Investing in Safety*

Johannes Breckenfelder[1], Veronica De Falco[2] and Marie Hoerova[1,3]

[1]European Central Bank
[2]Imperial College London
[3]CEPR

October 10, 2024

First draft: November 2023

Click here for latest version

Abstract

We offer an investor-based perspective on the demand for safe assets and the determination of convenience yields. Using proprietary securities holdings data, we characterize the investor base of both national and supranational safe assets in Europe. To determine who the marginal investor is, we exploit the largest ever joint issuance of supranational bonds by the European Commission to link how different investors rebalance their portfolios following this large shock to the supply of safe assets. We show that, for the same security, the marginal investors in supranational bonds are mutual funds and banks. These investors view the AAA-rated Commission bonds as substitutes for other supranational bonds. To study portfolio re-balancing of investors we construct an instrument based on their ex-ante propensity to hold other supranational bonds. We show that when they acquire Commission bonds, they re-balance away from other supranational bonds and, as a result, the yields on those bonds increase. However, investors do not view the Commission bonds as substitutes for national government bonds. We show that this result is driven by the domestic investors who do not substitute away from national bonds following the Commission bond issuance. Such home bias of domestic investors towards national bonds may help explain why the AAA-rated Commission bonds have substantially higher yields compared to national government AAA-rated securities.

*Breckenfelder is with the European Central Bank (ECB), email: johannes.breckenfelder@ecb.europa.eu; De Falco is with Imperical College London, email: v.de-falco@imperial.ac.uk; Hoerova is with the ECB and CEPR, email: marie.hoerova@ecb.europa.eu. We thank Jules van Binsbergen, Lira Mota, Alan Taylor, Harald Uhlig, and participants of the Barcelona Summer Forum 2024, 2023 Amsterdam Workshop on Safety and Liquidity for helpful comments and discussions. We are very grateful to Catalina Cozariuc for excellent research assistance. The views expressed are those of the authors and do not necessarily reflect those of the Eurosystem.

1 Introduction

Why do investors value "safe" assets? Is it because of their low credit risk, high liquidity, solid collateral value and/or because they can be used to meet regulatory requirements? These are important questions, particularly against the background of scarcity of safe assets around the world, which contributed to lowering the natural rate of interest (e.g., Caballero et al. (2017)). It is also a major issue in Europe where a recurrent debate over the lack of a pan-European safe asset that investors could hold led to various proposals on how it can be created (e.g., Brunnermeier et al. (2017)). Investors are willing to pay a premium for assets they perceive as safe – like U.S. Treasuries or German Bunds. This premium is often referred to as "safety premium" or "convenience yield" (e.g., Diamond and Van Tassel (2023)). It tends to rise in crisis times when safe assets are in particularly high demand as they tend to maintain their nominal value while the value of other assets typically falls (e.g., Baele et al. (2020), Kekre and Lenel (2021)). Although investor demand is one key determinant of convenience yields, we know little about who invests in - and prices – safe assets. This paper intends to fill this gap.

We set out to characterize the investor base of safe assets as well as understand how investors re-balance their safe asset holdings following shocks, with the ultimate goal of analyzing the determination of safety premia. To this end, we focus on government bonds - issued by both national governments as well as supranational institutions - in Europe. Bonds issued by governments are the prime candidates for being considered safe assets, as yields on bonds issued by private issuers often exceed those of their national governments. The European context offers a unique setting in several dimensions. First, there are 27 EU member states issuing national government bonds, with each issuer attracting a potentially different investor base. Second, there are several supranational issuers: the European Commission (EC), the European Investment Bank (EIB), the European Stability Mechanism (ESM) and the European Financial Stability Facility (EFSF).[1] Third, there was a large increase in the supply of safe assets in Europe as of late. In 2020, the European Union (EU) agreed on the

[1]The latter two institutions were established during the European debt crisis of 2010-2012. Their mission is to safeguard financial stability in Europe by providing financial assistance to countries using the euro (aka "euro area").

largest stimulus package ever financed in Europe, worth over 2 trillion EUR. The European Commission was tasked with raising funds in capital markets to fund the package, leading to a large issuance of EU bonds (see Figure 1). As EU bonds are guaranteed by all 27 EU governments, these bonds are AAA-rated by most credit agencies.[2]

By now, the European Commission has become the largest European supranational issuer (see Figure 2). The total amount of supranational bonds outstanding reached 1 trillion EUR in 2023, with that amount expected to go to 1.7 trillion EUR by 2026. For comparison, German federal government debt outstanding was 1.7 trillion EUR in 2023. We will exploit the large EU bond issuance in our empirical analysis to assess how investors re-allocate their safe asset holdings in response to this supply shock. Are the new bonds substitutes to the national bonds? What about other supranational bonds? Understanding investor behavior will help understand the puzzling fact that new EU bonds - although AAA-rated - have a substantial spread over another AAA-rated asset in Europe - the German Bunds - with the spread equal to 70 basis point at the end of 2023 (see Figure 3).

We start by characterizing who invests in safe assets in the euro area (EA), using proprietary securities holdings data - the Securities Holdings Statistics by Sector (SHSS) of the European Central Bank. It provides information, for each security held in the euro area or with a euro area custodian bank, about who holds a particular security, distinguishing among 24 different holder types, including households, mutual funds, banks, insurance corporations, and pension funds. Furthermore, we observe the country-domicile of the holder, for each EA country, with the residual to the total amount outstanding designating Foreign (non-euro-area) investors.

Comparing AAA-rated national government bonds with supranational bonds, we document several facts regarding their respective investor bases. First, the distribution across the key private EA investors - consisting of the EA banks, EA mutual funds, EA insurances, EA pension funds and EA households – differs. In particular, banks hold a smaller share of AAA-rated national debt compared to AAA-rated supranational debt. Second, national government bonds have a substantial domestic investor base while supranational bonds, by

[2]Precisely, bonds issued by the Commission are rated AAA/Aaa/AAA/AAA (outlook stable) by Fitch, Moody's, Scope and DBRS, and AA+ (outlook stable) by Standard & Poor's.

definition, lack domestic investors. Third, in the time series, holdings of AAA-rated national bonds by banks, insurances and pension funds have been declining over the past few years while these same investors increased their holdings of the EU bonds.

We then exploit the largest ever joint issuance of supranational AAA-rated bonds by the European Commission to link how different investors from different countries re-balance their portfolios following this large "shock" to the supply of safe assets. We use two main datasets. First, we rely on the Refinitiv's Thomson Reuters Lipper database (Lipper for short) which contains detailed mutual funds data, including their portfolios on a security level. This data enables us to study in great detail portfolio re-balancing by mutual funds which have been documented to be active, elastic investors who are responsive to shocks (e.g., Koijen et al. (2021), Fang et al. (2022)). We study how different funds, with different ex ante preferences for supranational European bonds, re-balance the *same* security following the EU bond issuance shock. We study re-balancing of other supranational bonds, other AAA-rated national bonds, as well as lower-rated national bonds, to determine which of these assets are viewed as close substitutes to the newly issued European safe assets. Second, we use the securities holdings statistics (SHSS) to investigate the same question, because this database enables us to study re-balancing by *all* investors, not only mutual funds, albeit at the more aggregated investor-type level. Still, we can conduct our analysis on security level and answer the question of how the same security is re-balanced by different investor types.

We measure re-balancing in two complementary ways: 1) changes in the weight of the security in an investor (type) portfolio and 2) changes in the nominal amounts held. The latter is a straightforward measure of changes in actual holdings while the former captures the notion that investors may have a preferred portfolio allocation across various asset classes.

Using Lipper mutual funds data, we show that, following the EU bond issuance, funds with higher ex ante preference for supranational bonds reduce their holdings of other supranational bonds, both in terms of amounts and in terms of portfolio weights. Therefore, funds view the bonds issued by supranational European institutions as substitutes. By contrast, funds do not significantly change their holdings of national bonds. Using the SHSS - thus considering other investor types beyond mutual funds - we show that, for the same security, the marginal investors in supranational bonds are banks and mutual funds. These investors

view the AAA-rated Commission bonds as substitutes for other supranational bonds: when they acquire Commission bonds, they re-balance away from other supranational bonds and, as a result, the yields on those bonds increase. However, investors do not view the Commission bonds as substitutes for national government bonds. We show that this result is driven by the domestic investors who do not substitute away from national bonds following the Commission bond issuance. Our results help explain why the AAA-rated Commission bonds have substantially higher yields compared to national government AAA-rated securities.

