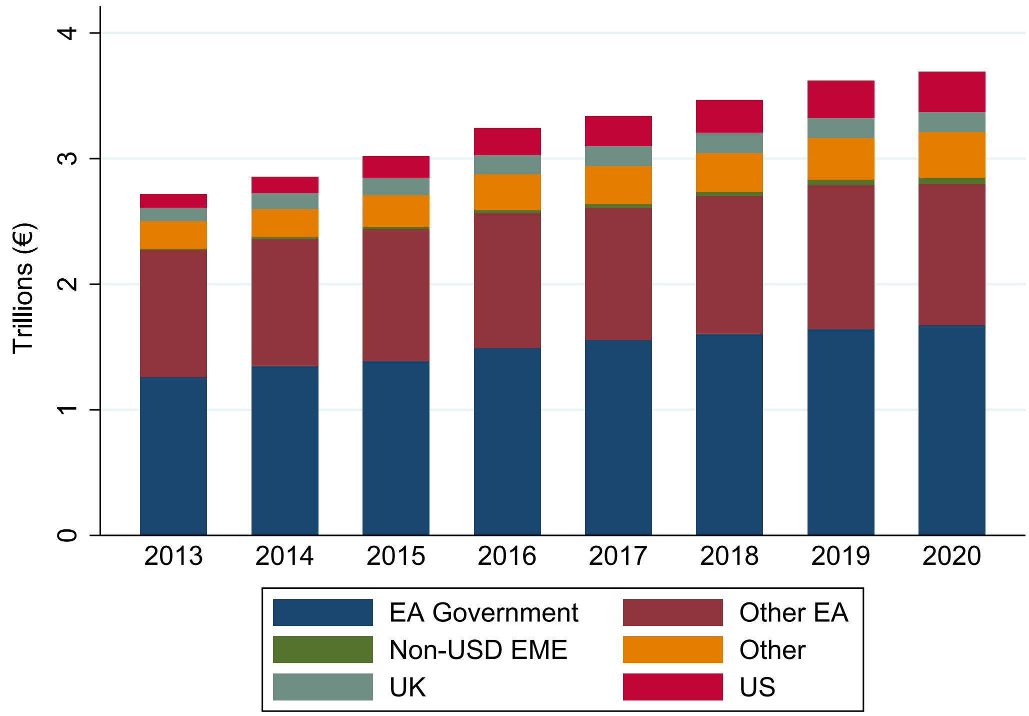
Figure 6: Life Insurers: Guaranteed and Investment Return



The figure reports the difference between the weighted average guaranteed interest rates and the return gap return on investment including unrealised gains/losses for Q4 2018 for life insurers and composites in the euro area. Data labels use International Organization for Standardization (ISO) country codes. The data source is the European Insurance and Occupational Pensions Authority (EIOPA).

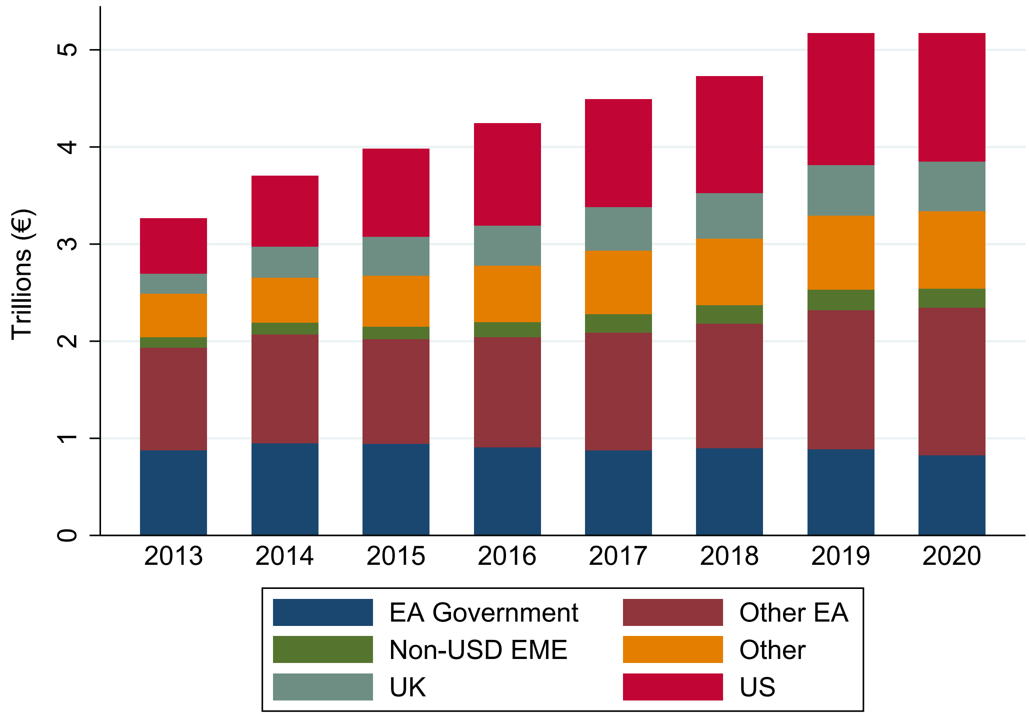
Notes* Due to the data availability, we use the return on investments excluding the unrealised gains/losses for the Netherlands (NL)

Figure 7: Euro Area Insurance Companies and Pension Funds Portfolio Rebalancing



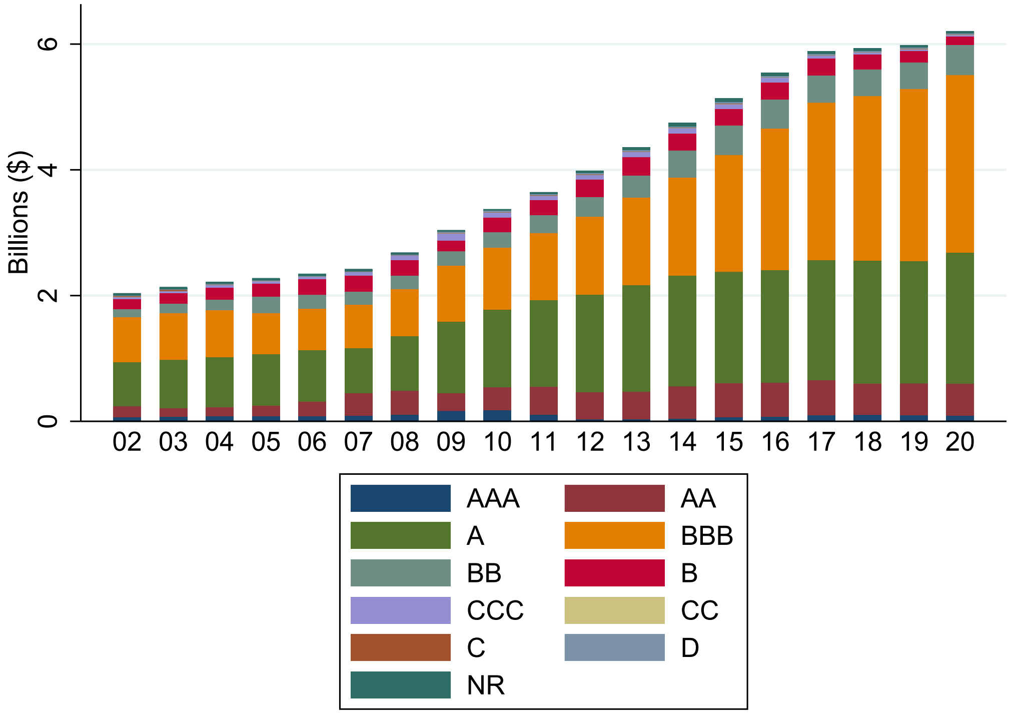
This figure plots the notional amounts of bond holdings by euro area insurance Companies and pension funds by issuer type from 2013 to 2020. "EA Government" refers to bonds issued by euro area governments, "Other EA" refers to bonds issued by monetary financial institutions, nonfinancial corporations and other financial institutions in the euro area. "UK" refers to the bonds issued by the UK government, monetary financial institutions, nonfinancial corporations and other financial institutions. "US" refers to the bonds issued by the U.S. government, monetary financial institutions, nonfinancial corporations, other financial institutions and U.S. dollar denominated bonds issued by emerging market economies (EMEs). "Non-USD EME" refers to euros or local currencies denominated bonds issued by EMEs. "Other" refers to bonds issued in other European Union countries, other advanced economies or offshore centers.

