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This paper contains research conducted within the network “Challenges for Monetary Policy Transmission in a Changing World Network” (ChaMP). It consists of economists from the European Central Bank (ECB) and the national central banks (NCBs) of the European System of Central Banks (ESCB).

ChaMP is coordinated by a team chaired by Philipp Hartmann (ECB), and consisting of Diana Bonfim (Banco de Portugal), Margherita Bottero (Banca d’Italia), Emmanuel Dhyne (Nationale Bank van België/Banque Nationale de Belgique) and Maria T. Valderrama (Oesterreichische Nationalbank), who are supported by Melina Papoutsi and Gonzalo Paz-Pardo (both ECB), 7 central bank advisers and 8 academic consultants.

ChaMP seeks to revisit our knowledge of monetary transmission channels in the euro area in the context of unprecedented shocks, multiple ongoing structural changes and the extension of the monetary policy toolkit over the last decade and a half as well as the recent steep inflation wave and its reversal. More information is provided on its [website](#).

* Views expressed are those of the authors and do not necessarily reflect official positions of De Nederlandsche Bank.

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Quantitative easing and preferred habitat investors in the euro area bond market *

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Abstract

In this study, we analyze the impact of the European Central Bank's (ECB) sovereign bond purchases on bond demand among euro area investors from 2015 to 2022. By employing a novel demand setup, using ownership shares of individual bonds, we separately estimate investor reactions to (i) ECB bond purchases and (ii) new bond issuances. Utilizing bond level data on securities holdings of euro area investors and the ECB, we show that insurance companies and pension funds act as preferred habitat investors and are reluctant to sell the bonds the ECB is buying. Conversely, non-euro area investors from the private sector primarily serve as counterparties for ECB purchases. Our findings indicate significant differences across bond maturities and credit ratings, but minimal differences across the different stages of the quantitative easing (QE) implementation periods and between domestic and non-domestic euro area bonds.

Keywords — quantitative easing, sovereign bonds, European Central Bank, PSPP, securities holdings statistics, bond demand.

JEL codes — E58, F42, G11, G15.

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I. Introduction

In response to the global financial crisis of 2007-2009, central banks implemented unconventional monetary policies, significantly expanding their balance sheets. Among these measures, large-scale bond purchase programs, known as quantitative easing (QE), were key interventions. By purchasing bonds of various maturities, central banks aimed to lower yields across the yield curve, particularly impacting longer-term yields. This encouraged investors to shift towards higher-yielding assets.

This paper examines the portfolio rebalancing channel, a primary mechanism through which QE influences financial markets and the broader economy (D’Amico et al., 2012; Carpenter et al., 2015; Joyce et al., 2017; Goldstein et al., 2018; Christensen and Krogstrup, 2022).¹ The portfolio rebalancing channel operates on the principle of imperfect substitutability between financial assets (Tobin, 1965). Preferred habitat investors, who prefer bonds with specific characteristics – for example, due to investment mandates or the search for certain duration risk –, are reluctant to disinvest in these bonds, even when yields decrease (Andrés et al., 2004; Vayanos and Vila, 2021). Central bank bond purchases reduce the availability of these bonds, creating scarcity that particularly affects preferred habitat investors (D’Amico et al., 2012).

A key contribution of our empirical analysis is investigating the presence of preferred habitat investors. We do so by examining changes in sovereign bond holdings in response to the ECB’s purchases from 2015 to 2022. We introduce a novel demand approach, observing the complete market, including both euro area and non-euro area investors, and ECB purchases.

By incorporating the demand for new issuances into our framework, we go beyond the typical focus on identifying marginal sellers. Instead, at the bond level we evaluate the sales of different investors relative to what each investor would be expected to sell if they acted proportionally to their holdings the ECB purchases certain bonds. This approach can identify preferred habitat characteristics of investors while ensuring that our method avoids falsely identifies preferred habitat behavior based solely on bond sales, which can be influenced by factors such as investor size or new bond issuances. Figure 1 illustrates this mechanism: while investor A sells the least during QE purchases, this is not a characteristic of preferred habitat per se because investor

¹For other transmission channels see Gagnon et al. (2011) on liquidity, Bauer and Rudebusch (2014) on signaling effects as well as Rodnyansky and Darmouni (2017) and Morais et al. (2019) on bank lending.

A buys even less of new bond supply. Conversely, investor C, the largest seller, has preferred habitat characteristics, because the sales are disproportionately low relative to investor C's purchases.

Using detailed ECB transaction data matched with bond-level holdings grouped by investor sectors our findings reveal that insurance companies and pension funds from the euro area as well as foreign official investors acted as preferred habitat investors. These investors were reluctant to sell bonds when the ECB was buying under QE. Specifically, we find that insurance companies sold 7.5 cents for every euro the ECB bought but they purchased 14.4 cents for every euro of new bonds issuances; for pension funds this was 2.9 cents sold when the ECB purchased, against 6.0 cents purchased of new issuances. Foreign official investors further sold 10.4 cents for every euro the ECB purchased, against 22.7 cents of purchases of new bonds.

By contrast, non-euro area private investors were the primary sellers of bonds purchased by the ECB, with private sector non-euro area investors disproportionately offloading their sovereign holdings. They sold 40.4 cents for every euro the ECB purchased while they bought only 24.2 cents of new bond supply. Euro area banks also sold a significant portion of their bonds when the ECB was buying, though to a lesser extent than foreign private investors. Specifically, European banks sold 20.1 cents for every euro the ECB bought but purchased 17.5 cents for new bond supply.

This study builds on existing research exploring investor willingness to sell bonds targeted by central banks during early QE phases. Previous studies suggest QE works by pushing domestic investor demand away from sovereign bonds (Carpenter et al., 2015; Goldstein et al., 2018; Joyce et al., 2017; Saito and Hogen, 2014). Our analysis extends this literature by distinguishing between investor responses to central bank purchases and new bond issuances within a single empirical framework, covering the full sovereign bond purchase programme (2015-2022) in the euro area.

For the euro area, Koijen et al. (2021) document that the banking sector and non-euro area investors primarily sold assets to the ECB in response to QE purchases. Albertazzi et al. (2021) find that ECB asset purchases prompted euro area investors from vulnerable countries to rebalance their portfolios. Similarly, Elsayed et al. (2023) show that banks were significant counterparts in the ECB's sovereign bond purchases. Conversely, Bergant et al. (2020) indicate

that euro-area investment funds and households shifted away from euro area sovereign bonds towards similar sovereign bonds non-euro area advanced economies. [Hudepohl \(2022\)](#) argues that ECB purchases led euro area investors to rebalance their portfolios towards riskier bonds from emerging markets.

Preferred habitat investors typically aim to match the duration of assets and liabilities. For instance, insurance companies and pension funds prefer long-maturity bonds due to their long-term liabilities, a demand reinforced by supervisory rules ([Domanski et al., 2017](#); [Carboni and Ellison, 2022](#)). Another characteristic is home bias in portfolio allocation, where investors prefer domestic assets ([Lane and Milesi-Ferretti, 2008](#); [Coerdacier and Rey, 2013](#)). For euro area investors, this implies a weaker reaction to price changes in euro area bonds due to fewer desirable substitutes in non-euro area bonds ([Brutti and Sauré, 2016](#)).