Our empirical methodology, which builds on Breckenfelder and De Falco (2023), is designed to deal with two key challenges. First, in principle, there are many drivers of asset "safety", including asset risk and liquidity. These attributes vary across assets and across time, and can be intertwined, making it challenging to pinpoint which factors drive the safety demand and how they are linked to the underlying investor preferences. The granularity of our data allows us to conduct the analysis on security level. Specifically, our regressions include a security–time fixed effect implying that we are comparing how different investors re-allocate the *same* security in the *same* quarter. Therefore, our results are not driven by differences across securities in risk, liquidity, collateral valuations etc. or by differences within a security across time (similar to Khwaja and Mian (2008)).[3]

Second, our across-investor variation on security level derives from the differential exposures of investors to the EU bond issuance. Clearly, investor choice to buy more or less EU bonds is endogenous which creates another challenge for our empirical analysis. We deal with it by constructing an instrument, for each investor (type) in each quarter, which gives us a quasi-exogenous measure of investor exposure to the EU bond issuance shock. The instrument is a Bartik (1991) style, shift-share instrument, where the "shifter" is the EU bond issuance in each quarter which is a "time-series" flow. The "shares" are the ex ante shares of the supranational bond market each investor owned in the second quarter of 2020, before EU bond issuance took off. Intuitively, the instrument uses investor ex ante holdings of other supranational bonds as an indicator of their preference for the new supranational asset, EU bonds. It postulates that the newly issued EU bonds in each quarter would be

[3]Indeed, a Bruegel policy paper by Claeys et al. (2023) discusses several dimensions along which EU bonds differ from national bonds. See also a Bruegel blog entry by Bonfanti and Garicano (2022).

allocated across investors in the proportions akin to their ex ante holdings of other supranational bonds. We show that this predicted allocation is a strong instrument for the actual acquisition of EU bonds. Bartik style instrument is well-suited for our setting, as we have an explicit common factor - the EU issuance - and we can trace out what the effect of this common shock on different investors is and how this changes investor demand for other (safe) asset classes.

Related literature. This paper is related to three strands of the literature: 1) the literature on safe assets and safe asset scarcity; 2) the literature on intermediary asset pricing and demand system asset pricing; and 3) the literature on safe assets in the European context.

First, our paper is related to the literature on safe assets and safe asset scarcity. On the theory front, He et al. (2019) study the determination of safe asset in a general equilibrium model in which investor demand for safe assets, as well as issuer fundamentals, together make an asset "safe". Gorton and Ordoñez (2022) analyze how private and public safe assets interact. Geromichalos et al. (2023) examine the relationship between asset safety and liquidity in a multi-asset, general equilibrium model. The emergence of a shortage of safe assets has been documented and analyzed in a number of recent works (see e.g. Caballero et al. (2017), Andolfatto and Williamson (2015) and Gorton and Laarits (2018)). The imbalance between safe asset supply and demand has important macroeconomic implications and some papers discuss the implications of scarcity for monetary policy. For example, Caballero and Farhi (2017) analyze a situation of a deflationary safety trap and point to policies of "helicopter drops" of money, safe public debt issuances, or swaps of private risky assets for safe public debt as possible ways to mitigate the negative impact of safe asset scarcity.

A large body of work studies convenience yields associated with holding safe assets, and link them to (other) asset prices (e.g., Krishnamurthy and Vissing-Jorgensen (2012), Nagel (2016), Jiang et al. (2018), Du et al. (2018), Jiang et al. (2020), Valchev (2020), Jiang et al. (2021), Engel (2020), Mota (2021), Binsbergen et al. (2022), Diamond and Van Tassel (2023)). Various measures emerge as proxies for convenience yields, ranging from readily available measures like spreads between corporate and government bonds to measures that

rely on CDS-bond basis or option-implied box rate data. Deviations from the covered interest rate parity have been used to infer international convenience yields. Acharya and Laarits (2023) document that the convenience yield of US Treasuries exhibits properties consistent with the hedging perspective of safe assets. Our contribution to the literature on safe assets is to take an investor-based perspective and link safe asset demand to the underlying (revealed) investor preferences.

Second, our paper contributes to the intermediary asset pricing literature (Greenwood and Vayanos (2010), Greenwood and Vayanos (2014), Vayanos and Vila (2021)) and growing work on demand system asset pricing (Koijen and Yogo (2019), Gabaix and Koijen (2021)) that has highlighted the role of investors' preferences in determining equilibrium asset prices. Coppola (2021) studies the role of ownership base for nearly identical bonds issued by the same firm to causally identify the elasticities of bond returns to investor base composition. Our contribution to this literature is to analyze the role of investors' preferences for the determination of convenience yields on safe assets. Methodologically, we build on the framework developed in Breckenfelder and De Falco (2023) who study how investor heterogeneity affects the effectiveness of central bank large-scale asset purchases.

Third, we relate to the discussion about safe assets in the European context. A scarce supply of safe euro-denominated assets has been repeatedly highlighted as an important constraint for the development of the Capital Markets Union and for advancing the global role of the euro. In addition, a reliance of banks across euro area countries on domestically issued government debt has been blamed for creating the sovereign-bank doom-loop (e.g., Brunnermeier et al. (2016), Brunnermeier et al. (2017)). The joint issuance of EU bonds agreed upon in 2020 - whereby, for the first time, debt would be contracted jointly and not be attributable to any one EU country - was hailed as a watershed of integration, a "Hamiltonian moment" (see also Bletzinger et al. (2022)). We exploit this joint issuance to understand what are the hallmarks of safe assets for investors, and specifically how investors perceive the new Pan-European asset in comparison to national government bonds.

The remainder of the paper is organized as follows. In Section 2, we describe the data and institutional background. In Section 3, we outline our empirical methodology. In Section 4, we characterize who holds safe assets in Europe. In Section 5, we study how investors

re-balance their safe asset portfolios following the large EU bond issuance shock. Section 6 concludes.

2 Data and Institutional Framework

In this Section, we first describe the data we use in our empirical analysis. We then discuss the institutional background of the safe asset supply "shock" we are exploiting, namely the joint issuance of Pan-European bonds.

2.1 Data

Our analysis relies on two main data sources: (1) the Securities Holding Database Aggregated by Sector (SHSS) collected by the European Central Bank which contains quarterly information on holdings of all securities held in the Euro area or with a euro area custodian; and (2) the Refinitiv's Thomson Reuters Lipper for Investment Fund Management database (Lipper for short), which covers detailed fund-level data, including security-level portfolio holdings. In what follows, we describe the two data sources in turn.

The SHSS database The SHSS database is collected on a security (ISIN) level). The data collection is based on Regulation ECB/2012/24) and, given that reporting is mandatory, the coverage is highly comprehensive. The data is collected quarterly, starting in the fourth quarter (Q4) of 2013. All securities held in the euro area or by a euro area custodian bank are covered. Financial institutions must report positions of both their direct investment and indirect investment as custodians for other agents.

The database provides information about who holds a particular security, distinguishing among 24 different holder types, including households, mutual funds, banks, insurance corporations, and pension funds. Furthermore, we observe the country-domicile of the holder, for each euro area country, with the residual to the total amount of security outstanding designating Foreign (non-euro-area) investors.

The type of security reported are debt security, listed shares, and investment funds shares. Beside the granular, security-by-security, coverage, the key advantage of this database for our purposes is that it provides comprehensive information about all investor types resident

to the euro area that hold a particular security. However, the database does not provide individual investors' portfolio holdings. This is where the Lipper database comes in handy.

The Lipper database We use the Lipper database to obtain individual portfolio holdings of one key investor type, the mutual fund sector. Mutual funds are one of the largest holders of bonds in the euro area, both government and corporate. They are also elastic investors that actively re-balance their portfolios in response to shocks (e.g., Koijen et al. (2021), Fang et al. (2022)). This makes them an interesting subset of investors to analyze in our context.

We retrieve mutual fund-level information on portfolio holdings at a quarterly frequency. We observe security-level portfolio holdings at market valuation and also as shares of total fund assets. Lipper sources the portfolio holdings directly from the fund management companies.

Finally, we merge holdings information from the SHSS and Lipper databases with the Centralized Securities Database (CSDB) that contains security-level characteristics such as price, yield, issuer country, issuer sector, nominal currency, and instrument type.

2.2 The event: EU bond issuance since 2020

Since the Global Financial Crisis and the ensuing sovereign debt crisis in the euro area, many calls have been made for a reform in the euro area, including the creation of a European safe asset to replace national sovereign bonds in their role as collateral for banks in repos and interbank loans (Alogoskoufis and Langfield (2019), Bénassy-Quéré et al. (2018), Leandro and Zettelmeyer (2018)). Proposals have also been put forward to create a fiscal capacity at the centre of the euro area to finance deficit spending (Arnold et al. (2018)). However, for many years, a joint issuance of debt in Europe was not much more than a theoretical construct.

The COVID-19 pandemic broke the taboo on a pan-European fiscal policy, through the program dubbed the 'Next Generation EU' or NGEU for short (Verwey, Langedijk and Kuenzel, 2020). For the first time in the history of the EU, large scale bond issuance at the centre is used to finance top-down grants and loans to national governments. This new financial arrangement — of debt contracted jointly, not attributable to any one EU country

— was hailed as a watershed of integration, a "Hamiltonian moment" that would lead to further European integration.

The EU had in fact issued debt before, but on a much smaller scale (see Figure 1). However, with the agreement on joint issuance reached in 2020, the debt issuance by the European Commission on behalf of the European Union has increased dramatically. Of the approximately €450 billion in outstanding EU debt as of end-2023, over 85 percent has arisen from borrowing since 2020. Large-scale borrowing is expected to continue until 2026, with funds now also used to grant concessional loans to support Ukraine. The EU increased its borrowing to create two new instruments in response to the COVID-19 crisis: Support to mitigate Unemployment Risks in an Emergency (SURE) and NextGenerationEU (NGEU). SURE was designed to reduce the financing cost of national short-term work schemes, which were a crucial tool to avoid an increase in unemployment during COVID-19 lockdowns, and consisted of EUR 98.4 billion in back-to-back loans distributed to 19 countries between 2020 and 2022. NGEU is the EU's EUR 800 billion temporary recovery instrument to support the economic recovery from the coronavirus pandemic and build a greener, more digital and more resilient future.