Figure 8: Euro Area Investment Funds Portfolio Rebalancing



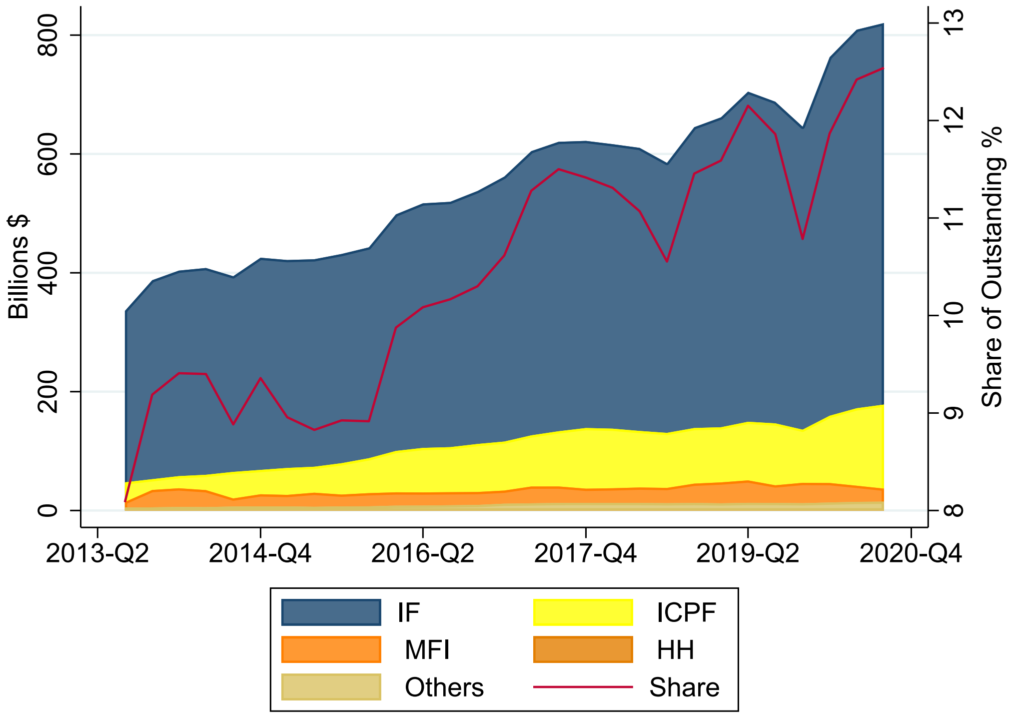
This figure plots the notional amounts of bond holdings by euro area investment funds by issuer type from 2013 to 2020. "EA Government" refers to bonds issued by euro area governments, "Other EA" refers to bonds issued by monetary financial institutions, nonfinancial corporations and other financial institutions in the euro area. "UK" refers to the bonds issued by the UK government, monetary financial institutions, nonfinancial corporations and other financial institutions. "US" refers to the bonds issued by the U.S. government, monetary financial institutions, nonfinancial corporations, other financial institutions and U.S. dollar denominated bonds issued by emerging market economies (EMEs). "Non-USD EME" refers to euros or local currencies denominated bonds issued by EMEs. "Other" refers to bonds issued in other European Union countries, other advanced economies or offshore centers.

Figure 9: Outstanding Corporate Bond Market Breakdown



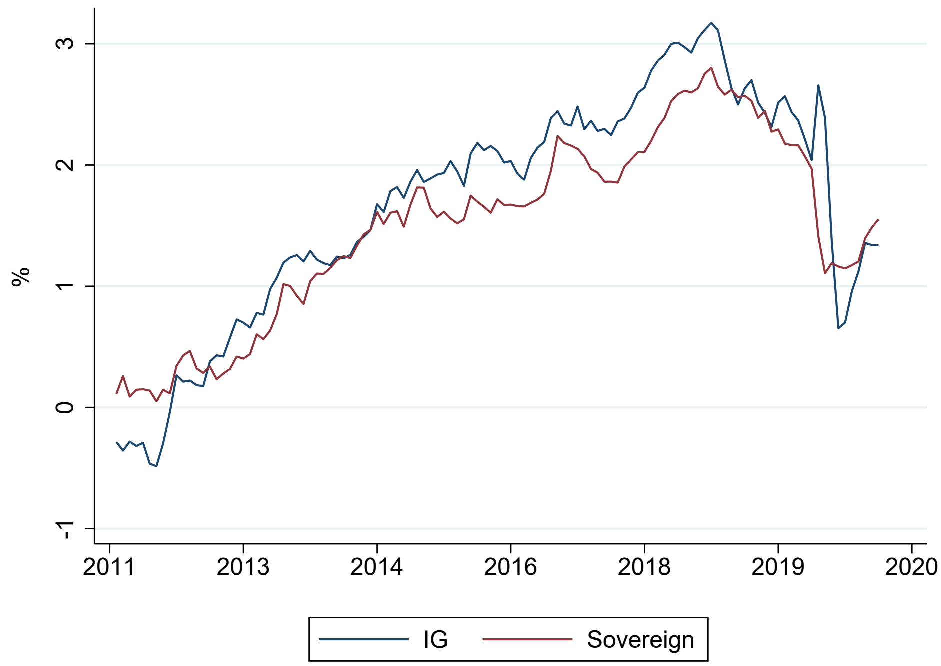
This figure plots the outstanding corporate bonds by credit rating from 2002 to 2020. The data source is Wharton Research Data Services (WRDS) Bond Returns.

Figure 10: Euro Area Investors' Holdings of U.S. NFC Bonds Breakdown



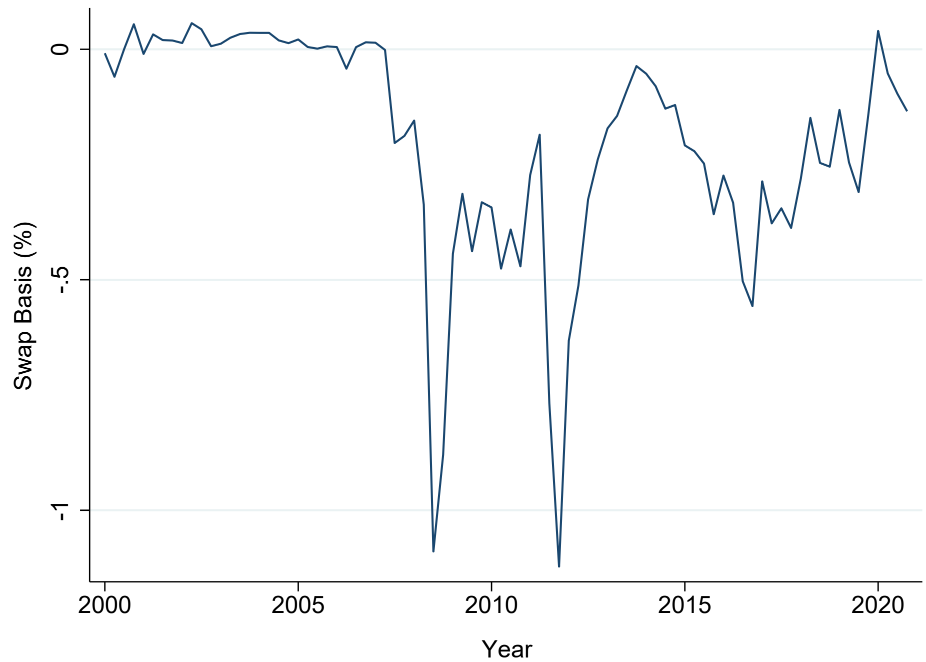
This figure plots the euro area investors' holdings U.S. nonfinancial corporate bonds by investor type from 2013:Q4 to 2020:Q4. The share outstanding is calculated as the euro area investors' holdings in Euros multiplied by the Euro-Dollar exchange rate multiplied by 100 divided by the outstanding nonfinancial corporate bond. "IF" refers to investment funds. "ICPF" stands for insurance companies and pension funds. "MFI" refers to monetary financial institutions. "HH" refers to households. "Others" refers to governments and non-financial corporations. The holdings data comes from the European Central Bank's Securities Holdings Statistics. The outstanding nonfinancial corporate bonds data comes from Federal Reserve Statistical Release Z.1, Financial Accounts of the United States, Table 213 line 2.