The ECB's asset purchase programs provide a unique opportunity to test the existence and stability of preferred habitat investors across various market conditions. This study utilizes a unique dataset of investor holdings, including ECB bond purchases ([Kojien et al., 2021](#); [Elsayed et al., 2023](#)).² Our study covers the period from 2015Q1 to 2022Q2, starting with the initiation of the largest QE program, the Public Sector Purchase Programme (PSPP), and includes the entire period of ECB purchases.

This study extends the literature by addressing the scarcity of studies on observed bond holdings to assess investor behavior. We distinguish between investor responses to central bank purchases and bond issuances within a single empirical framework. We analyze a long period (2015-2022) to assess the stability of preferred habitat behavior over time and across different PSPP phases. Finally, we document heterogeneous behavior in holdings of domestic and non-domestic euro area bonds.

Our results show that non-euro area investors were the main sellers of bonds purchased by the ECB, supporting [Kojien et al. \(2021\)](#). However, within this 'Rest of the world' category, private sector investors disproportionately offloaded their sovereign holdings purchased by the ECB. Euro area banks also acted as key counterparts, albeit to a lesser extent. Conversely, euro area insurance companies and pension funds acted as preferred habitat investors, showing less willingness to sell bonds purchased by the ECB.

²Throughout the paper we refer to ECB asset purchases which in practice cover the purchases by the ECB and national central banks from the Eurosystem.

Results suggest that preferred habitat is a time-invariant characteristic of investors. Comparing results across different QE periods, the elasticities of investor sector bond sales to ECB purchases remain stable. This reluctance of certain euro area investors to sell government bonds was crucial for QE’s effectiveness in the euro area. Insurance companies and pension funds, with a strong preference for holding euro area government bonds, amplified the impact of the ECB’s bond purchases. Despite the importance of preferred habitat investors for QE’s success, arbitrageurs also played a significant role by influencing price differentials across the euro area government bond market (Mudde et al., 2024). As the ECB intervened, non-euro area investors increasingly shifted away from euro area bonds, potentially affecting exchange-rate dynamics and adding another channel through which QE impacted the broader economy (Alpanda and Kabaca, 2020; Kolasa and Wesolowski, 2023). While the overall success of QE in the euro area continues to be evaluated, the behavior of preferred habitat investors supports key assumptions of portfolio rebalancing models underpinning QE.

This paper proceeds by describing the granular data on bond holdings across investor sectors and the ECB as well as the empirical methodology to derive bond demand functions and investigating preferred habitat in Section II. Section III presents the benchmark results and several extensions. Section IV concludes.

II. Data and Method

A. Data

This study utilizes the ECB Securities Holdings Statistics by Sector (SHS-S) dataset, which provides security-by-security information on quarterly holdings by euro-area-domiciled investors (Boermans, 2022). We combine SHS-S data with transaction data on ECB asset purchases at the security level.

Our focus is on sovereign bond purchases under the Public Sector Purchase Programme (PSPP), part of the broader Asset Purchase Programme (APP) and the Pandemic Emergency Purchase Programme (PEPP). The SHS-S dataset contains holdings at the sector-country level, but for our baseline analysis, we aggregate holdings for euro area investors to focus on sectoral behavior. We impute zeros for instances where no investors from a specific sector hold a bond in each quarter to maintain a balanced panel.

Institutional sectors are categorized according to the European System of Accounts (ESA) 2010 guidelines, resulting in eight sectors: Banks, Investment funds, Insurance companies, Pension funds, Other financials, Governments, Households, and Non-financial corporations (Boermans, 2022). Additionally, we include the (*ECB*) and a Rest of the World sector for foreign investors (Kojien et al., 2021). The data does not specify the sector for non-euro area investors, so they are aggregated into the Rest of the World sector.

The main metric is the market value of bond holdings by investors, denominated in euros. This data is enriched with attributes from the ECB’s Centralised Securities Database (CSDB), including security type, amount outstanding, maturity date, and issuer details. The sample consists of over 400,000 observations across 2,736 bonds, collected quarterly from 2015Q1 to 2022Q2.

Table 1 provides descriptive statistics for our dataset. The average bond has an outstanding amount of about EUR 6 billion and 7.5 years residual maturity. Euro area investors collectively hold more than non-euro area investors, though the latter’s holdings surpass those of any single European sector. Euro area banks and insurance companies are the largest sectors in terms of government bond ownership, holding on average 21% and 18% of each bond at the start of the sample, respectively. However, there is substantial variation in holdings across bonds.

[Insert Table 1 about here]

During 2014-2022, the Euro bond markets underwent significant structural changes, as shown in Figure 2, which depicts bond ownership progression against the outstanding amount for different investor sectors, including the central bank. Two periods of QE and falling interest rates led to significant shifts in investor portfolios, driven by the search for yield, preference for safer assets, and displacement due to the ECB’s growing market presence. The ECB’s stake increased from nearly zero to almost 40% of all outstanding bonds in less than a decade.

[Insert Figure 2 about here]

B. Method

To analyze the impact of ECB bond purchases on the holdings of various investor sectors, we employ a panel regression model. The literature offers several methodologies to estimate investor

responses to central bank purchases, including [Kojien and Yogo \(2019\)](#) with a demand system perspective, [Albertazzi et al. \(2021\)](#) using log holdings and pre- and post-announcement periods, and [Elsayed et al. \(2023\)](#) directly connecting to central bank purchases. Our regression setup tests for preferred habitat investors by estimating bond-level demand and analyzing responsiveness to ECB purchases and supply shifts. We use market values without log transformation for straightforward coefficient interpretation:

$$H_{i,s,t} = \beta_s^{ECB} \cdot InvestorSector_s \cdot ECB_{i,t} + \beta_s^{AO} \cdot InvestorSector_s \cdot Outstanding_{i,t} + \gamma_{i,s} + \mu_{s,t} + \epsilon_{i,s,t} \quad (1)$$

where $H_{i,s,t}$ represents the market value of investor sector s holdings of bond i in quarter t , $ECB_{i,t}$ denotes the market value of the ECB's holdings of bond i in quarter t , and $Outstanding_{i,t}$ is the market value of the total amount outstanding of bond i in quarter t . All values are in euros. Since all variables are measured in market value, we do not include bond prices or yields to avoid multicollinearity. The coefficients β_s^{ECB} and β_s^{AO} capture the marginal effects of ECB holdings and outstanding amounts, respectively, on the holdings by each investor sector s , adjusted for sector-specific factors.³

The terms $\gamma_{i,s}$ and $\mu_{s,t}$ represent bond-investor and investor-quarter fixed effects, controlling for unobserved heterogeneity. Bond-investor fixed effects ($\gamma_{i,s}$) account for idiosyncratic factors affecting an investor sector's holdings of a particular bond over time, such as risk preferences specific to the bond-sector pair. Investor-quarter fixed effects ($\mu_{s,t}$) control for temporal factors influencing each sector's holdings in each quarter, such as macroeconomic conditions, market liquidity, or regulatory changes. We cluster standard errors at the bond-investor sector level to account for potential residual correlation.

The estimated coefficients indicate the proportional response of investor holdings to ECB's bond purchases. A positive β_s^{ECB} indicates that investor sector s 's holdings increase with ECB purchases, while a negative value suggests a displacement effect. The coefficient β_s^{AO} reflects changes in holdings in response to variations in the total amount of bonds outstanding. A positive β_s^{AO} implies that investor sectors increase their holdings as the outstanding amount of

³Our regression model is similar to a seemingly unrelated regression (SUR) model, estimating a system of regressions for each investor sector to analyze their responses to ECB purchases and outstanding amounts.

available bonds expands.