As a result, the European Commission has become the largest supranational issuer (see Figure 2). The total amount of European supranational bonds outstanding - counting also issuers other than the Commission - reached 1 trillion EUR in 2023, with that amount expected to go to 1.7 trillion EUR by 2026. For comparison, German federal government debt outstanding was 1.7 trillion EUR in 2023. To issue such a large amount of EU debt efficiently, the European Commission quickly built a comprehensive borrowing strategy, based on the best practices of major EU issuers, using a mixture of syndicated transactions and auctions, and relying on a large primary dealer network.

An important question is how this borrowing is backed. Here, the EU uses the EU budget and its headroom. The headroom is the difference between the own resources ceiling (i.e., the maximum amount of resources that the Commission can ask Member States to contribute in a given year) and the funds that it actually needs to cover the expenses foreseen by the budget. A sufficiently high ceiling allows the EU to cover all of its financial obligations and contingent liabilities falling due in a given year.

To ensure sufficient headroom for the NGEU borrowing, the EU has increased the Permanent 1.4% Own Resources Ceiling of its budget by 0.6 percentage points of the EU's Gross National Income (GNI). This increase is limited in time, until 2058, and is only used in the context of the recovery from the coronavirus pandemic. This increase in the Own Resource ceiling will expire when all funds will have been repaid and all liabilities will have ceased to exist. As a last resort, repayment can be guaranteed through an increase in member states' contributions to the EU budget (using the increase in the callable headroom). Contributions to the EU budget are an unconditional legal obligation of all Member States under the EU Treaties.

These arrangements serve as a guarantee that the EU will be able to make repayments under any circumstances. This led to EU bonds being rated AAA by most credit agencies. Specifically, bonds issued by the Commisison are rated AAA/Aaa/AAA/AAA (outlook stable) by Fitch, Moody's, Scope and DBRS and AA+ (outlook stable) by Standard Poor's.

3 Empirical methodology

In this Section, we outline our empirical methodology which builds on Breckenfelder and De Falco (2023). Briefly, our goal is to identify investors that are differentially exposed to the EU bond issuance - aka a shock to the supply of safe assets - and compare investor responses to the shock. There are two challenges we need to address. First, investor choice to buy more or less EU bonds is endogenous. We will deal with this challenge by constructing an instrument, based on quasi-exogenous exposure. Second, securities in investor portfolios are not randomly allocated across investors and over time. We will deal with this challenge by conducting our analysis on a security level, thus comparing the behavior of different investors while holding the security fixed. To deal with a time-varying component within the same security, we will include a security–time fixed effect. Thus, we end up comparing how different investors re-allocate the *same* security in the *same* quarter. This set-up ensures that our results are not driven by differences across securities or within a security across time (similar to Khwaja and Mian (2008)).

Having analyzed changes in portfolio allocation, we then test whether these changes -

induced by the EU issuance - have effects on prices of other safe assets.

3.1 First stage: Constructing quasi-exogenous exposure

In the first stage, we construct quasi-exogenous exposure of investors to the issuance shock. We predict which investors are more or less likely to buy EU bonds based on their ex-ante holdings of other supranational bonds. Intuitively, we take a revealed preference approach, conjecturing that investors that have a higher share of their portfolio in other supranational bonds are more likely to buy the newly issued EU bonds.

We measure how much each investor (type) owned of the supranational market before EU issuance and interact it with the flow of EU issuance over time. The instrument is a Bartik style, shift-share instrument, where the "shifter" is the EU issuance shock which is a "time-series" flow. The "shares" are the share of the supranational market each investor (type) owned. The instrument predicts that the EU bonds would be allocated across investors in the same proportions as other supranationals' market allocation.

To this end, the variable $Exposure_{i,t}$ denotes, for each investor (type) i and each quarter t, a change in holdings (buys minus sales) of the newly issued EU bonds b (summed over the different EU bonds) as a share of that investor's total portfolio:

$$Exposure_{i,t} = \frac{\sum_b \Delta Amount_{b,i,t}}{TotalPortfolio_{i,t}} \tag{1}$$

The variable $PredExposure_{i,t}$ measures, for each investor (type) i and each quarter t, potential change in holdings (buys minus sales) of the newly issued EU bonds in quarter t, based on investor's portfolio allocation to other supranational bonds s in the second quarter (Q2) of 2020, before EU bond issuance took off, again as a share of that investor's total portfolio:

$$PredExposure_{i,t} = \frac{\sum_b Share_{s,i,2020q2} \Delta EUissuance_{b,t}}{TotalPortfolio_{i,t}} \tag{2}$$

First, for each EU bond b, we calculate how much is issued in a given quarter t, and we predict how an investor changes its holdings of this bond, based on their ex ante (Q2 2020) portfolio allocation to supranational bonds. By summing over bond holdings b for each investor, we get

a predicted exposure variable whose variation across investors is driven by quasi-exogenous exposure to the EU issuance shock due to the variation in ex ante portfolio allocation to supranational bonds. In the language of shift-share designs, we say that $Share_{s,i,2020q2}$, the ex-ante exposure, is uncorrelated with unobserved determinants of the outcome variable, as in Goldsmith-Pinkham et al. (2020).

Armed with the two exposure measures, we test whether $PredExposure_{i,t}$ is a good instrument for the actual exposure $Exposure_{i,t}$, i.e., we regress how much funds buy of EU bonds on how much the instrument predicts they would buy:

$$Exposure_{i,t} = \alpha_t + \beta PredExposure_{i,t} + \epsilon_{i,t} \tag{3}$$

where $Exposure_{i,t}$ and $PredExposure_{i,t}$ are as defined above, α_t is the time fixed effect, and $\epsilon_{i,t}$ is the error term.

3.2 Second stage: Portfolio re-balancing

In the second stage of our instrumental variable approach, we test how investors re-balance securities in their portfolios when they buy EU bonds. In particular, do they sell other supranational bonds? Do they substitute away from other AAA-rated government bonds? What about lower-rated national government bonds?

We measure re-balancing in two complementary ways: 1) changes in the weight of a security in an investor (type) portfolio and 2) changes in the nominal amounts of a security held. The latter is a straightforward measure of changes in actual holdings while the former captures the notion that investors may have a preferred portfolio allocation across various asset classes.

The hypothesis we test is whether investor (types) that are more exposed to the new EU bond issuance re-balance their holdings of other safe assets. The second-stage regression is as follows:

$$Rebalancing_{n,i,t} = \mu_{n,t} + \theta Exposure_{i,t} + \epsilon_{n,i,t} \tag{4}$$

where $Rebalancing_{n,i,t}$ is a change in holdings of security n by investor (type) i in quarter t

(measured either as a change in the weight of a security in an investor (type) portfolio or as a change in the nominal amounts of a security held), $\mu_{n,t}$ is a security-quarter fixed effect, and $\epsilon_{n,i,t}$ is the error term.

Controlling for quarter by security fixed effects is important as we want to make sure we identify re-balancing that is driven only by the new EU bond issuance rather than other factors. Indeed one of the identification threats in this exercise is potential non-random assignment of funds and securities, in other words funds more exposed could be holding securities that are different from the ones held by less exposed funds. By introducing quarter by security fixed effects, we are holding the security fixed in each point in time and testing whether funds that are more exposed re-balance more towards the same security as compared to funds that are less exposed. The security fixed effects control for any observable and unobservable security time-varying factor that could be correlated with the error term $\epsilon_{n,i,t}$.

In the next step of our analysis, we aim to understand what the impact of re-balancing on prices is. Since prices are a security by quarter characteristic, in the price analysis we have to drop quarter by security fixed effects. Our strategy is to identify a set of observable controls that can be a good proxy for security fixed effects, to mimic the results of the within-security estimator. A similar identification strategy has been used in the context of bank lending to address potential sorting across borrowers and lenders by Khwaja and Mian (2008) and Chodorow-Reich (2014). Hence, in our second stage, we also consider a specification with several control variables - such as Issuer country, Issuer sector, Asset type, and Currency - to check that our estimates remain broadly unchanged compared to the specification with security-quarter fixed effects. If so, we employ these controls in our price impact regressions, which we discuss next.

3.3 Price impact of re-balancing

Ultimately, we are interested in understanding how investor portfolio re-balancing induced by the EU bond issuance affects yields of safe assets. For instance, if we find that investors with higher exposure to EU bond issuance reduce the portfolio share of other supranational bonds more, we test whether the yield of supranational bonds held by more exposed investors increases compared to the yield of supranational bonds held by less exposed investors.