Figure 11: Excess Returns on U.S. Bonds over Euro Area Bonds



This figure plots excess returns on 10-year U.S. Treasury bonds over the 10-year German Bunds and on U.S. investment-grade corporate Bonds over euro area investment-grade corporate bonds from June 2011 to December 2020. The U.S. investment corporate bonds is the SP 500 Investment Grade Bond Index. The euro area investment-grade corporate bonds is the SP Eurozone Investment Grade Corporate Bond Index. The date source for the sovereign returns is the Federal Reserve Bank of St. Louis. The data source for the corporate bonds returns is SP Global Market Intelligence.

Figure 12: Short-term Euro/Dollar Basis



This figure plots the three-month Libor cross-currency basis, measured in percentage points for euro/dollar. The data is on quarterly basis from 2000:Q1 to 2020:Q4. The date source is Bloomberg.

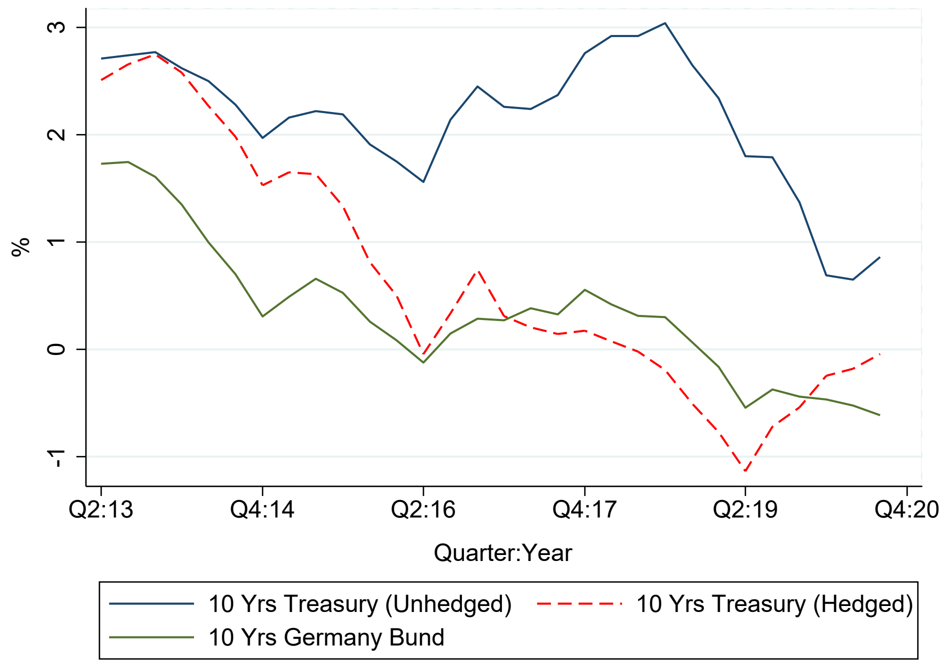
Figure 13: The Relationship between U.S. Term Spread and U.S. Monetary Policy

This figure plots the coefficient on the federal funds rate from the following rolling window regression:

$$TS_t = \alpha + \beta\, FFR_t + \epsilon_t$$

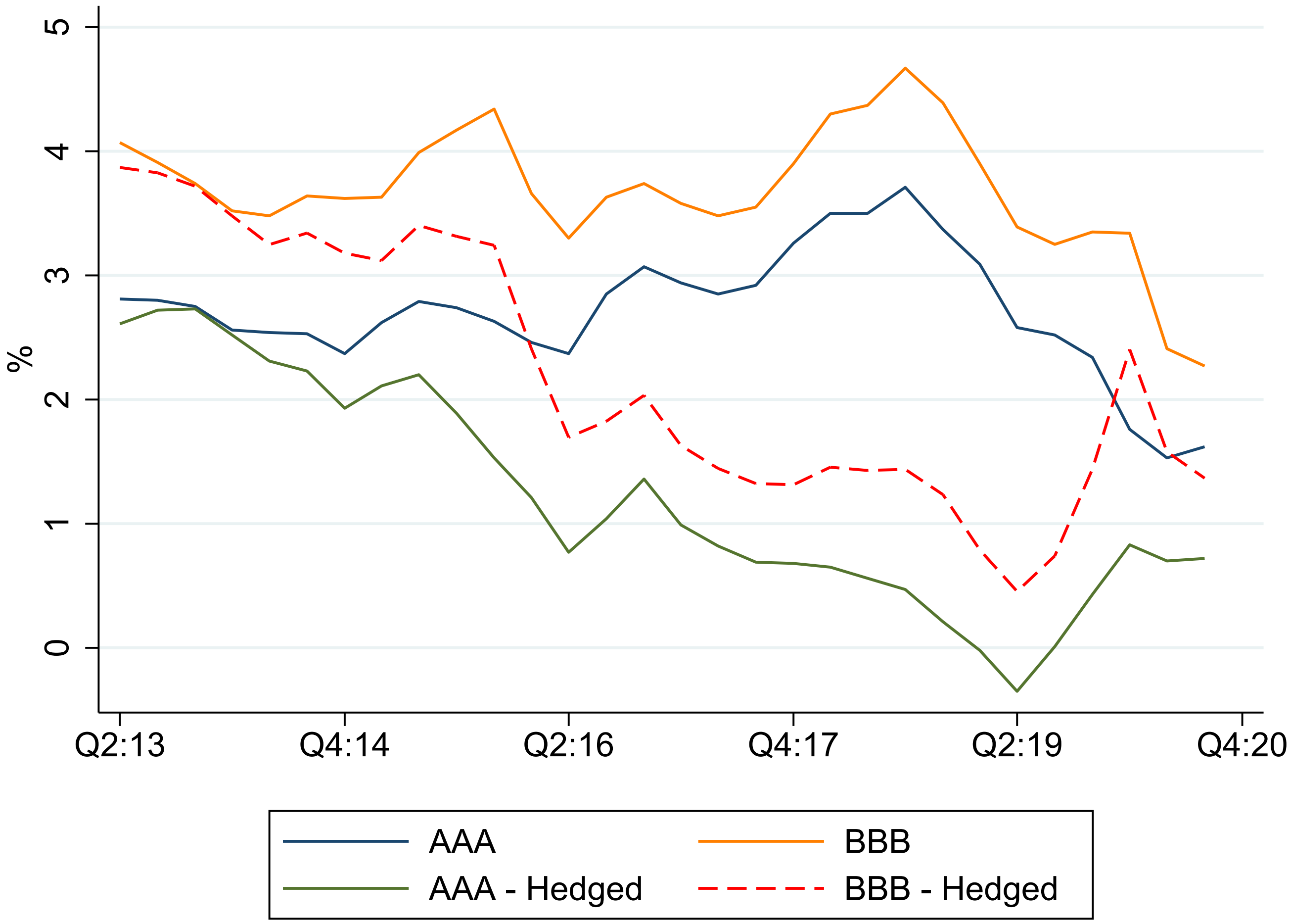
The window of the rolling regressions is 20 quarters. TS_t is the term spread in quarter t calculated as the return on the 10-years Treasury bonds minus the return on the 3-month Treasury bill and FFR_t is the federal fund rate in quarter t. The coefficients are presented in percentage points. The quarterly sample period is from 1982:Q1 to 2020:Q4. Dashed lines represent 95% confidence intervals on the point estimates for each horizon based on standard errors clustered by time.