The empirical setup allows for intuitive interpretation of the regression coefficients. For example, if the ECB purchases EUR 1 billion in a specific bond, investors from sector s buy EUR β_s^{ECB} billion. In market equilibrium, summing β_s^{ECB} for all s equals -1, and summing β_s^{AO} for all s equals 1. This ensures that if the ECB buys EUR 1 billion, other sectors sell EUR 1 billion, enhancing result interpretability.⁴

Preferred habitat investors are defined as those less responsive to ECB purchases compared to new issuances, formally $|\beta_s^{ECB}| < |\beta_s^{AO}|$. This implies their relative share of holdings increases following ECB purchases.

To address endogeneity concerns, the ECB announces its bond purchases ahead of time, ensuring predetermined aggregate figures. The ECB's market-neutral strategy distributes purchases in proportion to each eligible bond's relative market capitalization, adhering to issue share limits. We mitigate potential endogeneity through bond-time and investor-time fixed effects. Bond-time fixed effects capture uniform, time-sensitive bond attributes, while investor-time fixed effects account for sector-specific variations over time. By assigning zero to bond-sector-quarter combinations with zero holdings, bond-investor fixed effects are defined for all sectors and bonds. These fixed effects isolate changes in bond holdings within each investor-quarter while controlling for broader portfolio adjustments. Trades by intermediaries are assumed to settle within the quarter, aligning with our data timing.

Figure 3 shows the evolution of investor sector shares in the sovereign bond market. The ECB's sovereign bond holdings increased from nearly zero to about 40% by 2022-Q2. The holdings of the Rest of the World appear to move contrary to ECB purchases, while euro area government holdings increased sharply in early 2020 due to pandemic-related issuances which were initially retained.

[Insert Figure 3 here]

⁴In a scenario where all investors adjust their holdings proportionally to changes in the outstanding amount, β_s^{ECB} and β_s^{AO} would be equal but with opposite signs. Divergences from this equality suggest deviations from proportional behavior, highlighting the presence of different elasticities across investor sectors. The preferred habitat model predicts that certain investor sectors will be less inclined to sell bonds when the ECB purchases because of their preference to continue to hold such securities, displaying weaker reaction to overall market movements and to an increased demand. Such investor behavior implies that the estimated β_s^{ECB} coefficient for a given *InvestorSector* s is disproportionately low for their holdings.

III. Results

A. Main results

Table 2 presents the results of our main regression. In the first column, β_s^{ECB} estimates the role of each sector as a marginal seller in response to the ECB’s purchases within a given quarter. The results indicate that all investor sectors, except for the government, sold bonds to the ECB. Foreign investors emerge as the primary sellers, accounting for more than half of the amount purchased by the ECB. Banks and investment funds also feature as significant sellers, followed by insurance companies and pension funds with smaller volumes of sales. The remaining investor sectors contribute less than 3 percentage points each to the bond sales. The magnitude of the coefficients β_s^{ECB} varies significantly across investors, partly reflecting differences in portfolio sizes.

[Insert Table 2 about here]

While β_s^{ECB} provides insights into the marginal sellers, it does not fully capture the preferred habitat characteristics of the different institutional sectors. Investors with preferred habitat characteristics tend to be less responsive to price changes, implying they would sell a smaller proportion of their portfolio when demand or supply shifts, such as when the ECB purchases.⁵ To identify preferred habitat investors accurately, it is crucial to also analyze β_s^{AO} , which reflects investor behavior in response to changes in the amount of bonds outstanding.

Turning our attention to β_s^{AO} , we note that the main sellers – foreign investors, banks, and investment funds – are also significant buyers when the outstanding amount changes. This partly reflects the large size of these investor sectors and the advantages of holding newly issued bonds, such as higher liquidity. However, $|\beta_s^{ECB}| > |\beta_s^{AO}|$ indicates that these investors are more elastic, selling more than expected if sales were proportional to holdings. For example, when the ECB buys €1 of a bond, banks account for 20.1 cents of the sales to the ECB, while banks buy 17.5 cents when governments issue €1 of new bonds. This comparison reveals the key mechanism of our analysis: certain investors sell more in response to ECB purchases than

⁵Consider an extreme case where an investor sells half of the central bank’s purchases but originally held three-quarters of these bonds. This implies that the other half was sold by investors with the remaining quarter of holdings, indicating a more elastic portfolio.

they acquire in response to new issuances, demonstrating higher elasticity and weaker preferred habitat behavior.

Our findings suggest that foreign investors and euro area investment funds, followed by euro area banks, are the most responsive to ECB purchases. These results complement early findings from [Kojen et al. \(2021\)](#), who show that, during 2015Q1-2017Q4, primarily foreign investors and euro area banks were the primary sellers in response to the ECB asset purchases. Similarly, [Paludkiewicz \(2021\)](#) highlights euro area banks' sales during quantitative easing from 2013Q1-2015Q4. We extend these findings by showing how investor bond shares shift in response to bond-specific ECB purchases while considering the supply side over the entire sovereign bond purchase period in the euro area.

Table 2 also reveals that investment funds exhibit a larger difference between $|\beta_s^{ECB}|$ and $|\beta_s^{AO}|$ compared to banks, suggesting more elastic behavior. This contrasts with findings by [Kojen et al. \(2021\)](#) and [Elsayed et al. \(2023\)](#), who report that banks are more elastic than investment funds. Our results align with [Bergant et al. \(2020\)](#), who show that euro area investment funds and households actively rebalanced away from ECB-eligible bonds towards foreign sovereign bonds with similar characteristics.

A notable result in Table 2 is the distinct behavior of insurance companies and pension funds compared to other investor sectors. Consistent with earlier assumptions in the literature, we confirm that insurance companies – and, to a lesser extent, pension funds – exhibit strong preferred habitat characteristics. They are less likely to sell relative to their holdings when the ECB is buying, instead purchasing new issues in larger quantities. Specifically, insurance companies sell 7.5 cents for every euro the central bank buys but purchase 14.4 cents for every euro of new bonds issued, aligning them with the characteristics of buy-and-hold investors.

Figure 4 displays the estimated regression coefficients where the coefficients for the ECB purchases and the sovereign bond amount outstanding are combined. The figure shows that especially insurance companies and pension funds respond in line with preferred habitat.

[Insert Figure 4 here]

B. Preferred habitat in different segments of the yield curve

We explore the heterogeneity across bond types, particularly by maturity. The [Vayanos and Vila \(2021\)](#) preferred habitat model assumes certain investors have a tendency to hold bonds with longer residual maturities and are less responsive to price changes. Our main specification in [Table 2](#) assumes a uniform coefficient for each investor, yet this impact may vary along different segments of the yield curve. Given the diverse range of government bond maturities, we investigate whether investor elasticities differ across these segments.

To achieve this, we introduce an interaction term for discrete maturity segments for each investor sector. The estimated model now includes categorical variables for residual maturity categories: 0 to 3 years, 3 to 7 years, 7 to 10 years, and more than 10 years. This addition allows us to explore how investor responses differ within specific bond market segments. These maturity segments distribute the sample of bonds into four similar-sized groups, each representing a roughly equal amount outstanding.

$$\begin{aligned}
 H_{i,s,t} = & \beta_s^{ECB,MatSeg} \cdot MaturitySegment_{i,t} \cdot InvestorSector_s \cdot ECB_{i,t} \\
 & + \beta_s^{AO,MatSeg} \cdot MaturitySegment_{i,t} \cdot InvestorSector_s \cdot Outstanding_{i,t} \\
 & + \gamma_{i,s} + \mu_{s,t} + \epsilon_{i,s,t}
 \end{aligned} \tag{2}$$

$MaturitySegment_{i,t}$ denotes bond i time-to-maturity segment at quarter t , and the remaining variables have the same definitions as before. Note that a specific bond i can appear in several maturity segments during the sample period because its residual maturity decreases over time. For example, a bond with 10 years residual maturity in 2014 is considered in the 7-10 years group, but by 2022 it falls into the 0-3 years category. [Table 3](#) displays the results.