First, we define the change in nominal amounts that investor (types) in our sample hold of each security. This variable quantifies how much a security n is purchased by all investors (indexed by i) in our sample, in quarter t:

$$\Delta(NomAmount_{n,t}) = \Delta \sum_{i} NomAmount_{n,i,t} \tag{5}$$

Second, we define an instrument that isolates the change in quantity that is driven by investors re-balancing due to the issuance of EU bonds. We calculate $PredFlow_{n,i,t}$ as the predicted quantity change for a security n by each investor (type) i due to the exposure to the EU bond issuance:

$$PredictedFlow_{n,i,t} = (\sum_{n} Share_{s,i,2020q2} * \Delta EUissuance_{b,t}) * Weight_{n,i,t-1} \tag{6}$$

This is a shift-share instrument where the shifter is based on investor's portfolio allocation to other supranational bonds s in the second quarter (Q2) of 2020, before EU bond issuance took off, and the shares are $Weight_{n,i,t-1}$, portfolio weights of the security n in the previous quarter. We consider the shifter quasi-exogenous (Borusyak et al. (2022)). Intuitively, we predict investors to adjust their portfolio holdings according to their previous portfolio allocation.

We use these predicted flows at the security-flow level to calculate predicted change in nominal amounts of security n held by investors:

$$\Delta(PredNomAmount)_{n,t} = \Delta(\sum_{i} PredictedFlow_{n,i,t}) \tag{7}$$

We are interested in studying the potential selling of other bonds induced by the issuance and purchase of EU bonds. For this reason we define a measure of "selling" as the negative value of the predicted flow and the change in nominal amount:

$$SellingNomAmount_{n,t} = -\Delta(NomAmount)_{n,t} \tag{8}$$

and

$$PredSellingNomAmount_{n,t} = -\Delta(PredNomAmount)_{n,t}. \tag{9}$$

We use the predicted selling flows as an instrument for the realized selling flows. Finally, we test how re-balancing induced by the issuance of EU bonds impacted the yield of another security n in quarter t using the following IV specification:

$$\Delta Yield_{n,t} = \gamma_t * Controls_n + \delta SellingNomAmount_{n,t} + \epsilon_{n,t} \tag{10}$$

where *SellingNomAmount* is instrumented by the predicted selling flows, *PredSellingNomAmount*.

We include security by controls fixed effects in the specification so that securities that are more exposed because they are held by more exposed investors are comparable to the less exposed ones. The control variables are the ones selected in the previous section: Issuer country, Issuer sector, Asset type, Currency.

4 Who holds European safe assets?

In this section we characterize the investor base of safe assets. We focus on central government bonds - issued by both national governments as well as supranational institutions - in Europe. Bonds issued by governments are the prime candidates for safe assets, as yields on those bonds are typically are lower bound on yields issued by private issuers in the same country. For our analysis of national safe assets, we consider central government bonds issued by the EU member states who are the members of the euro area. For some of our analysis, we split the national government issuers into several asset classes by rating, considering AAA-rated issuers (such as Germany), AA/A-rated issuers (such as France and Spain) and BBB-rated issuers (such as Italy). For our analysis of supranational safe assets, in addition to EU bonds issued by the European Commission, we consider bonds issued by the other supranational issuers - the European Investment Bank (EIB), the European Stability Mechanism (ESM) and the European Financial Stability Facility (EFSF) - jointly as one asset class. We focus on the sample Q2 2020 - Q3 2023, to capture the period over which the new

EU bond issuance took off.

4.1 Investor base of supranational bonds

Figure 4 shows the distribution of holdings of EU bonds across key private EA investors: banks, insurances, funds, households, and pension funds. Banks are the largest investors into the EU bonds, followed by mutual funds and insurances, and pension funds. Households are holding a small fraction of total as direct holdings. In the time series, banks and insurances have increased their holdings substantially over the past year.

Figure 5 shows the distribution of holdings of the other supranational bonds (issued by the EIB, ESM and EFSF) across key private EA investors. The one difference with respect to the EU bonds is that insurances - that used to be the largest private EA holder of the supranational bonds, followed by banks - have reduced the holdings over the past couple of years while banks have increased their holdings, thus overtaking insurances as the largest holder. Mutual funds are the third largest holder and pension funds the fourth largest holder of the supranational bonds.

4.2 Investor base of national bonds

Figure 6 shows the distribution of holdings of AAA-rated national government bonds. Here, the largest holder sector is EA mutual funds, followed by EA pension funds. Banks and insurances only enter in the third and the fourth place, respectively. Households' direct holdings constitute a small proportion of total which, however, has been increasing as of late.

In sum, comparing AAA-rated national government bonds with supranational bonds, we document several differences in investor bases. First, the distribution across the key private EA investors - consisting of EA banks, EA mutual funds, EA insurances, EA pension funds and EA households – differs. In particular, banks hold a smaller share of AAA-rated national debt compared to AAA-rated supranational debt. Second, national government bonds have a substantial domestic investor base while supranational bonds, by definition, lack domestic investors. Third, in the time series, holdings of AAA-rated bonds by banks, insurances and

pension funds have been declining steadily over the past few years while these same investors increased their holdings of the EU bonds.

5 Portfolio re-balancing due to EU bond issuance shock

In this section, we study how different investors re-allocate their portfolios following the large "shock" to the supply of safe assets, the EU bond issuance. We use two datasets to study this link. In subsection 5.1 below, we present results based on the detailed funds data from the Lipper database. Using funds' portfolios on a security level, we can study in great detail portfolio re-balancing by funds. In subsection 5.2 below, we present results based on the securities holdings statistics because this database enables us to study re-balancing by *all* investors, not only mutual funds, albeit at the more aggregated investor-type level. Still, we can conduct our analysis on security level and answer the question of how the same security is re-balanced by different investor types. We will also exploit the investor-domicile dimension that this database gives us.

5.1 Mutual funds' re-balancing

Results from the first stage regression (equation 3) are reported in Table 2. Results for exposure as measured by the weight in the portfolio are reported in Column (1) while results for exposure as measured by the nominal amount are reported in Column (2). For both measures, the estimated coefficients are positive and statistically significant at the 1% level, implying that higher holdings of the supranational bonds in Q2 2020 predict higher holdings of the newly issued EU bonds down the line. Importantly, the F-statistics is above 34, indicating a strong instrument.

Given this first stage, we now turn to our main specification, which tests how more exposed funds re-balanced the other safe assets (equation 4). Results are presented in Table 3. Columns (1) and (2) present results for re-balancing of the other supranational bonds (those issued by the EIB, ESM and EFSF, likewise pre-dominantly AAA-rated). Columns (1) reports results for the weight-in-portfolio measure while Column (2) reports results using the nominal-amount measure. Columns (3), (4) and (5) present results for re-balancing

of the national government bonds, for AAA-rated, AA/A-rated and BBB-rated sovereigns, respectively.

There are two key results. First, funds that acquire newly issued EU bonds reduce their holdings of the other supranational bonds, both in terms of the nominal amounts and in terms of their portfolio weights. Interpreting the coefficient in Column (2) in economic terms, given that an average fund invests in 65 distinct supranational bonds, for 1 unit increase in holdings of the EU bonds, a fund reduces its holdings of the other supranational European bonds by 0.42 units.

Second, results for the national government bonds show that funds do not significantly adjust their holdings following the acquisition of the EU bonds. Put differently, funds do not view the EU bonds as substitutes for the national bonds they hold.

5.2 Investor re-balancing

In this section, we conduct a complementary analysis using the securities holdings statistics because this database enables us to study re-balancing by *all* investors. It also allows us to distinguish between domestic and non-domestic investors. We will use the domicile dimension to test whether domestic investors have different elasticities of substitution between the national and supranational safe assets.

Table 4 presents results for re-balancing, in terms of nominal amounts, of the other supranational bonds (those issued by the EIB, ESM and EFSF; likewise pre-dominantly rated AAA) following the EU bond issuance. Across all investors and domiciles (Column (1)), EU bonds appear to be substitutes for the supranational bonds. However, Columns (2) - (6) reveal interesting heterogeneity across investors.[4] While Funds and Banks reduce their holdings of the other supranationals following the acquisition of the EU bonds - thus suggesting they are substitutes - households treat them as complements while insurances and pension funds do not display any significant re-balancing.

Table 5 shows how investors re-balance national government bonds following the large EU bond issuance, in terms of nominal amounts. Overall, investors do not significantly

[4]Note that within each column, the variation on a security level comes from a heterogeneous exposure of a particular investor type across different domiciles.

re-balance away from the national government bonds (column (1)). Columns (2) to (6) display re-balancing by different investor types. Banks and Insurances reduce their holdings of national bonds following the purchase of EU bonds. Households and pension funds are the ones acquiring more national bonds, suggesting that they treat them as complements to EU bonds.

To understand why investors treat EU bonds and national bonds differently, we zoom in on one particular difference, namely, that supranational issuers lack domestic investor base. To this end, Table 7 displays re-balancing of national government bonds while distinguishing among domestic and non-domestic investors. Indeed, Column (1) reveals that domestic investors did not alter their holdings in response the EU bond issuance while non-domestic investors did treat them as substitutes. Importantly, while non-domestic banks and insurances re-balanced away from the national bonds, non-domestic households and pension funds acquired more of them.

5.3 Impact on yields

In this section, we analyze the impact of investor re-balancing on bond yields, starting with the impact on supranational yields.

As outlined in Section 3, the first step in this analysis is to identify a set of observable controls that can be a good proxy for security-quarter fixed effects since we cannot employ those any longer. To this end, in our second stage re-balancing regressions from the previous section, we consider a specification with several control variables - such as Issuer country, Issuer sector, Asset type, and Currency - to check that our estimates remain broadly unchanged compared to the specification with security-quarter fixed effects.