Figure 14: Treasury Returns for European Investors



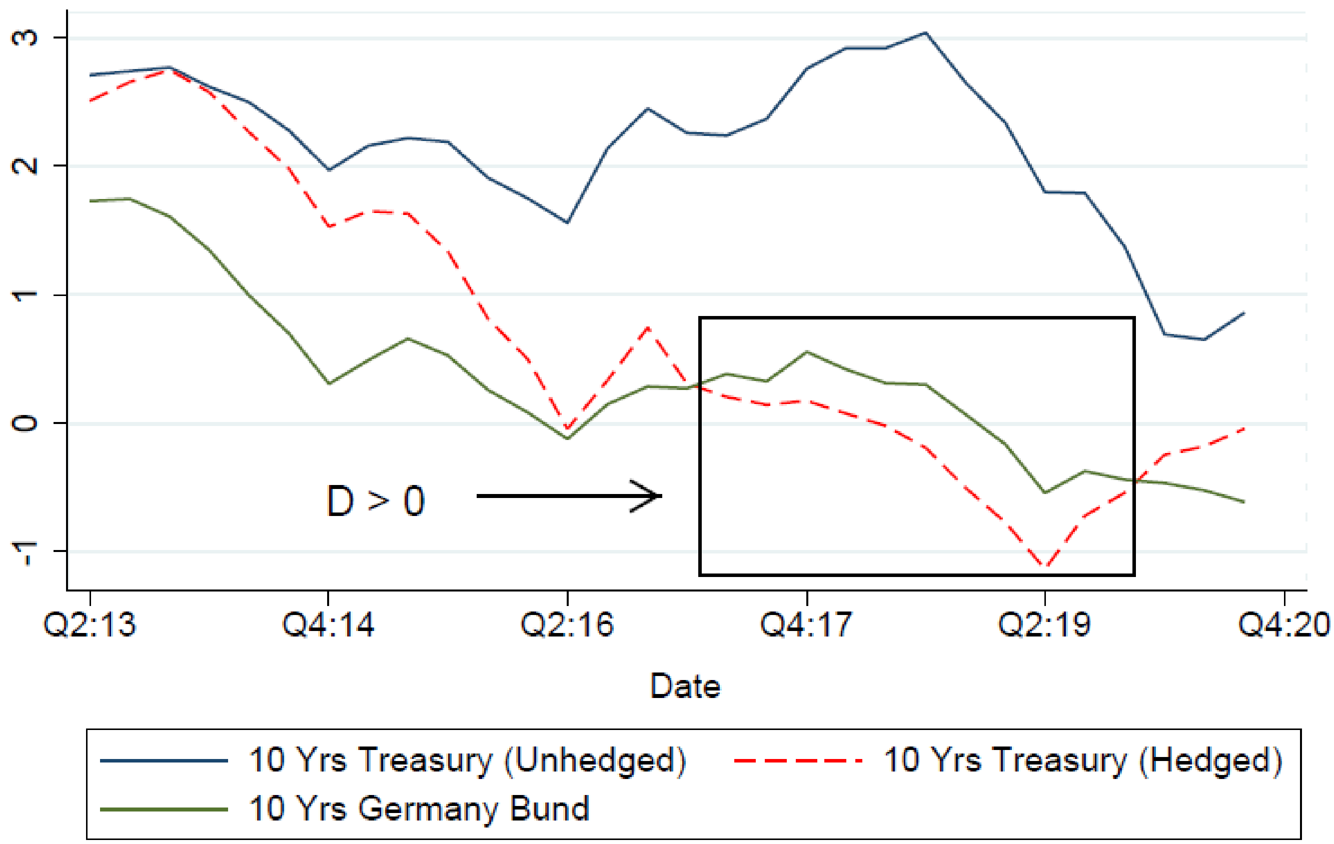
This figure plots the unhedged yields on the 10-years U.S. Treasury bonds, hedged yields on the 10-years U.S. Treasury bonds, and yields on the 10-years German Bunds on quarterly basis from 2013:Q2 to 2020:Q4. Hedged yields assume a rolling three-month Euro-Dollar cross currency swap hedge. In particular, the hedged yield is the yield on the 10-years U.S. Treasury bonds minus the 3-month Euro-Dollar swap rate. The date source for the returns on the 10-years Treasury bond and German Bund is the Federal Reserve Bank of St. Louis. The data source for the swap rate is Bloomberg.

Figure 15: Corportae Bond Returns for European Investors



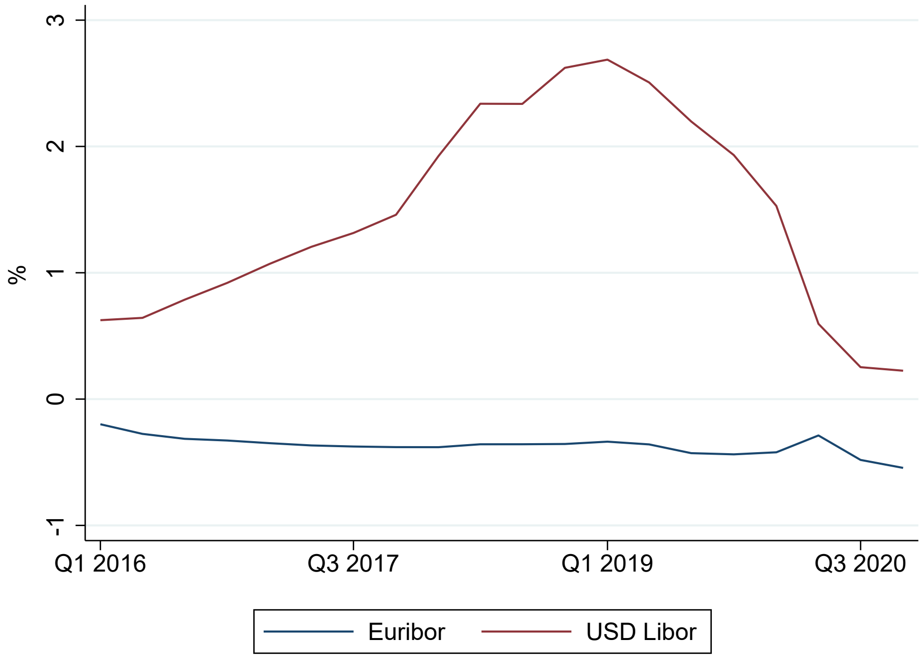
This figure plots the unhedged and hedged yields on the U.S. corporate bonds for euro area investors by credit rating. The yields are ICE BofA AAA and BBB effective yields. Hedged yields assume a rolling three-month Euro-Dollar cross currency swap hedge. In particular, the hedged yield is the effective yield minus the 3-month Euro-Dollar swap rate. The data is on quarterly basis from 20013:Q2 to 2020:Q4. The data source for the indices effective yields is the Federal Reserve Bank of St. Louis. The data source for the swap rate is Bloomberg.

Figure 16: Treasury Returns for European Investors



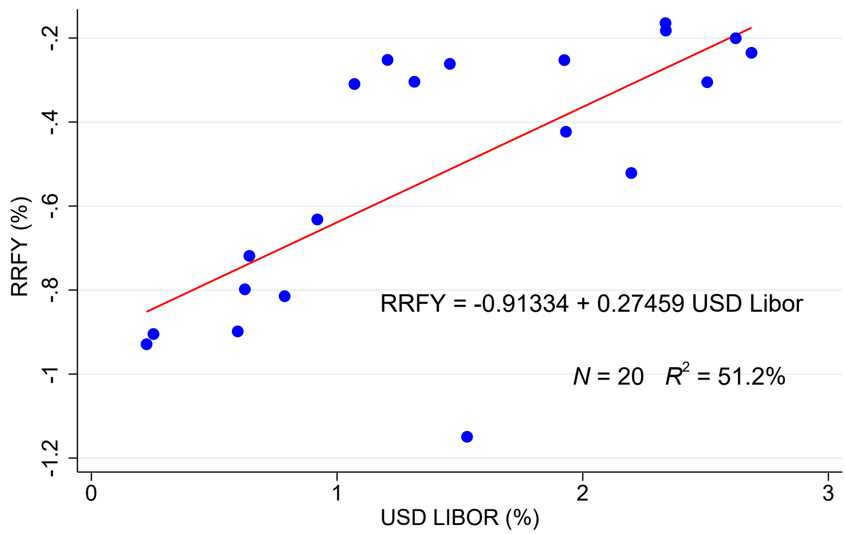
This figure plots the unhedged yields on the 10-years U.S. Treasury bonds, hedged yields on the 10-years U.S. Treasury bonds, and yields on the 10-years German Bunds on quarterly basis from 2013:Q2 to 2020:Q4. Hedged yields assume a rolling three-month Euro-Dollar cross currency swap hedge. In particular, the hedged yield is the yield on the 10-years U.S. Treasury bonds minus the 3-month Euro-Dollar swap rate. D is the return on the "hedge portfolio" which is the 10 Yrs German Bund return minus the 10 Yrs Treasury return on hedged basis. In this figure we assume the FX hedge ratio (ϕ) is 100%. The date source for the returns on the 10-years Treasury bond and German Bund is the Federal Reserve Bank of St. Louis. The data source for the swap rate is Bloomberg.