[Insert Table 3 about here]

We focus on the sectors displaying the most elastic or inelastic behavior in the main regression ([Table 2](#)). Banks were particularly active sellers at the shorter end of the yield curve. After adjusting for bond-investor and time-investor fixed effects, banks sold €0.22 for every €1 of short-term bonds purchased by the ECB. This proportion decreases for longer maturities, dropping to €0.15 for the longest segment. Conversely, their buying activity in response to changes in the

amount outstanding shows small variation across maturity buckets, implying greater elasticity in the short-term segment. In contrast, foreign investors and investment funds exhibit more elastic behavior with longer-term bonds. Insurance companies and pension funds, identified as preferred habitat investors, are significantly more reluctant to sell in the longer segments of the yield curve. Both exhibit strong demand for newly issued bonds with longer residual maturities.⁶ [Elsayed et al. \(2023\)](#) document similar behavior for insurance companies and pension funds (ICPFs). Ceteris paribus, ICPFs are less inclined to sell bonds with long residual maturities when the ECB purchases these bonds. While our results show strong responsiveness of investment funds to sell longer residual maturity bonds following ECB purchases, [Elsayed et al. \(2023\)](#) do not find a relationship between maturity and ECB purchases for investment funds.

C. Time-varying elasticities

The reactions to ECB purchases may vary over time, i.e., the elasticities of investors' bond holdings can be state-dependent. For example, certain investor sectors might display preferred habitat behavior during the early phases of the sovereign bond purchases but become more active sellers later, possibly due to low interest rates prompting a search for yield or because more elastic investors become inelastic after selling a significant portion of their portfolios. Additionally, as highlighted in [Figure 2](#), the intensity of ECB purchases varied over time.

To investigate time-varying preferred habitat behavior, we extend our main regression by adding an interaction between *InvestorSector* and a categorical variable denoting the ECB policy regime (time period) and our explanatory variables. Concretely, we estimate:

$$\begin{aligned}
 H_{i,s,t} = & \beta_s^{ECB,Regime} \cdot Regime_t \cdot InvestorSector_s \cdot ECB_{i,t} \\
 & + \beta_s^{AO,Regime} \cdot Regime_t \cdot InvestorSector_s \cdot Outstanding_{i,t} \\
 & + \gamma_{i,s} + \mu_{s,t} + \epsilon_{i,s,t}
 \end{aligned} \tag{3}$$

where *Regime_t* includes the categories "QE 1" (2015:Q1 to 2018:Q4), "QE taper" (2019:Q1 to 2020:Q1), and "QE 2" (2020:Q2 to 2022:Q2). The rest of the variables are as in the main regression.

⁶Unreported results show that the main results are not dependent on the recency of issuance, defined as the newness of a bond within either the quarter or one year of issuance date.

[Insert Table 4 about here]

Table 4 displays the results. Overall, we do not observe strong differences across different time periods, suggesting that the preferred habitat effects are persistent. Note that the coefficients for government holdings of bonds differ across time, likely due to governments issuing bonds and retaining them for liquidity purposes during Covid. In general, investors with high elasticities are consistent over various cycles, showing that much of the absorption from ECB purchases came from non-euro area investors.

D. Home bias and preferred habitat

Does the preferred habitat nature of some investors depend on the assets being domiciled in their domestic jurisdiction? To analyze this, we enhance our main regression by incorporating an interaction term with a $Jurisdiction_{i,s,c}$ dummy variable. This variable is assigned a value of Home when the investor’s domicile country matches that of the bond issuer, and Foreign otherwise. For example, the value is Home for Spanish investment funds holding bonds issued by the Spanish government, and Foreign for Spanish investment funds holding bonds issued by the French government.

This extension investigates how home bias in investment behaviors may affect responses to ECB purchases, particularly in how investors respond to central bank purchases of domestic versus foreign bonds. The home bias tendency of European investors is well-documented (Lane and Milesi-Ferretti, 2008; Coeurdacier and Rey, 2013). Our analysis complements this literature by focusing on home bias within the context of preferred habitat, specifically examining the selling behavior of investors in response to ECB purchases. Concretely, we estimate:

$$\begin{aligned}
 H_{i,s,c,t} = & \beta_s^{ECB, Jurisdiction} \cdot Jurisdiction_{i,s,c} \cdot InvestorSector_{s,c} \cdot ECB_{i,t} \\
 & + \beta_s^{AO, Jurisdiction} \cdot Jurisdiction_{i,s,c} \cdot InvestorSector_{s,c} \cdot Outstanding_{i,t} \\
 & + \gamma_{i,s,c} + \mu_{s,t} + \epsilon_{i,s,c,t}
 \end{aligned} \tag{4}$$

Here, c indicates a split between home country and other euro area countries.⁷ This allows us to test if $\beta_s^{ECB, Jurisdiction=Home} > \beta_s^{ECB, Jurisdiction=Foreign}$, ceteris paribus.

⁷Note we cannot split the Rest of the World category in home and foreign.

Table 5 presents our findings regarding the role of home bias in investors' reactions to ECB purchases. We find that, overall, domestic bonds were sold to the ECB to a greater extent than non-domestic euro area bonds. This pattern suggests that while investors may display home bias in their bond portfolios, this bias does not necessarily prevent them from selling domestic assets when faced with ECB interventions.

[Insert Table 5 about here]

However, the coefficients associated with ECB purchases for domestic holdings are significantly negative but less so compared to foreign bonds, indicating that while domestic bonds are sold, investors tend to retain them slightly longer than non-domestic ones. In particular, banks and insurance companies display a stronger reluctance to sell domestic bonds relative to foreign ones, though they still participate in the sale.

Furthermore, the results suggest that the difference between domestic and non-domestic bond sales is not driven solely by home bias but also by residual maturity, as highlighted by the stronger influence of this factor in Table 3. This finding emphasizes that while home bias plays a role in investment decisions, other factors like bond maturity can be more decisive in determining the timing and extent of sales in response to central bank actions.

E. Credit rating influence in preferred habitat

In this extension we incorporate an additional interaction term involving an *IssuerRating* categorical variable, which takes the value "Core" for bonds issued by sovereigns with a credit rating of AA or higher, and "Non-core" for all others.⁸ With this modification, we examine if the investor response to central bank purchases varies between bonds issued by sovereigns with higher credit ratings, thereby assessing how credit rating influences preferred habitat behavior. The revised model is:

$$\begin{aligned}
 H_{i,s,t} = & \beta_{s,j}^{ECB} \cdot IssuerRating_i \cdot InvestorSector_s \cdot ECB_{i,t} \\
 & + \beta_{s,j}^{AO} \cdot IssuerRating_i \cdot InvestorSector_s \cdot Outstanding_{i,t} \\
 & + \gamma_{i,s} + \mu_{s,t} + \epsilon_{i,s,t}
 \end{aligned} \tag{5}$$

⁸Specifically, sovereign bonds issued by Austria, Belgium, Finland, France, Germany, and the Netherlands are considered Core.