Table **??** presents the results. Column (1) repeats results of Table 4 (Column (1)), which employs security-quarter fixed effects. Instead, Column (2) drops the security-quarter fixed effects and identifies a set of observable controls that can be a good proxy for the dropped fixed effects. The controls included are Issuer country, Issuer sector, Asset type, and Currency. It is apparent that these controls substitute very well for the dropped fixed effects. We will therefore employ them in our yield impact regressions, which we discuss next.

Table **??** shows the first stage results of the impact of investor re-balancing on yields of supranational bonds. In the regression, *SellingNomAmount* is instrumented by *Pred-SellingNomAmount*. The controls included are Issuer country, Issuer sector, Asset type, and Currency. The results indicate that the instrument is strong.

Table **??** displays results of the second stage, which assesses the impact of re-balancing due to EU bond issuance on yields of supranational bonds. Results indicate that the yields on other supranational bonds increase. This is consistent with EU bonds and supranational bonds being substitutes. Intuitively, as investors buy more of the newly issued EU bonds and re-balance away from the other supranational bonds (as documented in the previous section), prices of such substitute bonds decrease and their yields increase.

6 Conclusion

What makes an asset "safe"? In this paper, we offer an investor-based perspective on the demand for safe assets and the determination of convenience yields. Using proprietary securities holdings data, we first characterize the investor base of both national and supranational safe assets in Europe. We find that the distribution of investors across these two types of assets differs in several dimension. First, the distribution across the key private EA investors - consisting of the EA banks, EA mutual funds, EA insurances, EA pension funds and EA households – differs. In particular, banks hold a smaller share of AAA-rated national debt compared to AAA-rated supranational debt. Second, national government bonds have a substantial domestic investor base while supranational bonds, by definition, lack domestic investors. Third, in the time series, holdings of AAA-rated bonds by banks and insurances have been declining steadily over the past few years while these same investors increased their holdings of the EU bonds.

We then study portfolio re-allocation by different investors following a large shock to the supply of safe assets, the largest ever joint issuance of supranational bonds by the European Commission. The aim is to determine who is the marginal investor in safe assets, and to link investor behavior to prices. To this end, we study re-allocation on security level, to ensure that our results are linked to different investors and their preferences rather than differences

in risk, liquidity etc. *across* securities. Using this approach, we show that marginal investors in supranational bonds are predominantly banks and mutual funds. These investors view the AAA-rated Commission bonds as substitutes for other supranational bonds. We show that when they acquire Commission bonds, they re-balance away from other supranational bonds and, as a result, the yields on those bonds increase. However, investors do not view the Commission bonds as substitutes for national government bonds. We show that this result is driven by the domestic investors who do not substitute away from national bonds following the Commission bond issuance. Such home bias of domestic investors towards national bonds may help explain why the AAA-rated Commission bonds have substantially higher yields compared to national government AAA-rated securities.

References

Acharya, V. and Laarits, T. (2023). When do treasuries earn the convenience yield? a hedging perspective. Working paper.

Alogoskoufis, S. and Langfield, S. (2019). Regulating the doom loop. Working paper, European Central Bank.

Andolfatto, D. and Williamson, S. (2015). Scarcity of safe assets, inflation, and the policy trap. Journal of Monetary Economics, 73:70–92.

Arnold, N. G., Barkbu, B. B., Ture, . H. E., Hou, W., and Yao, J. (2018). A central fiscal stabilization capacity for the euro area. Working paper, IMF Staff Discussion Notes No. 2018/003.

Baele, L., Bekaert, G., Inghelbrecht, K., and Wei, M. (2020). Flights to safety. The Review of Financial Studies, 33(2):689–746.

Bartik, T. J. (1991). Who benefits from state and local economic development policies? W.E. Upjohn Institute for Employment Research.

Binsbergen, v. J. H., Diamond, W. F., and Grotteria, M. (2022). Risk-free interest rates. Journal of Financial Economics, 143(1):1–29.

Bletzinger, T., Greif, W., and Schwaab, B. (2022). Bond convenience yields and exchange rate dynamics. Journal of Risk and Financial Management, 15(11):1–13.

Bonfanti, G. and Garicano, L. (2022). Do financial markets consider european common debt a safe asset? Blog post, Bruegel.

Borusyak, K., Hull, P., and Jaravel, X. (2022). Quasi-experimental shift-share research designs. The Review of Economic Studies, 89(1):181–213.

Breckenfelder, J. and De Falco, V. (2023). Investor heterogeneity and large-scale asset purchases. Working paper, ECB and Harvard University.

Brunnermeier, M. K., Garicano, L., Lane, P., Pagano, M., Reis, R., Santos, T., Van Nieuwerburgh, S., and Vayanos, D. (2016). Esbies: Safety in the tranches. American Economic Review Papers and Proceedings, 106(5):508–512.

Brunnermeier, M. K., Langfield, S., Pagano, M., Reis, R., Van Nieuwerburgh, S., and Vayanos, D. (2017). Esbies: Safety in the tranches. Economic Policy, 32(90):175–219.

Bénassy-Quéré, A., Brunnermeier, M., Enderlein, H., Farhi, E., Fratzscher, M., Fuest, C., Gourinchas, P.-O., Martin, P., Pisani-Ferry, J., Rey, H., Schnabel, I adn Véron, N., Weder di Mauro, B., and Zettelmeyer, J. (2018). Reconciling risk sharing with market discipline: A constructive approach to euro area reform. Working paper, CEPR Policy Insight No. 91.

Caballero, R. and Farhi, E. (2017). The safety trap. Review of Economic Studies, 85(1):223–274.

Caballero, R. J., Farhi, E., and Gourinchas, P.-O. (2017). The safe assets shortage conundrum. Journal of Economic Perspectives, 31(3):29–46.

Chodorow-Reich, G. (2014). The employment effects of credit market disruptions: Firm-level evidence from the 2008–9 financial crisis. The Quarterly Journal of Economics, 129(1):1–59.

Claeys, G., McCaffrey, C., and Welslau, L. (2023). The rising cost of european union borrowing and what to do about it. Policy brief 12/2023, Bruegel.

Coppola, A. (2021). In safe hands: The financial and real impact of investor composition over the credit cycle. Working paper, Stanford University.

Diamond, W. and Van Tassel, P. (2023). Risk-free rates and convenience yields around the world. Working paper, Federal Reserve Bank of New York.

Du, W., Im, J., and Schreger, J. (2018). The us treasury premium. Journal of International Economics, 112:167–181.

Engel, C. (2020). Safe us assets and us capital flows. Journal of International Money and Finance, 102:102102.

Fang, X., Hardy, B., and Lewis, K. K. (2022). Who holds sovereign debt and why it matters. Working paper, National Bureau of Economic Research.

Gabaix, X. and Koijen, R. S. (2021). In search of the origins of financial fluctuations: The inelastic markets hypothesis. Working paper, National Bureau of Economic Research.

Geromichalos, A., Herrenbrueck, L., and Lee, S. (2023). Asset safety versus asset liquidity. Journal of Political Economy, 131(5):1172–1212.

Goldsmith-Pinkham, P., Sorkin, I., and Swift, H. (2020). Bartik instruments: What, when, why, and how. American Economic Review, 110(8):2586–2624.

Gorton, G. and Laarits, T. (2018). Collateral damage. Working paper no. w24298, National Bureau of Economic Research.

Gorton, G. and Ordoñez, G. (2022). The supply and demand for safe assets. Journal of Monetary Economics, 125:Pages 132–147.

Greenwood, R. and Vayanos, D. (2010). Price pressure in the government bond market. American economic review, 100(2):585–590.

Greenwood, R. and Vayanos, D. (2014). Bond supply and excess bond returns. The Review of Financial Studies, 27(3):663–713.

He, Z., Krishnamurthy, A., and Milbradt, K. (2019). A model of safe asset determination. American Economic Review, 109(4):1230–1262.

Jiang, Z., Krishnamurthy, A., and Lustig, H. (2018). Foreign safe asset demand for us treasurys and the dollar. In AEA Papers and Proceedings, volume 108, pages 537–541. American Economic Association 2014 Broadway, Suite 305, Nashville, TN 37203.

Jiang, Z., Krishnamurthy, A., and Lustig, H. (2020). Dollar safety and the global financial cycle. Working paper, National Bureau of Economic Research.

Jiang, Z., Krishnamurthy, A., and Lustig, H. (2021). Foreign safe asset demand and the dollar exchange rate. The Journal of Finance, 76(3):1049–1089.

Kekre, R. and Lenel, M. (2021). The flight to safety and international risk sharing. Working paper, National Bureau of Economic Research.

Khwaja, A. I. and Mian, A. (2008). Tracing the impact of bank liquidity shocks: Evidence from an emerging market. American Economic Review, 98(4):1413–1442.

Koijen, R. S., Koulischer, F., Nguyen, B., and Yogo, M. (2021). Inspecting the mechanism of quantitative easing in the euro area. Journal of Financial Economics, 140(1):1–20.

Koijen, R. S. and Yogo, M. (2019). A demand system approach to asset pricing. Journal of Political Economy, 127(4):1475–1515.

Krishnamurthy, A. and Vissing-Jorgensen, A. (2012). The aggregate demand for treasury debt. Journal of Political Economy, 120(2):233–267.