Figure 17: U.S. and Euro Monetary Policy

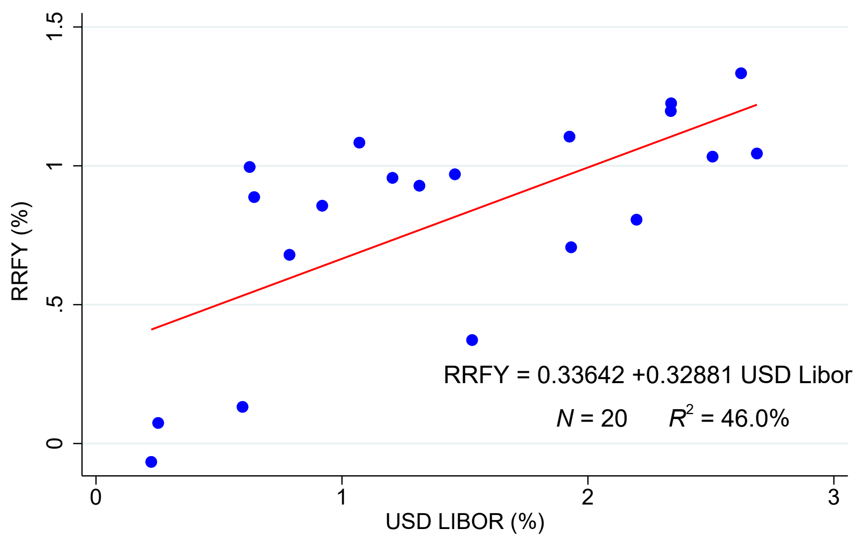


This figure plots the three months Libor rate on the U.S. dollar and euro as a proxy for the monetary policy rates in the two jurisdictions. The data is on quarterly basis from 2016:Q1 to 2020:Q4. The date source is the Federal Reserve Bank of St. Louis.

Figure 18: U.S. Monetary Policy and Excess Credit Spread on EA investors' NFC Bond Portfolio



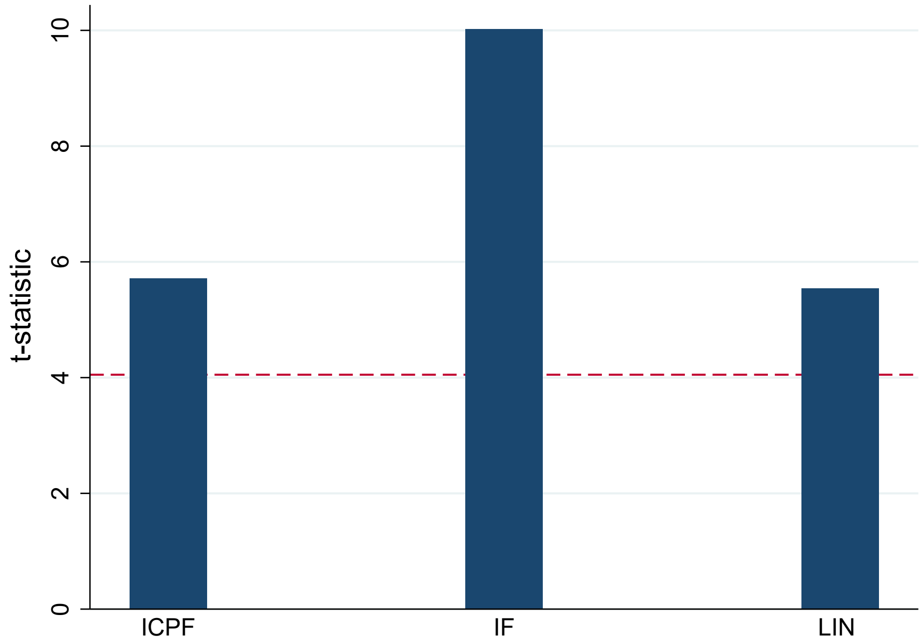
(a) EA Insurance Companies and Pension Funds



(b) EA Investment Funds

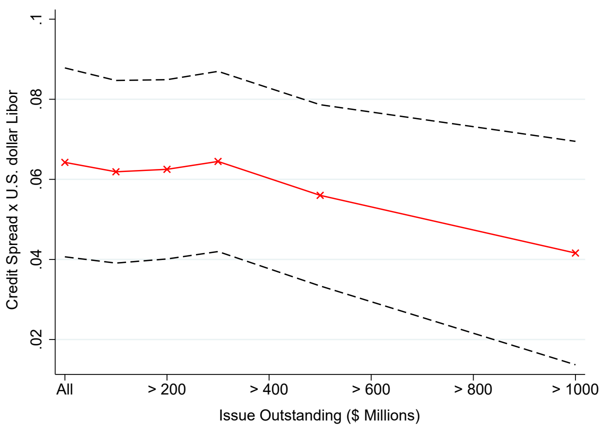
The figure plots our relative reaching for yield (RRFY) measure defined in Equation 9 on the three month U.S dollar Libor rate, both in percentage points. Panel A reports results for euro area insurance companies and pension funds, and Panel B reports results for euro area investment funds. The sample period is from 2016:Q1 to 2020:Q4. The data source for the holdings data is from the ECB Sectoral Securities Holding Statistics. The data source for the U.S. dollar Libor is the Federal Reserve Bank of St. Louis. The data source for all corporate bonds outstanding in the market is WRDS Bond Database.

Figure 19: First-Stage t-Statistic

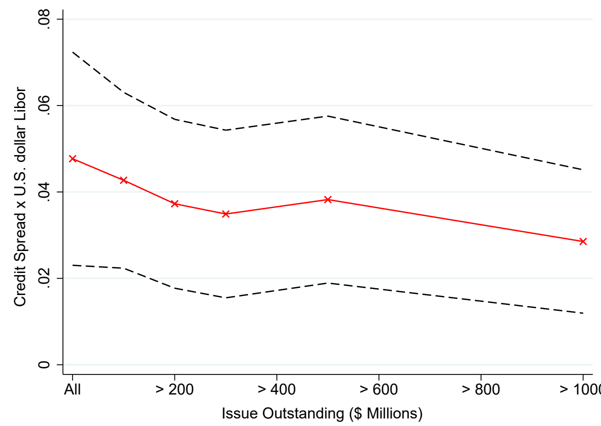


This Figure plots the minimum first-stage t-statistic across sectors on the instrument for the credit spread. The critical value for rejecting the null of weak instruments is 4.05 (Stock and Yogo (2005)). The quarterly sample period is from 2016:1 to 2020:4.

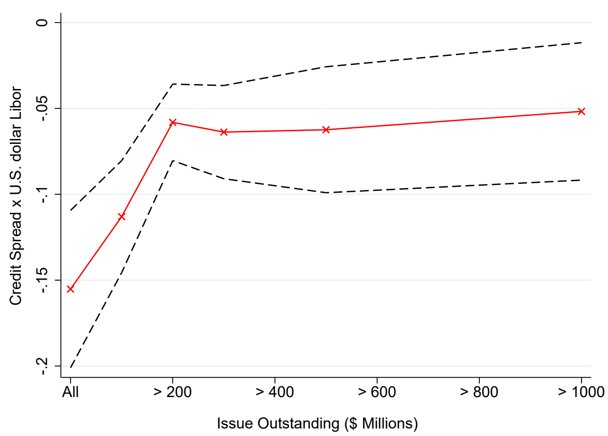
Figure 20: Interaction Term between Credit Spread and U.S.dollar Libor