The findings are summarized in Table 6, with some notable differences relative to the main regressions from Table 2, providing a nuanced view of the investor responses to ECB purchases when considering credit ratings. Specifically, foreign investors showed a pronounced tendency to sell, but also to buy, core bonds more than non-core bonds. Conversely, banks demonstrated stronger activity in non-core markets and had greater elasticity to lower their exposure to their core portfolio. Insurance companies, identified as preferred habitat investors, had a significant preference for non-core bonds, actively purchasing them and refraining from selling when the ECB made purchases, a trend not as evident with core bonds. One explanation could be a search for yield, as insurers offer guaranteed returns on some products and these returns need to be realized by the insurance company. Moreover, pension funds sold core bonds more actively but also emerged as notably stronger buyers, fitting within the preferred habitat behavior, whereas their participation in non-core bond markets was more limited.

[Insert Table 6 about here]

F. Splitting foreign holdings in official and private sector

Our study presents evidence that non-euro area investors acted as main counterparties for the ECB sovereign bond purchases. To further understand the role of the 'Rest of the World', we split the Rest of the World holdings into official holdings and private holdings. The SHS-S data contains portfolios of foreign central banks and governments that invest through euro area custodians. While this data only has partial coverage, it still covers over 1 trillion euros of foreign official holdings (see also [Ferdinandusse et al. \(2020\)](#) who assume that foreign officials act as preferred habitat investors). These portfolios can serve different purposes, such as foreign exchange reserve management, but for us the important contribution is to distinguish private foreign investors from foreign officials. Noting that part of the foreign official holdings will still be categorized as 'Rest of the World' investor sector given our residual approach, using the partial foreign official holdings data allows us to more accurately estimate how foreign official investors responded to the ECB purchases.

The results, presented in Table 7, confirm that the previously discussed behavior of Rest of the World investors – characterized by very elastic holdings and a tendency to accommodate ECB purchases – can be attributed primarily to private investors. In this table, the Rest of the

World sector is split into official and private holdings for clarity, ensuring it does not appear as an additional sector but rather a more detailed categorization of the existing one. The foreign official sector can be characterized empirically as preferred habitat investors, selling 10.4% when the ECB buys while acquiring 22.7% of new outstanding bonds. Compared to euro area insurance companies and pension funds, the foreign official holders display a stronger response to the ECB purchases. However, considering their absorptive capacity of sovereign issuances suggests that the foreign sector did not unwind their portfolios much in response to the ECB asset purchases. Hence, the findings in Table 7 confirm that foreign official investors, including central banks and governments, in addition to insurance companies and pension funds from the euro area, acted as preferred habitat investors in response to the ECB purchases.

[Insert Table 7 about here]

IV. Conclusion

Theory posits that preferred habitat investors are crucial in driving interest rate reductions when central banks engage in large-scale asset purchases. Our study examines the behavior of different investors during the ECB's asset purchases from 2015 to 2022. We find that non-euro area investors, primarily from the private sector, and to a lesser extent, euro area banks, were the main counterparties for the ECB's asset purchases. In contrast, insurance companies, pension funds, and foreign official investors, such as central banks and governments, were less willing to sell bonds targeted by the ECB programs. Using granular data on ECB purchases at the bond level, we conclude that preferred habitat investors exist in the euro area bond market, potentially driving the price wedges necessary for QE programs to influence interest rates at the zero lower bound.

Our results also reveal heterogeneity across maturity segments. As predicted by the preferred habitat model, we find the strongest effects for insurance companies and pension funds in the long maturity segment, reflecting their long-term liabilities and strong preferred habitat in this segment.

Our findings suggest that euro area banks and non-euro area investors were the key sellers to the ECB, acting mostly as arbitrageurs in response to QE. Additionally, the coefficients for the largest investor sectors (banks, insurance companies, investment funds, and rest of the world

investors) are remarkably stable over time, indicating that trading behavior is a time-invariant characteristic of these sectors regardless of the different phases of the asset purchasing programs and even indistinguishable between domestic and non-domestic euro area sovereign bonds.

The preferred habitat of large investor sectors has implications for central banks when they decrease the size of their balance sheets. New debt issuances and sales by the central bank need to be absorbed by more elastic investors, such as banks, investment funds, and investors from outside the euro area. The pace of balance sheet reduction must ensure that investors can absorb the additional supply to avoid significant interest rate changes. For example, [Harrison \(2024\)](#) shows that quantitative easing is most effective when conducted quickly, while a more gradual quantitative tightening path is better from a welfare perspective.

Future research can build on the insights gained regarding the preferred habitat characteristics of different investor sectors. The presence of preferred habitat investors can impact financial stability, as the bond ownership structure affects amplification in fire sale situations. When ownership is concentrated among investors facing a common shock, such as during the UK gilt market stress in September-October 2022, fire sale dynamics can emerge. Preferred habitat investors are generally less responsive to price changes, providing stable demand for long-term assets. However, this stable demand means they are less effective at bringing market prices to their fundamental levels. For financial stability, it is important to have a significant share of arbitrageurs who can step in to stabilize prices during fire sale dynamics.

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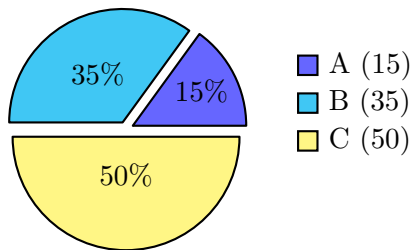
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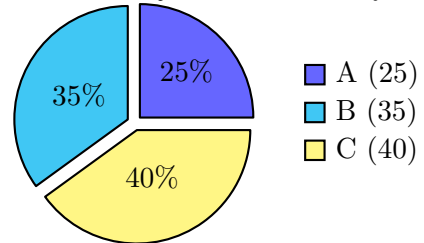
V. Figures

FIGURE 1 – CONCEPTUALIZATION OF BOND OWNERSHIP SHARES, SUPPLY AND ECB PURCHASES

Government issues 100 (e.g., in a tap)