Leandro, A. and Zettelmeyer, J. (2018). The search for a euro area safe asset. Working paper, Peterson Institute for International Economics.

Mota, L. (2021). The corporate supply of (quasi) safe assets. Working paper, MIT Sloan.

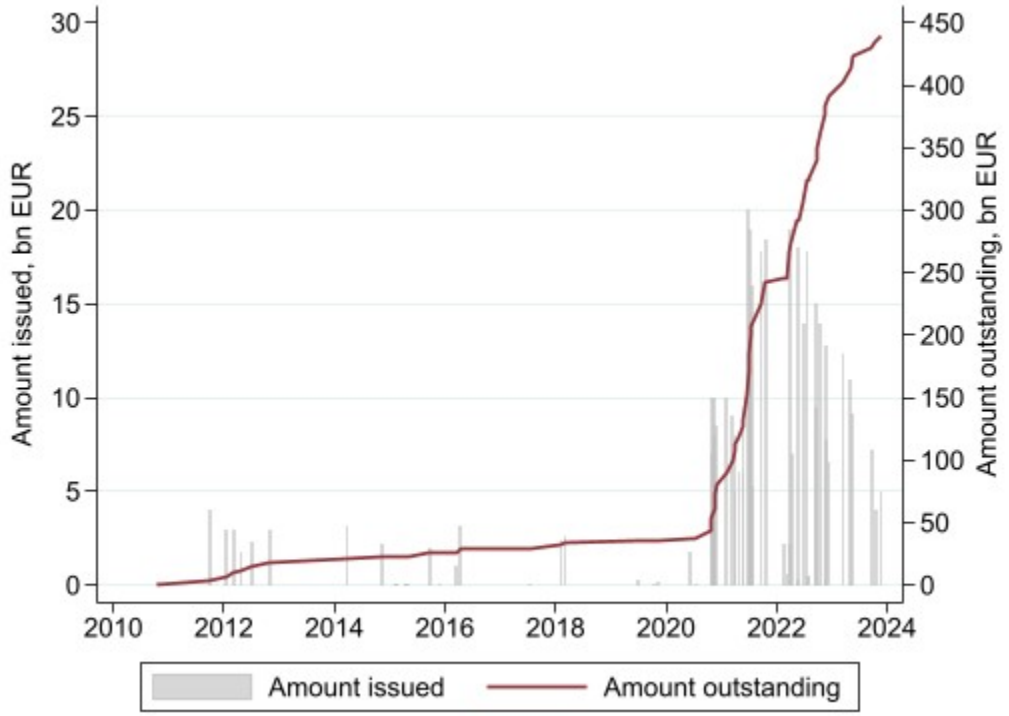
Nagel, S. (2016). The liquidity premium of near-money assets. The Quarterly Journal of Economics, 131(4):1927–1971.

Valchev, R. (2020). Bond convenience yields and exchange rate dynamics. American Economic Journal: Macroeconomics, 12(2):124–166.

Vayanos, D. and Vila, J.-L. (2021). A preferred-habitat model of the term structure of interest rates. Econometrica, 89(1):77–112.

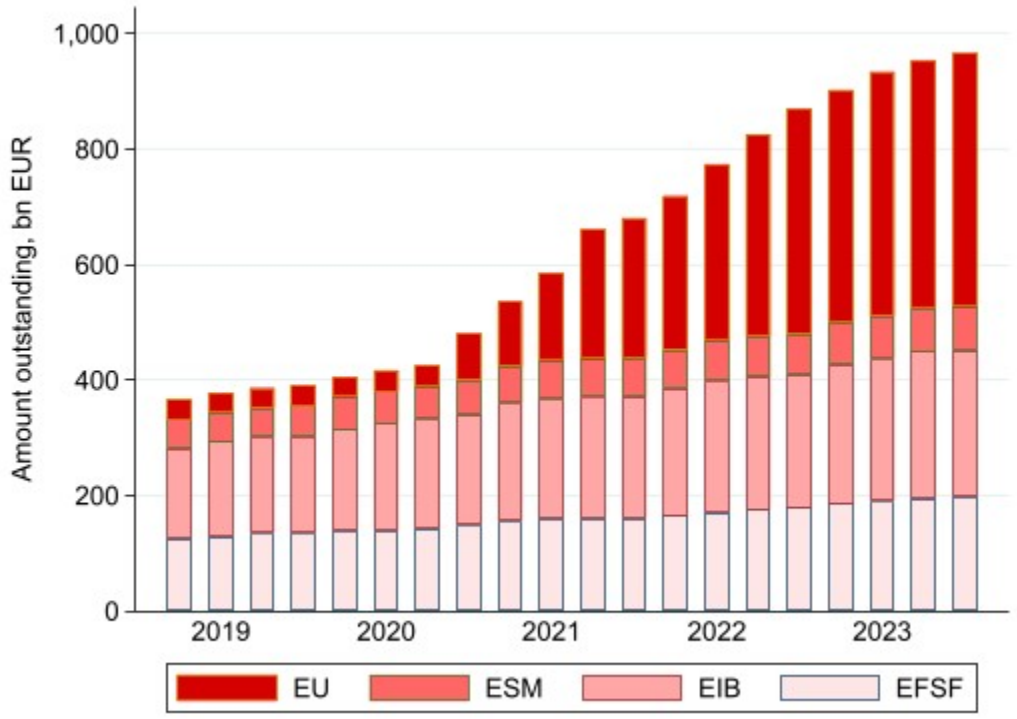
FIGURES

Figure 1: EU bond issuances



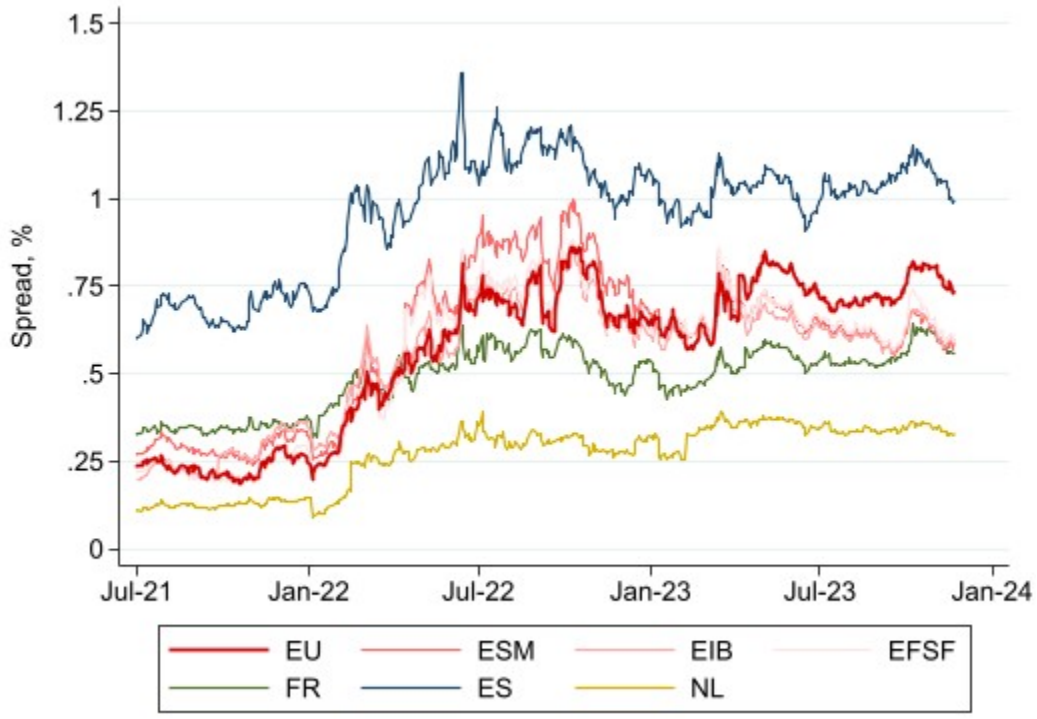
Note: EU common debt issuance (bn EUR, left scale) and debt outstanding (bn EUR, right scale), 2010-2023.
Source: Bloomberg.