(a) EA ICPF



(b) EA Investment Funds



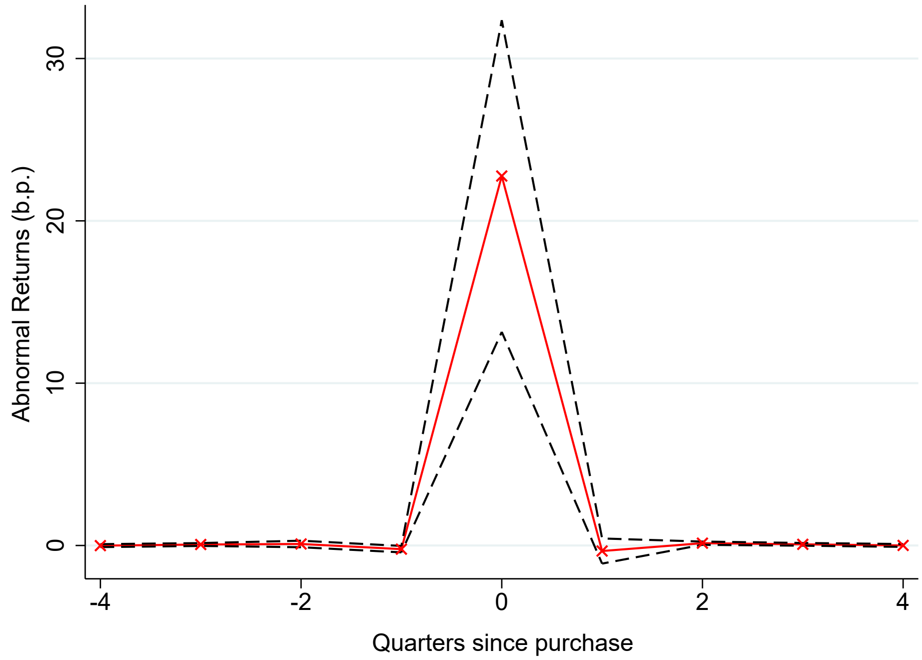
(c) U.S. Life Insurers

This figure reports the coefficient on the interaction term between bond's credit Spread and U.S.dollar Libor from the regression:

$$\log(\mathrm{H}_{i,t}(n)) = \beta_{1,i}\mathrm{CS}_{i,t}(n) + \beta_{2,i}\ y_t^{\$} + \beta_{3,i}\mathrm{CS}_{i,t}(n) \cdot\ y_t^{\$} + \beta_{4,i}\ y_t^{e} + \beta_{5,i}^{'}\mathrm{X}_t(n) + \epsilon_{i,t}(n)$$

We run the regression for different levels of issue outstanding. For euro area investors, these levels are all issue outstanding amounts, larger than € 100 million, larger than € 200 million, larger than € 300 million, larger than € 500 million and larger than € 1 billion. For the U.S. life insurers, these levels are all issue outstanding amounts, larger than $ 100 million, larger than $ 200 million, larger $ 300 million, larger $ 500 million and larger than $ 1 billion. Dashed lines represent 95% confidence intervals on the point estimates for each issue amount outstanding. Dashed lines represent 95% confidence intervals on the point estimates for each issue amount outstanding.

Figure 21: Quarterly abnormal return around European Investors' purchases

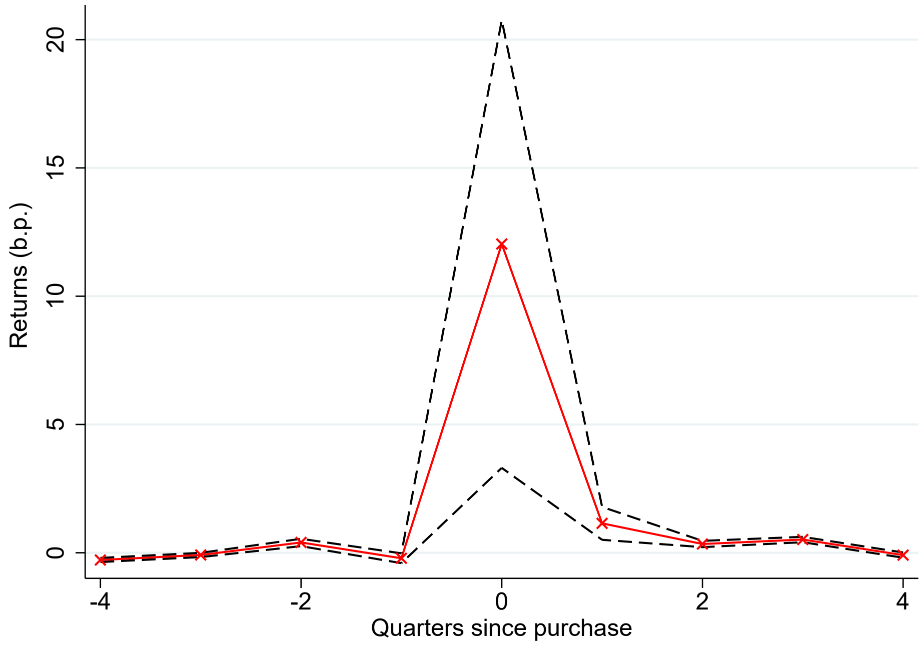


This figure plots the coefficients on the interaction term EAbuy x U.S. dollar Libor from the regression in Equation (15):

$$Abret_{i,t+h} = \alpha\, EAbuy_{i,t} + \beta\, EAbuy_{i,t} \cdot y_t^{\$} + \gamma \mathrm{X}_{i,t} + \epsilon_{i,t}$$

The coefficients are presented in basis points. The quarterly sample period is from 2016:Q1 to 2020:Q4. Dashed lines represent 95% confidence intervals on the point estimates for each horizon based on standard errors clustered by issuer.

Figure 22: Quarterly raw return around European Investors' purchases

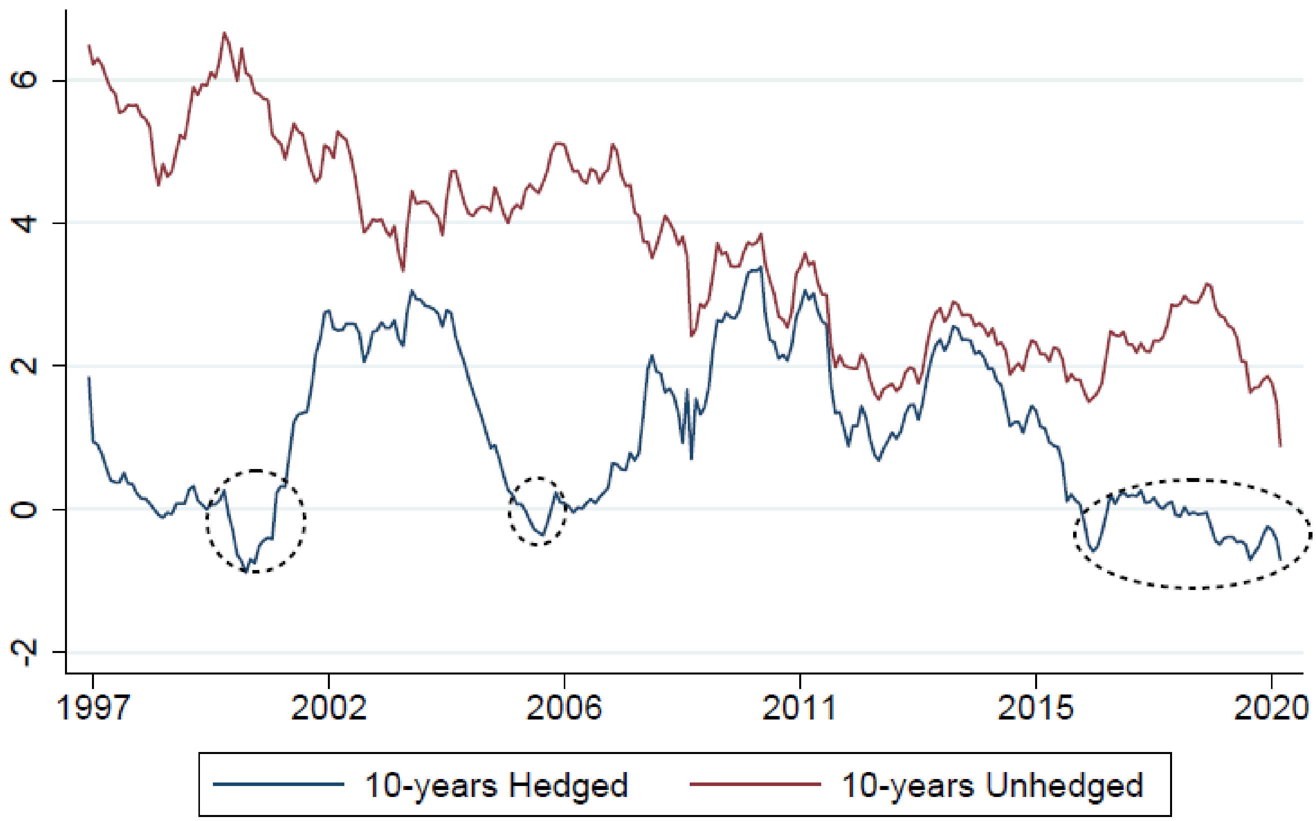


This figure plots the coefficients on the interaction term EAbuy x U.S. dollar Libor from the regression in Equation (16):

$$ret_{i,t+h} = \alpha_i + \alpha_t + \gamma\, EAbuy_{i,t} + \beta\, EAbuy_{i,t} \cdot y_t^{\$} + \epsilon_{i,t}$$

The coefficients are presented in basis points. The quarterly sample period is from 2016:Q1 to 2020:Q4. Dashed lines represent 95% confidence intervals on the point estimates for each horizon based on standard errors clustered by issuer.