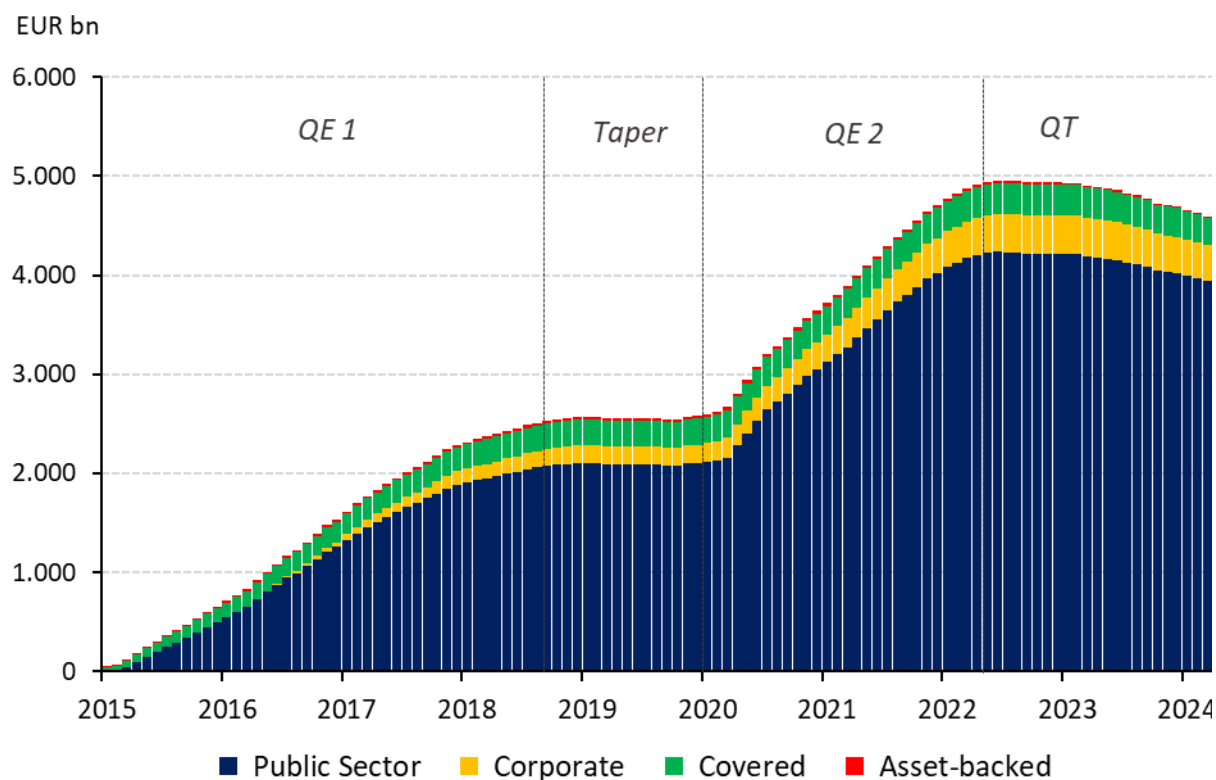


ECB buys 100 under QE



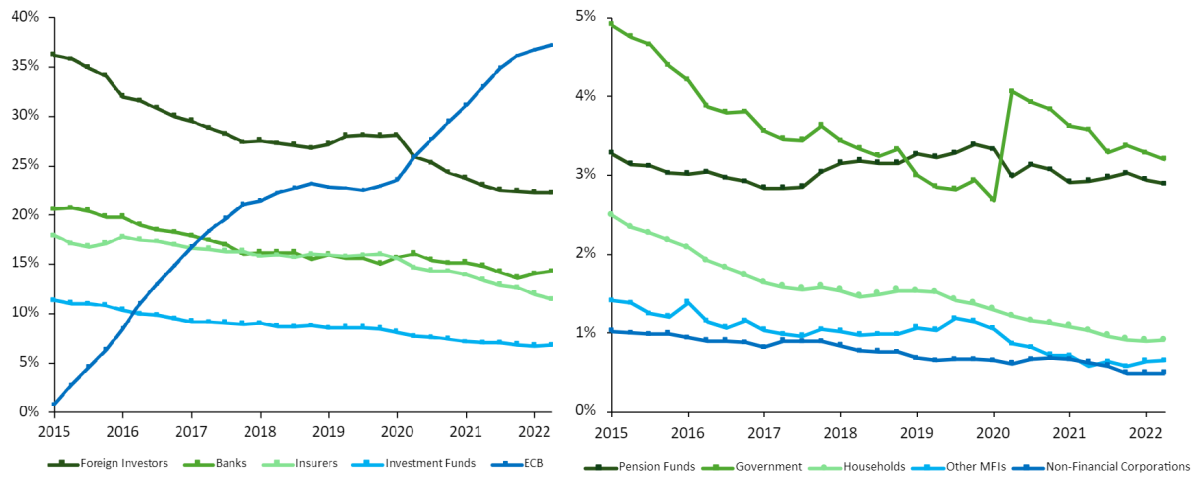
Notes: Distribution of purchases and sales by investors A, B, and C. The left pie chart illustrates how the bond issuance is distributed among the investors, and the right pie chart shows how the sales are distributed when the ECB purchases the bonds.

FIGURE 2 – ECB BOND HOLDINGS IN THE MONETARY POLICY PORTFOLIO, BY ASSET-CLASS



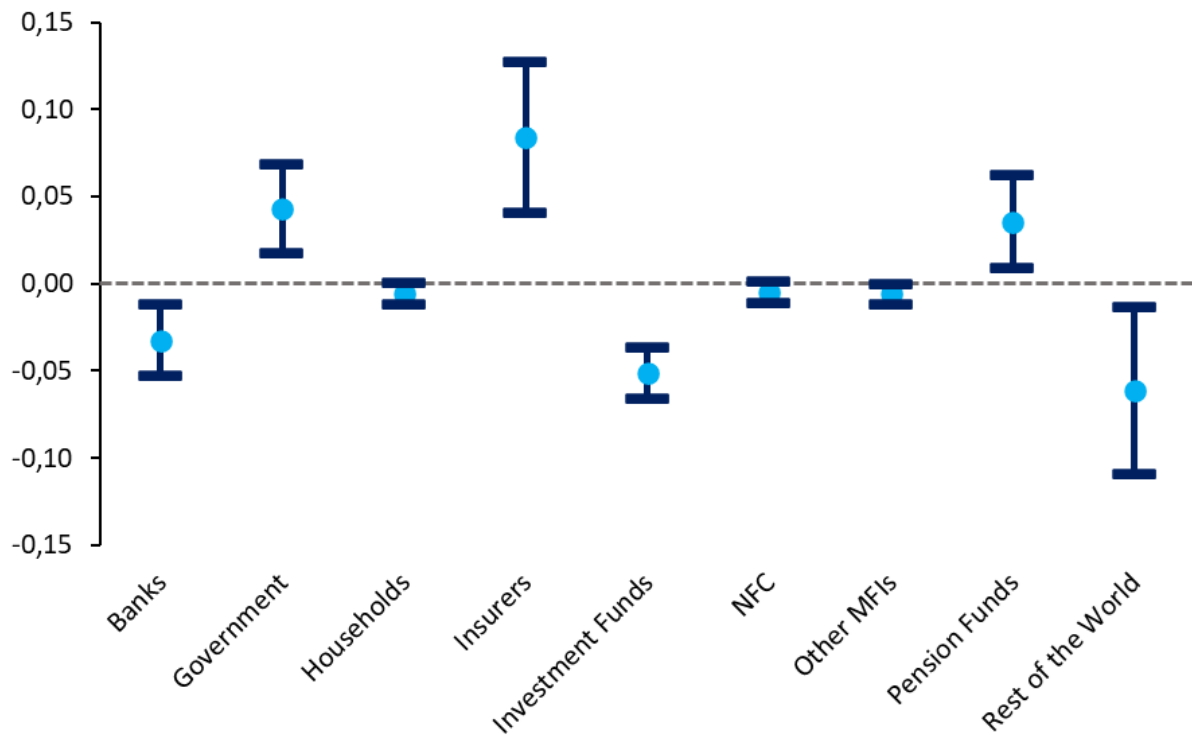
Notes: This figure shows the Eurosystem holdings of different official asset purchase programmes, where the *Public Sector*, which includes the Public Sector Purchase Programme (PSPP) and Pandemic Emergency Purchase Programme (PEPP), is dominant in size and relevant for our sample of sovereign bonds. Covered includes the various covered bond asset purchase programmes.