Figure 2: European supranational bonds outstanding



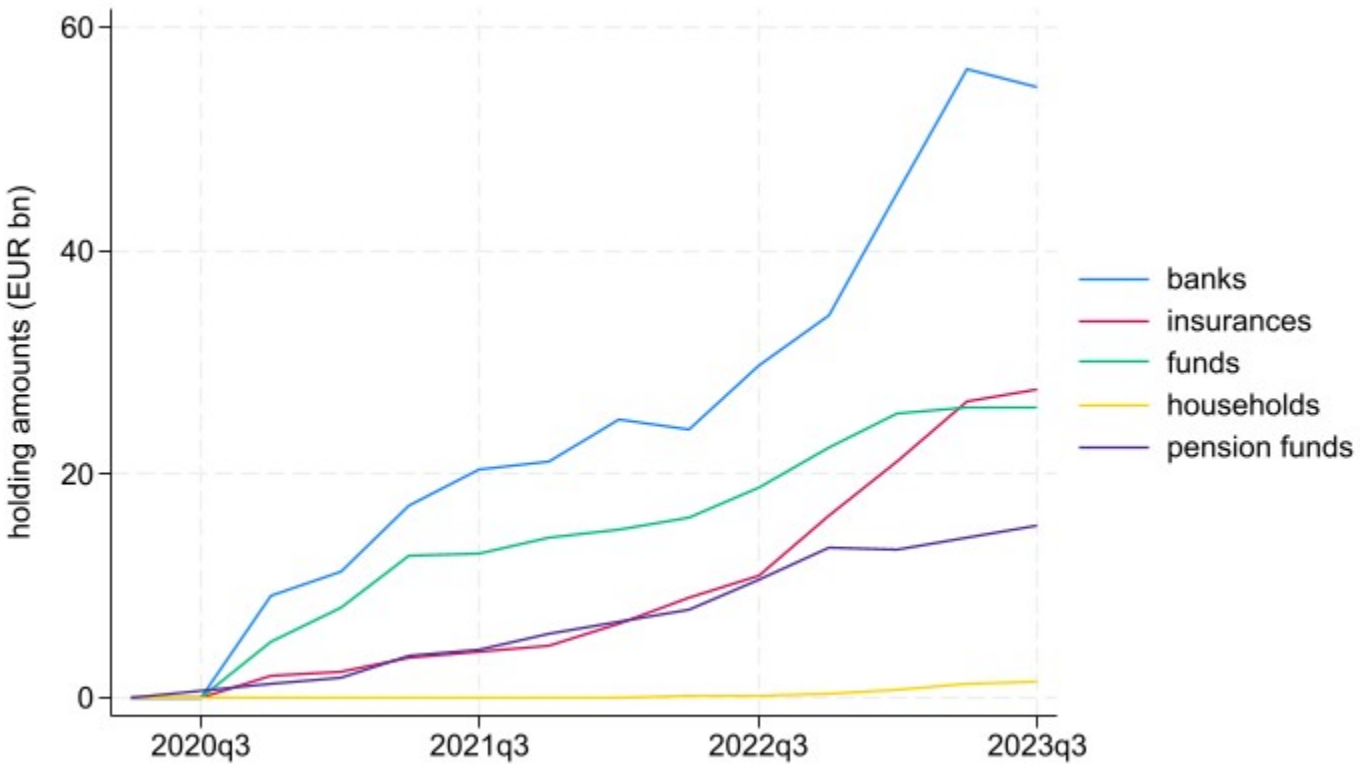
European supranational debt outstanding (bn EUR), 2019-2023. Source: Bloomberg.

Figure 3: Spreads to German Bunds



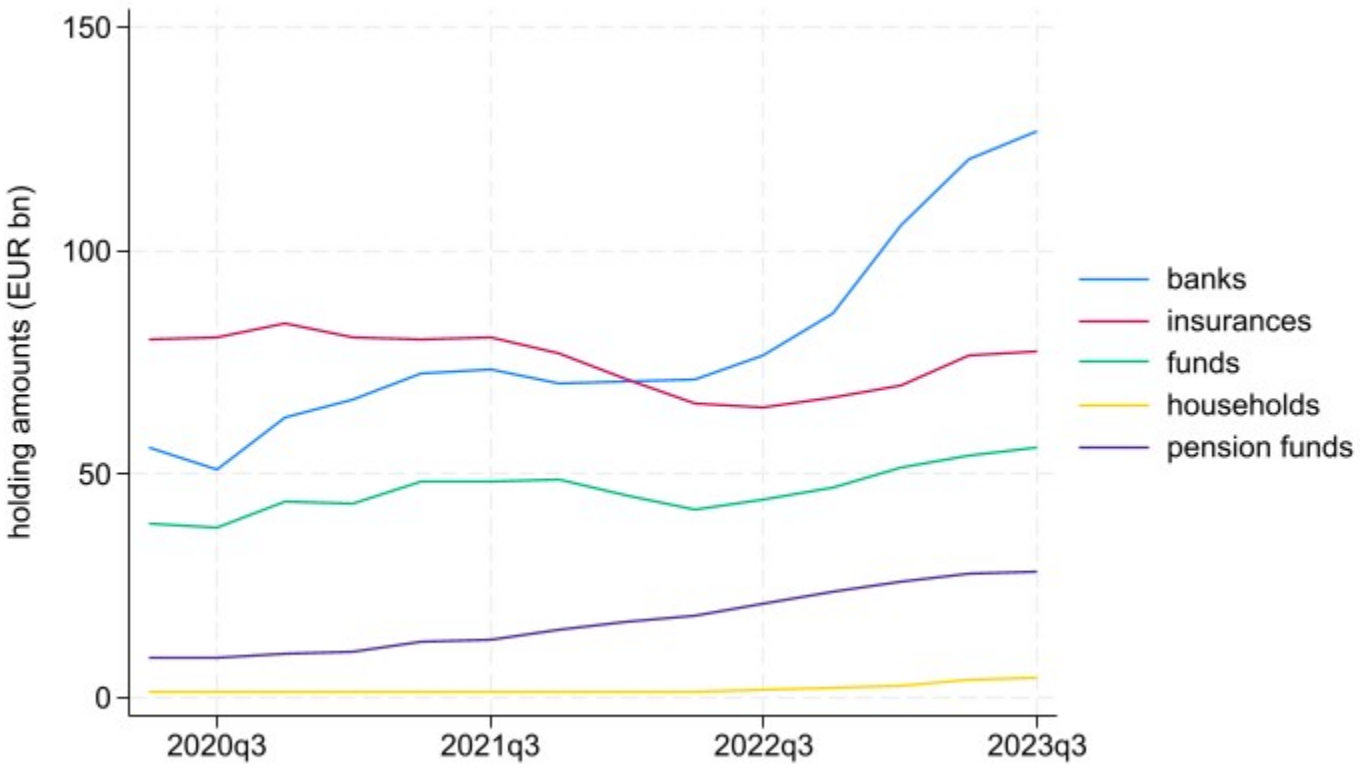
Note: Spreads to German Bunds (in %) of 10-year national bonds (FR, ES, IT, NL, FI) and supranational bonds (EU, EIB, ESM, EFSF), 2021-2023. Source: Bloomberg.

Figure 4: Key private investors in the EU bonds



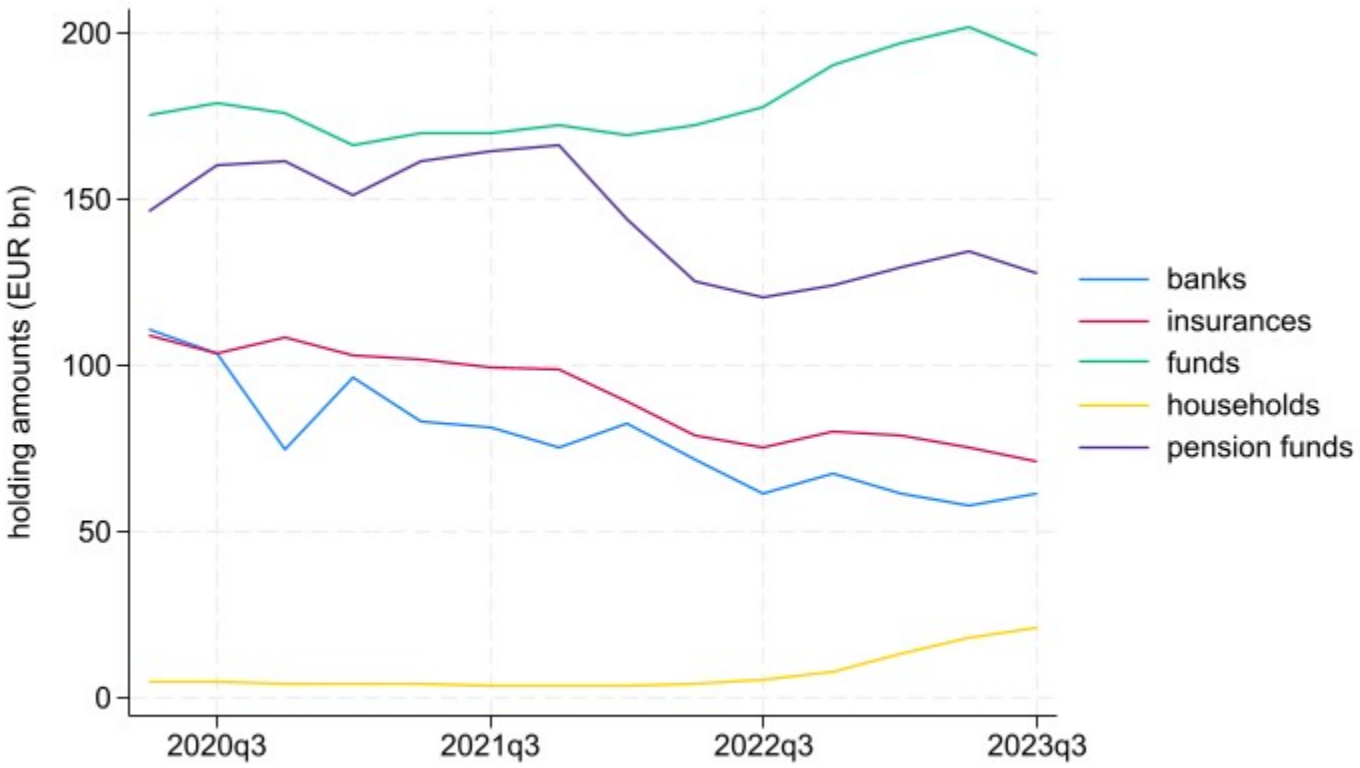
Note: Holdings of the EU bonds (EUR bn), distribution across key private EA investors (banks, insurances, funds, households, pension funds), 2020 - 2023. Source: SHS.