Figure 23: Treasury Returns for Japanese Investors



This figure plots the unhedged yields on the 10-years U.S. Treasury bonds and on monthly basis from 1997 to 2020. Hedged yields assume a rolling three-month Dollar-Yen cross currency swap hedge. In particular, the hedged yield is the yield on the 10-years U.S. Treasury bonds minus the 3-month Dollar-Yen swap rate. The date source for the returns on the 10-years Treasury bond is the Federal Reserve Bank of St. Louis. The data source for the swap rate is Bloomberg.

Table 1: Summary Statistics by Investor Type

	Mean	Std. Dev.	10th	50th	90th	N
Euro Area ICPF:						
Credit Spread (%)	3.71	2.14	1.35	3.45	6.12	111709
Time to Maturity (30/365 convention)	9.23	8.36	1.71	6.17	25.02	111709
The par value of debt (€ Millions)	17.6	73.3	0.11	2.66	17.4	111709
Amount Outstanding (€ Billions)	1.79	49.2	0.40	1.24	3.35	111641
Euro Area Investment Funds:						
Credit Spread (%)	3.87	2.25	1.43	3.60	6.38	151718
Time to Maturity (30/365 convention)	9.66	8.56	1.63	6.42	25.02	151718
The par value of debt (€ Millions)	40.6	70.7	0.38	14.4	109	151718
Amount Outstanding (€ Billions)	1.09	31.0	0.17	0.72	2.35	150947
U.S. Life Insurance Companies:						
Credit Spread (%)	1.78	1.59	0.51	1.30	3.60	100179
Time to Maturity (30/365 convention)	10.59	9.02	2	7	26	100179
The par value of debt ($ Millions)	145.74	123.36	57.54	119.81	298.72	100179
Amount Outstanding ($ Billions)	0.66	0.61	0.25	0.50	1.25	87279
Bond Returns:						
Average Monthly Return (%)	0.63	1.72	-0.91	0.42	2.56	192933

Notes: This table summarizes bond-quarter level statistics by euro area insurance companies and pension funds (ICPFs), euro area investment funds and U.S. life insurance companies. Credit spread and bond returns are winsorized at the top and bottom 1% level. The data source for the euro area investors' holdings is the ECB Sectoral Securities Holding Statistics. The data source for the U.S. life insurerance companies' holdings is the eMAXX . Bond characteristics and yields are from the ESCB's Centralised Securities Database (CSDB). Bond returns are from WRDS Bond Returns. Sample period is from 2016Q1 to 2020Q2.

Table 2: Reaching for yield at the extensive margin 2016-2020

	ICPF	IF	ICPF	IF
USD Libor	0.439***	0.746***	0.017***	0.021**
	(0.099)	(0.220)	(0.005)	(0.009)
Post	1.656***	2.456***	0.058***	0.061***
	(0.220)	(0.487)	(0.011)	(0.020)
N	20	20	582	620
Maturity FE	No	No	Yes	Yes

Notes: Columns (1) and (2) report regression results of Equation 7 where the dependent variable is the difference between the weight of U.S. dollar denominated non-Treasury bonds in the euro area investor's global bond portfolio and the weight of U.S. dollar denominated Treasury bonds in the euro area investor's global bond portfolio. Columns (3) and (4) report regression results of Equation 8 where the dependent variable is the weight of U.S. dollar denominated non-Treasury bonds in the euro area investor's global bond portfolio with maturity of m years and the weight of U.S. dollar denominated Treasury bonds in the euro area investor's global bond portfolio with maturity of m years, where where m is 0, 1, 2, ..., 30 years. The U.S. dollar Libor is the three months U.S. dollar Libor rate. Post is a dummy variable which takes value of one for quarters after 2020:Q1. Results are based on quarterly data from 2016-Q1 to 2020-Q4. Columns 3 & 4 include maturity-bin fixed effects. Standard errors are clustered around issuers. The symbols ***, **, and * indicate significance levels at 1%, 5%, and 10%, respectively.

Table 3: Estimated nonfinancial corporate bond demand by investor sector 2016-2020

	EA ICPF	EA IF	U.S. LI
USD Libor	-0.289***	-0.160**	0.300***
	(0.062)	(0.065)	(0.043)
Credit Spread	-0.035	-0.032	0.094***
	(0.027)	(0.021)	(0.028)
Credit Spread X USD Libor	0.064***	0.048***	-0.155***
	(0.012)	(0.013)	(0.023)
Euribor	0.755***	0.738***	-0.747***
	(0.149)	(0.143)	(0.123)
USD Term Spread	-0.032	0.044	0.119***
	(0.049)	(0.061)	(0.043)
EA Term Spread	-0.051	-0.160**	-0.0474
	(0.055)	(0.067)	(0.047)
EA Credit Spread	-0.110**	-0.128***	0.361***
	(0.047)	(0.038)	(0.045)
Maturity	-0.002*	-0.003***	0.005***
	(0.001)	(0.001)	(0.001)
Outstanding	0.114***	0.155***	0.020
	(0.012)	(0.015)	(0.013)
Swap Basis	-0.039	-0.008	-0.225***
	(0.087)	(0.072)	(0.041)
Lag Log Holdings	0.928***	0.933***	0.957***
	(0.013)	(0.011)	(0.018)
Number of observations	85689	111972	84208
Number of bonds	9171	11390	6942

Notes: This table reports GMM instrumental variables estimates of nonfinancial corporate bond demand 11 by investor sector. The credit spread is the bond yield spread over a treasury bond with similar maturity. The USD LIBOR is the 3-month U.S. LIBOR rate. The Euribor is the 3-month Euribor. The quarterly sample from 2016Q1 to 2020Q4. Robust standard errors clustered by issuer are reported in parentheses. "EA" refers to euro area, "ICPF" refers to insurance companies and pension funds, "IF" refers to investment funds and "U.S. LI" refers to the U.S. life insurance companies. The symbols ***, **, and * indicate significance levels at 1%, 5%, and 10%, respectively.

Table 4: Estimated nonfinancial corporate bond demand by investor sector 2016-2020

	EA ICPF	EA IF	U.S. LI
Swap	-0.151***	-0.116***	-0.003
	(0.027)	(0.033)	(0.028)
Credit Spread	-0.033	-0.159***	0.022
	(0.042)	(0.048)	(0.030)
Credit Spread X Swap	0.054***	0.088***	-0.013
	(0.013)	(0.017)	(0.018)
USD Term Spread	0.184***	0.395***	-0.040***
	(0.049)	(0.066)	(0.013)
EA Term Spread	-0.236***	-0.482***	0.073***
	(0.061)	(0.087)	(0.018)
EA Credit Spread	0.075	0.251***	-0.054*
	(0.0667)	(0.088)	(0.032)
Maturity	-0.003***	-0.003***	0.007***
	(0.0009)	(0.0006)	(0.0005)
Outstanding	0.128***	0.174***	0.080***
	(0.013)	(0.018)	(0.011)
Lag Log Holdings	0.915***	0.909***	0.883***
	(0.015)	(0.016)	(0.012)
Number of observations	85690	111971	84208
Number of bonds	9170	11389	9070

Notes: This table reports GMM instrumental variables estimates of nonfinancial corporate bond demand 14 by investor sector. The credit spread is the bond yield spread over a treasury bond with similar maturity. "Swap" is the three month EUR-Dollar swap rate. The quarterly sample is from 2016Q1 to 2020Q4. Issuer fixed effects are included. Robust standard errors clustered by issuer are reported in parentheses. "EA" refers to euro area, "ICPF" refers to insurance companies and pension funds, "IF" refers to investment funds and "U.S. LI" refers to the U.S. life insurance companies. The symbols ***, **, and * indicate significance levels at 1%, 5%, and 10%, respectively.