FIGURE 3 – INVESTOR SHARES OF SOVEREIGN BONDS PURCHASED BY THE ECB



Notes: Evolution of euro area sovereign bond holdings, measured as ownership shares over time, across euro area investors, the ECB, and, the Rest of the World investors defined as 'foreign investors', sources SHS-S, CSDB and ECB transactions data.

FIGURE 4 – INVESTOR NET RESPONSES TO ECB PURCHASES AND NEW ISSUANCES



Notes: Coefficients are derived from Table 2 for each investor sector. Confidence intervals are at the 95% level, using standard errors obtained with the delta method.

VI. Tables

TABLE 1 – SUMMARY STATISTICS

	Mean	Std	Median	N
Amount outstanding (EUR mln)	5,973.1	9,319.8	1,463.8	407,529
Core countries	5,370.7	9,616.4	1,138.2	254,205
Non-core countries	6,971.9	8,714.9	3,069.9	153,324
Residual maturity (years)	7.40	6.50	5.50	407,529
0 to 3 years	1.59	0.78	1.75	101,169
3 to 7 years	4.75	1.14	4.75	144,738
7 to 10 years	8.31	0.88	8.25	70,497
Over 10 years	17.35	6.09	15.5	91,125
Investor holdings (EUR mln):				
Banks	981.9	1,653.6	348.6	45,281
Investment funds	519.0	846.8	135.6	45,281
Insurance companies	918.9	2,384.7	98.0	45,281
Pension funds	183.7	598.4	17.8	45,281
Other financials	57.4	214.9	0.4	45,281
Government	166.4	550.5	11.2	45,281
Households	87.7	465.8	2.7	45,281
Non-financial corporations	44.4	205.7	1.4	45,281
ECB	1,384.4	2,492.7	291.8	45,281
Rest of the World	1,641.1	3,554.5	214.9	45,281

Notes: Data are taken from the ECB Securities Holdings Statistics Sectoral Module (SHS-S), the ECB Centralised Securities Database (CSDB) and ECB transactions data. The investor sectors are grouped based on ESA2010 sectoral classifications (see also Appendix A).

TABLE 2 – MAIN REGRESSION: RESPONSES OF DIFFERENT INVESTORS TO ECB PURCHASES

Sector	(A) Regression outcome		(B) Linear combination
	β^{ECB}	β^{A0}	$\hat{\beta}^{ECB} + \hat{\beta}^{A0}$
Banks	-0.201*** (0.014)	0.175*** (0.011)	-0.026** (0.010)
Investment funds	-0.159*** (0.008)	0.112*** (0.005)	-0.047*** (0.006)
Insurance companies	-0.075*** (0.015)	0.144*** (0.021)	0.069*** (0.018)
Pension funds	-0.029*** (0.009)	0.060*** (0.009)	0.031** (0.013)
Other financials	-0.017*** (0.003)	0.012*** (0.002)	-0.006** (0.002)
Governments	0.047** (0.014)	-0.003 (0.006)	0.044** (0.010)
Households	-0.020*** (0.006)	0.015*** (0.003)	-0.005* (0.003)
Non-financial corporations	-0.014*** (0.004)	0.009** (0.002)	-0.005* (0.003)
Rest of World	-0.529*** (0.025)	0.476*** (0.025)	-0.053** (0.022)
Bond-Quarter FE	Yes		
Sector-Quarter FE	Yes		
Adjusted R^2	0.964		
Observations	407,529		

*, ** and *** indicate significance at the 10%, 5% and 1% levels. The columns β^{ECB} and β^{A0} show the coefficient estimates of the regression on Equation (1). The third column shows the sum of both coefficients and whether this is different from zero. Standard errors are clustered at the bond-investor level.

TABLE 3 – PORTFOLIO HOLDINGS AND THE ROLE OF MATURITY SEGMENTATION

Sector	Residual Maturity Segment	(A) Regression outcome		(B) Linear combination
		β^{ECB}	β^{A0}	$\hat{\beta}^{ECB} + \hat{\beta}^{A0}$
Banks	Short	-0.221*** (0.025)	0.165** (0.013)	-0.056*** (0.018)
	Mid-Short	-0.220*** (0.024)	0.172*** (0.012)	-0.049*** (0.016)
	Mid-Long	-0.197*** (0.026)	0.168*** (0.012)	-0.028 (0.020)
	Long	-0.148*** (0.017)	0.159*** (0.011)	0.012 (0.015)
Investment funds	Short	-0.056*** (0.015)	0.085*** (0.006)	0.028** (0.011)
	Mid-Short	-0.115*** (0.011)	0.107*** (0.006)	-0.008 (0.009)
	Mid-Long	-0.162*** (0.012)	0.120*** (0.006)	-0.041*** (0.009)
	Long	-0.214*** (0.016)	0.126*** (0.006)	-0.088*** (0.012)
Insurance companies	Short	0.002 (0.014)	0.087*** (0.016)	0.089*** (0.018)
	Mid-Short	-0.024 (0.017)	0.105*** (0.015)	0.081*** (0.020)
	Mid-Long	-0.014 (0.021)	0.127*** (0.017)	0.112*** (0.027)
	Long	-0.024 (0.032)	0.163*** (0.025)	0.139*** (0.033)
Pension funds	Short	-0.041*** (0.009)	0.054*** (0.007)	0.013*** (0.008)
	Mid-Short	-0.014* (0.007)	0.048*** (0.006)	0.034*** (0.008)
	Mid-Long	-0.011 (0.009)	0.051*** (0.007)	0.040*** (0.010)
	Long	-0.008 (0.027)	0.070*** (0.010)	0.061** (0.025)
Other financials	Short	-0.020*** (0.006)	0.011*** (0.003)	-0.010** (0.005)
	Mid-Short	-0.022*** (0.005)	0.011*** (0.002)	-0.011*** (0.004)
	Mid-Long	-0.017*** (0.005)	0.012*** (0.002)	-0.006** (0.004)
	Long	-0.007 (0.005)	0.008*** (0.002)	0.001 (0.004)
Governments	Short	0.057*** (0.020)	-0.003 (0.006)	0.055*** (0.017)
	Mid-Short	0.034** (0.013)	0.001 (0.006)	0.035*** (0.010)
	Mid-Long	0.015 (0.013)	0.004 (0.006)	0.018* (0.010)
	Long	0.062* (0.031)	-0.009 (0.009)	0.053** (0.024)

PORTFOLIO HOLDINGS AND THE ROLE OF MATURITY SEGMENTATION (CONTINUED)

Sector	Residual Maturity Segment	(A) Regression outcome		(B) Linear combination
		β^{ECB}	β^{A0}	$\hat{\beta}^{ECB} + \hat{\beta}^{A0}$
Non-financial corporations	Short	0.000 (0.003)	0.004*** (0.001)	0.004* (0.002)
	Mid-Short	-0.003 (0.004)	0.005*** (0.001)	0.002 (0.003)
	Mid-Long	-0.027*** (0.008)	0.012*** (0.003)	-0.015** (0.006)
	Long	-0.010* (0.005)	0.011*** (0.003)	-0.000 (0.003)
Rest of World	Short	-0.727*** (0.048)	0.591*** (0.025)	-0.136*** (0.037)
	Mid-Short	-0.628*** (0.034)	0.538*** (0.023)	-0.090*** (0.024)
	Mid-Long	-0.572*** (0.031)	0.491*** (0.021)	-0.081*** (0.026)
	Long	-0.609*** (0.038)	0.451*** (0.025)	-0.158*** (0.034)
Bond-Quarter FE		Yes		
Sector-Quarter FE		Yes		
Adjusted R^2		0.966		
Observations		407,529		

*, ** and *** indicate significance at the 10%, 5% and 1% levels. Standard errors are clustered at the bond-investor-maturity level. The columns β^{ECB} and β^{A0} show the coefficient estimates. The third column shows their linear combination and significance.