Figure 5: Key private investors in the supranational bonds



Note: Holdings of the supranational bonds (EUR bn), distribution across key private EA investors (banks, insurances, funds, households, pension funds), 2020 - 2023. Source: SHS.

Figure 6: Key private investors in AAA-rated national government bonds



Note: Holdings of the AAA-rated national government bonds (EUR bn), distribution across key private EA investors (banks, insurances, funds, households, pension funds), 2020 - 2023. Source: SHS.

TABLES

Table 1: Funds' exposure - Summary statistics

	Lipper funds					
	mean	sd	p10	p50	p90	count
Exposure	.0282546	.244895	-.004492	0	.0450343	29231
Pred Exposure	.0215704	.0631107	0	0	.0660356	29231
Tot Assets(€Bil)	3.1503	50.63812	.0133468	.1496025	1.75567	28548

Note: The table reports summary statistics of mutual funds from the Lipper database. Exposure is calculated as the amount each fund buys of the newly issued EU bonds in a given quarter. Predicted Exposure is a shift-share instrument that measures how much a fund can potentially buy based on their portfolio allocation to the supranational bonds in Q2 2020. Total assets corresponds to the total amount held by each fund in each quarter in EUR billion.

Table 2: Mutual funds' re-balancing: First stage

	(1) exposure (weight in portfolio)	(2) exposure (nominal amount)
predicted exposure	0.029***	0.074***
	(0.005)	(0.011)
observations	15,422	15,422
R2	0.074	0.095
time FE	YES	YES
F-statistics	34.07	45.64

Note: The table reports regressions of the form $Exposure_{i,t} = \alpha_t + \beta PredExposure_{i,t} + \epsilon_{i,t}$. *Exposure* is calculated as the change in holdings of the newly issued EU bonds, for each fund in a given quarter. *Predicted Exposure* is a shift-share instrument that measures how much a fund can potentially hold of the newly issued EU bonds based on their portfolio allocation to the supranational bonds in Q2 2020 (before the EU bond issuance took off). Standard errors are reported in parentheses. Standard errors are two-way clustered at the fund and quarter level. *,**,*** indicate significance at the 10%, 5%, and 1% level, respectively.

Table 3: Mutual funds' re-balancing: Second stage

	(1)	(2)	(3)	(4)	(5)
	(2SLS)	(2SLS)	(2SLS)	(2SLS)	(2SLS)
	supranational bonds		euro area government bonds		
	weight in portfolio	nominal amount	AAA	AA-A	BBB
Exposure	-0.111***	-0.006***	-0.005	0.014	0.002
	(0.040)	(0.002)	(0.022)	(0.015)	(0.019)
observations	61613	61613	68886	183075	95792
mutual funds	978	978	971	1029	932
time X security FE	YES	YES	YES	YES	YES
cluster	fund	fund	fund	fund	fund

Note: The table reports regressions of the form $Rebalancing_{n,i,t} = \mu_{n,t} + \theta Exposure_{i,t} + \epsilon_{n,i,t}$. $Rebalancing_{n,i,t}$ corresponds to the change in holdings of supranational bonds (as measured by the change in portfolio weight, Column (1), and as measured by the change in nominal amount held, Column (2)), the change in nominal holdings of national AAA-rated bonds (Column (3)), the change in nominal holdings of national AA/A-rated bonds (Column (4)), and the change in nominal holdings of national BBB-rated bonds (Column (5)). All regressions control for quarter by security fixed effects. Standard errors are reported in parentheses. Standard errors are two-way clustered at the fund and quarter level. *,**,*** indicate significance at the 10%, 5%, 1% level, respectively.

Table 4: Investor re-balancing of supranational bonds: Second stage

	(1) all	(2) funds	(3) banks	(4) households	(5) insurances	(6) pension funds
Exposure	-0.0032***	-0.0040***	-0.0032***	0.0099***	-0.0041	-0.0008
	(0.0008)	(0.0008)	(0.0006)	(0.0012)	(0.0024)	(0.0012)
Observations	63,916	13,606	12,726	6,816	14,103	5,225
-	-	-	-	-	-	-
Bond FE	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES
Time x Bond FE	YES	YES	YES	YES	YES	YES
-	-	-	-	-	-	-
Clustered Std. Err.	portfolio	portfolio	portfolio	portfolio	portfolio	portfolio

*** p<0.01, ** p<0.05, * p<0.1

Note: The table reports regressions of the form $Rebalancing_{n,i,t} = \mu_{n,t} + \theta Exposure_{i,t} + \epsilon_{n,i,t}$. $Rebalancing_{n,i,t}$ corresponds to the change in holdings of supranational bonds. Column (1) reports results across all investors and domiciles; Columns (2) - (6) report results for the key holder sector (funds, banks, households, insurances and pension funds). All regressions control for quarter by security fixed effects. Standard errors are reported in parentheses. Standard errors are clustered at the investor level. *,**,*** indicate significance at the 10%, 5%, 1% level, respectively.

Table 5: Investor re-balancing of government bonds: Second stage

	(1) all	(2) funds	(3) banks	(4) households	(5) insurances	(6) pension funds
Exposure	-0.0016	0.0021*	-0.0029	0.1675***	-0.0018**	0.0077***
	(0.0010)	(0.0012)	(0.0019)	(0.0211)	(0.0007)	(0.0019)
Observations	571,516	103,853	92,451	61,324	118,783	47,735
-	-	-	-	-	-	-
Bond FE	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES
Time x Bond FE	YES	YES	YES	YES	YES	YES
-	-	-	-	-	-	-
Clustered Std. Err.	portfolio	portfolio	portfolio	portfolio	portfolio	portfolio

*** p<0.01, ** p<0.05, * p<0.1

Note: The table reports regressions of the form $Rebalancing_{n,i,t} = \mu_{n,t} + \theta Exposure_{i,t} + \epsilon_{n,i,t}$. $Rebalancing_{n,i,t}$ corresponds to the change in holdings of government bonds. Column (1) reports results across all investors and domiciles; Columns (2) - (6) report results for the key holder sector (funds, banks, households, insurances and pension funds). All regressions control for quarter by security fixed effects. Standard errors are reported in parentheses. Standard errors are clustered at the investor level. *,**,*** indicate significance at the 10%, 5%, 1% level, respectively.

Table 6: Investor re-balancing of national bonds: Second stage

	(1) all sovereign	(2) AAA	(3) AA/A	(4) BBB
Exposure	-0.0016	0.0034	-0.0011	-0.0048***
	(0.0010)	(0.0048)	(0.0018)	(0.0013)
Observations	571,516	88,165	259,985	172,275
-	-	-	-	-
Bond FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Time x Bond FE	YES	YES	YES	YES
-	-	-	-	-
Clustered Std. Err.	portfolio	portfolio	portfolio	portfolio

*** p<0.01, ** p<0.05, * p<0.1

Note: The table reports regressions of the form $Rebalancing_{n,i,t} = \mu_{n,t} + \theta Exposure_{i,t} + \epsilon_{n,i,t}$. $Rebalancing_{n,i,t}$ corresponds to the change in holdings of national bonds. Column (1) reports results across all sovereign bonds, Columns (2) - (4) report results for AAA, AA/A, and BBB-rated national bonds. All regressions control for quarter by security fixed effects. Standard errors are reported in parentheses. Standard errors are clustered at the investor level. *,**,*** indicate significance at the 10%, 5%, 1% level, respectively.

Table 7: Domestic vs non-domestic investor re-balancing of government bonds: Second stage

	(1) domestic	(2) non domestic	(3) non domestic funds	(4) non domestic banks	(5) non domestic households	(6) non domestic insurances	(7) non domestic pension funds
Exposure	0.0040	-0.0022***	-0.0016	-0.0043***	0.0256***	-0.0011**	0.0075***
	(0.0093)	(0.0008)	(0.0016)	(0.0012)	(0.0035)	(0.0004)	(0.0008)
Observations	94,061	473,525	92,926	73,478	52,018	101,761	39,079
-	-	-	-	-	-	-	-
Bond FE	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES
Time x Bond FE	YES	YES	YES	YES	YES	YES	YES
-	-	-	-	-	-	-	-
Clustered Std. Err.	portfolio	portfolio	portfolio	portfolio	portfolio	portfolio	portfolio

*** p<0.01, ** p<0.05, * p<0.1

Note: The table reports regressions of the form $Rebalancing_{n,i,t} = \mu_{n,t} + \theta Exposure_{i,t} + \epsilon_{n,i,t}$. $Rebalancing_{n,i,t}$ corresponds to the change in holdings of national bonds, distinguishing between domestic (= same domicile as the issuer) and non-domestic investors. Column (1) reports results across all domestic investors. Columns (2) - (7) report results for the key holder sector non-domestic investors (all non-domestic, non-domestic funds, non-domestic banks, non-domestic households, non-domestic insurances and non-domestic pension funds). All regressions control for quarter by security fixed effects. Standard errors are reported in parentheses. Standard errors are clustered at the investor level. *,**,*** indicate significance at the 10%, 5%, 1% level, respectively.