Table 5: Monthly Abnormal Return Around EA Investors' Purchases

Quarter	EA Buy	Standard Error	EA Buy x $y_t^{\$}$	Standard Error	N
-4	-0.007	0.046	-0.021	0.068	148628
-3	-0.093	0.065	0.062	0.045	155402
-2	-0.142	0.159	0.094	0.103	162433
-1	0.343**	0.1566	-0.224**	0.101	170846
0	-36.735***	7.533	22.761***	4.899	191775
1	0.470	0.619	-0.340	0.395	162248
2	–0.261***	0.0815	0.143***	0.051	145997
3	-0.166**	0.066	0.073*	0.043	131648
4	-0.0198	0.070	0.004	0.044	118323

Notes: This table reports results for the regression:

$$Abret_{i,t+h} = \alpha\, EAbuy_{i,t} + \beta\, EAbuy_{i,t} \cdot y_t^{\$} + \gamma \mathrm{X}_{i,t} + \epsilon_{i,t}$$

with h $\in$ [-4; 4]. $EAbuy_{i,t}$ is an indicator variable which equals one if euro area investors buys a bond i in quarter t. $y_t^{\$}$ is the three month U.S. Libor rate instrumented with the monetary policy shocks to Libor rates. To adjust for risk, the abnormal return of bond i in quarter t, denoted as $Abret i,t$, is calculated as the quarterly average of its raw monthly return minus the monthly return on the benchmark portfolio to which it belongs. It is presented in basis points (bps). Issuer and time fixed effects are included. Standard errors are clustered around issuers and time. The symbols ***, **, and * indicate significance levels at 1%, 5%, and 10%, respectively.

Table 6: Monthly Raw Return Around EA Investors' Purchases

Quarter	EA Buy	Standard Error	EA Buy x $y_t^{\$}$	Standard Error	N
-4	0.429***	0.062	-0.281***	0.041	156118
-3	0.201***	0.062	-0.086**	0.042	163677
-2	-0.558***	0.113	0.402***	0.073	171507
-1	0.447***	0.154	-0.213**	0.098	179446
0	-13.128*	7.006	12.034***	4.452	187009
1	-1.874***	0.521	1.147***	0.327	175215
2	-0.541***	0.101	0.342***	0.063	157258
3	-0.855***	0.083	0.516***	0.053	141791
4	0.178**	0.082	-0.091*	0.052	127139

Notes: This table reports results for the regression in Equation (16):

$$ret_{i,t+h} = \alpha_i + \alpha_t + \gamma\, EAbuy_{i,t} + \beta\, EAbuy_{i,t} \cdot y_t^{\$} + \epsilon_{i,t}$$

with h ∈ [-4; 4]. $EAbuy_{i,t}$ is an indicator variable which equals one if euro area investors buys a bond i in quarter t. $y_t^{\$}$ is the three month U.S. Libor rate instrumented with the monetary policy shocks to Libor rates. The raw return of bond i in quarter t is denoted as $reti,t$. It is calculated as the quarterly average of its raw monthly return. It is presented in basis points (bps). Bond and time fixed effects are included. Standard errors are clustered around bonds and time. The symbols ***, **, and * indicate significance levels at 1%, 5%, and 10%, respectively.

Table 7: Quarterly Bond-Level Issuance Around EA Investors' Purchases

	All	AAA/AA/A	BBB	Non-IG	NR
EA Buy x USD Libor	0.099***	0.076	0.042***	-0.023	1.168**
	(0.021)	(0.099)	(0.012)	(0.023)	(0.589)
N of Observations	56037	6715	5931	1402	41895
Number of Issuers	1486	419	557	241	485

Notes: This table reports results for the regression in Equation 19:

$$log(\text{Issuance}_{i,t}) = \beta\, EAbuy_{i,t} \cdot y_t^{\$} + \gamma \mathrm{X}_{i,t} + \epsilon_{i,t}$$

$EAbuy_{i,t}$ is an indicator variable which equals one if euro area investors buys a bond i in quarter t. $y_t^{\$}$ is the three month U.S. Libor rate instrumented with the monetary policy shocks to Libor rates. The dependent variable is the log of bond i issuance in quarter t. $X_{i,t}$ includes coupon rate and squared coupon rate of the bond, and the remaining time to maturity. Issuer and time fixed effects are included. Standard errors are clustered around issuers. The symbols ***, **, and * indicate significance levels at 1%, 5%, and 10%, respectively.

Table 8: Quarterly Firm-Level Issuance Around EA Investors' Purchases

	All	AAA/AA/A	BBB	Non-IG	NR
Hold x USD Libor	0.084**	0.029	0.055***	0.030	0.335***
	(0.036)	(0.046)	(0.017)	(0.027)	(0.002)
N of Observations	3088	542	874	463	1111
Number of Issuers	961	177	290	162	327

Notes: This table reports results for the regression in Equation 20:

$$log(\text{Issuance}_{f,t}) = Hold_{f,t} \cdot y_t^{\$} + \epsilon_{i,t}$$

$EAbuy_{i,t}$ is an indicator variable which equals one if euro area investors buys a bond i in quarter t. $y_t^{\$}$ is the three month U.S. Libor rate instrumented with the monetary policy shocks to Libor rates. The dependent variable is the log of bond i issuance in quarter t. $X_{i,t}$ includes coupon rate and squared coupon rate of the bond, and the remaining time to maturity. Issuer and time fixed effects are included. Standard errors are clustered around issuers. The symbols ***, **, and * indicate significance levels at 1%, 5%, and 10%, respectively.

Appendix

Implication 1

Taking the first order condition of Equation 3 with respect to $y_\$$, we get:

$$\frac{\partial w^*_{C_\$}}{\partial y_\$} = \frac{\left(\frac{2R_G D}{(1-\phi)^2 \sigma_F^2}\right)\left(\frac{C_\$}{\sigma_\$^2}\right)(1-\rho-\phi)}{S^2} \tag{21}$$

where $S = \left(\frac{D}{(1-\phi)\sigma_F}\right)^2 + \left(\frac{C_e}{\sigma_e}\right)^2 + \left(\frac{C_\$}{\sigma_\$}\right)^2 > 0$. It is the sum of the squares of the risk adjusted returns. The U.S. corporate bond's allocation is decreasing in the U.S. monetary policy rate if $\frac{\partial w^*_{C_\$}}{\partial y_\$} < 0$. This is true if the following conditions are fulfilled:

1. Positive return gap: $R_G > 0$
2. Positive yield on the "hedge portfolio": $D > 0$
3. Positive credit spreads: $C_\$ > 0$.
4. High hedge ratio: $\phi > 1-\rho$.

Implication 2

Taking the cross derivative of Equation 3 with respect to $C_\$$ and $y_\$$, we get:

$$\frac{\partial^2 w^*_{C_\$}}{\partial C_\$ \partial y_\$} = \frac{\left(\frac{2R_G D}{(1-\phi)^2 \sigma_\$^2 \sigma_F^2}\right)(1-\rho-\phi)\left[\left(\frac{D}{(1-\phi)\sigma_F}\right)^2 + \left(\frac{C_e}{\sigma_e}\right)^2 - \left(\frac{C_\$}{\sigma_\$}\right)^2\right]}{S^3} \tag{22}$$

The higher the U.S. monetary policy rate, the stronger the demand of U.S. corporate bonds with higher credit spreads if $\frac{\partial^2 w^*_{C_\$}}{\partial C_\$ \partial y_\$} > 0$. This is true if the following conditions are fulfilled:

1. Positive return gap: $R_G > 0$

2. Positive yield on the "hedge portfolio": D > 0

3. High hedge ratio: $\phi > 1 - \rho$.

4. Higher relative credit spreads: $(\frac{C_{\$}}{\sigma_{\$}})^2 > (\frac{D}{(1-\phi)\sigma_F})^2 + (\frac{C_e}{\sigma_e})^2$.