TABLE 4 – INVESTOR SENSITIVITY DURING DIFFERENT REGIMES OF THE APP

Sector	Regime	(A) Regression outcome		(B) Linear combination
		β^{ECB}	β^{A0}	$\hat{\beta}^{ECB} + \hat{\beta}^{A0}$
Banks	QE 1	-0.178*** (0.019)	0.177*** (0.011)	-0.001 (0.015)
	Taper	-0.173*** (0.025)	0.167** (0.012)	-0.006 (0.018)
	QE 2	-0.182*** (0.019)	0.169*** (0.012)	-0.013 (0.012)
Investment funds	QE 1	-0.147*** (0.011)	0.120*** (0.005)	-0.027** (0.009)
	Taper	-0.097*** (0.014)	0.099*** (0.005)	0.002 (0.010)
	QE 2	-0.092*** (0.010)	0.091*** (0.005)	-0.001 (0.007)
Insurance companies	QE 1	-0.022 (0.019)	0.142*** (0.021)	0.120*** (0.023)
	Taper	-0.004 (0.023)	0.135*** (0.022)	0.131*** (0.022)
	QE 2	-0.063*** (0.018)	0.139*** (0.021)	0.076*** (0.020)
Pension funds	QE 1	-0.025*** (0.008)	0.059*** (0.009)	0.034*** (0.008)
	Taper	-0.047*** (0.011)	0.064*** (0.009)	0.018 (0.010)
	QE 2	-0.034*** (0.012)	0.062*** (0.009)	0.028* (0.013)
Other financials	QE 1	-0.009* (0.005)	0.010*** (0.002)	0.001 (0.003)
	Taper	-0.036*** (0.008)	0.017*** (0.003)	-0.019*** (0.005)
	QE 2	-0.024*** (0.004)	0.014*** (0.002)	-0.010*** (0.003)
Governments	QE 1	-0.040*** (0.009)	0.004 (0.006)	-0.036*** (0.010)
	Taper	-0.051*** (0.012)	0.010 (0.005)	-0.042*** (0.009)
	QE 2	0.060*** (0.017)	-0.005 (0.007)	0.054*** (0.011)

INVESTOR SENSITIVITY DURING DIFFERENT REGIMES OF THE APP (CONTINUED)

Sector	Regime	(A) Regression outcome		(B) Linear combination
		β^{ECB}	β^{A0}	$\hat{\beta}^{ECB} + \hat{\beta}^{A0}$
Households	QE 1	-0.020*** (0.007)	0.018*** (0.004)	-0.003 (0.003)
	Taper	-0.001 (0.003)	0.011*** (0.002)	0.011*** (0.003)
	QE 2	0.000 (0.002)	0.008** (0.002)	0.009*** (0.002)
Non-financial corporations	QE 1	-0.004 (0.005)	0.009*** (0.002)	0.005* (0.003)
	Taper	-0.010** (0.005)	0.009*** (0.002)	-0.002 (0.003)
	QE 2	-0.008** (0.003)	0.007*** (0.002)	-0.001 (0.003)
Rest of World	QE 1	-0.553*** (0.028)	0.461*** (0.025)	-0.091*** (0.025)
	Taper	-0.577*** (0.038)	0.488*** (0.027)	-0.089*** (0.030)
	QE 2	-0.653*** (0.033)	0.514*** (0.026)	-0.139*** (0.027)
Bond-Quarter FE		Yes		
Sector-Quarter FE		Yes		
Adjusted R^2		0.965		
Observations		407,529		

*, ** and *** indicate significance at the 10%, 5% and 1% levels. Standard errors are clustered at the bond-investor-regime level. The columns β^{ECB} and β^{A0} show the coefficient estimates. The third column shows their linear combination and significance.

TABLE 5 – PREFERRED HABITAT IN DOMESTIC AND NON-DOMESTIC SOVEREIGN BOND HOLDINGS

Sector	Type of Holding	(A) Regression outcome		(B) Linear combination
		β^{ECB}	β^{A0}	$\hat{\beta}^{ECB} + \hat{\beta}^{A0}$
Banks	Foreign	-0.072*** (0.007)	0.052*** (0.004)	-0.020*** (0.005)
	Home	-0.127*** (0.014)	0.119*** (0.010)	-0.009 (0.009)
Investment funds	Foreign	-0.134*** (0.007)	0.091*** (0.004)	-0.043*** (0.005)
	Home	-0.023*** (0.003)	0.018*** (0.002)	-0.005** (0.003)
Insurance companies	Foreign	-0.032*** (0.005)	0.039*** (0.004)	0.007 (0.005)
	Home	-0.041** (0.013)	0.100*** (0.020)	0.059*** (0.016)
Pension funds	Foreign	-0.020*** (0.007)	0.050*** (0.009)	0.031** (0.012)
	Home	-0.009*** (0.003)	0.010*** (0.003)	0.001 (0.004)
Other financials	Foreign	-0.004 (0.002)	0.005*** (0.001)	0.001 (0.002)
	Home	-0.014*** (0.002)	0.007*** (0.001)	-0.007*** (0.002)
Governments	Foreign	-0.005*** (0.001)	0.003*** (0.001)	-0.002** (0.001)
	Home	0.022* (0.009)	0.024** (0.006)	0.045*** (0.010)
Households	Foreign	0.000 (0.000)	0.001*** (0.000)	0.001*** (0.000)
	Home	-0.021*** (0.006)	0.014*** (0.003)	-0.006** (0.003)
Non-financial corporations	Foreign	-0.001 (0.001)	0.001** (0.001)	0.000 (0.001)
	Home	-0.014*** (0.004)	0.008** (0.002)	-0.005* (0.003)
Rest of World	Foreign	-0.503*** (0.023)	0.458*** (0.024)	-0.045** (0.021)
Bond-Quarter FE		Yes		
Sector-Quarter FE		Yes		
Adjusted R^2		0.963		
Observations		769,777		

*, ** and *** indicate significance at the 10%, 5%, and 1% levels. Standard errors are clustered at the bond-investor-maturity level. "Home" refers to sovereign bonds issued in the investor's domestic country, while "Foreign" refers to those issued outside. Rest of World only has "Foreign" observations because it represents international investors by definition.

TABLE 6 – HETEROGENEITY IN BOND HOLDINGS CREDIT RATINGS: CORE AND NON-CORE EURO AREA GOVERNMENTS

Sector	IssuerRating	(A) Regression outcome		(B) Linear combination
		β^{ECB}	β^{A0}	$\hat{\beta}^{ECB} + \hat{\beta}^{A0}$
Banks	Non-core	-0.332*** (0.028)	0.333*** (0.019)	0.002 (0.019)
	Core	-0.135*** (0.012)	0.107*** (0.011)	-0.028** (0.010)
Investment funds	Non-core	-0.184*** (0.015)	0.146*** (0.008)	-0.038*** (0.010)
	Core	-0.146*** (0.010)	0.098*** (0.006)	-0.048*** (0.007)
Insurance companies	Non-core	0.003 (0.015)	0.165*** (0.011)	0.167*** (0.016)
	Core	-0.115*** (0.018)	0.141*** (0.029)	0.026 (0.022)
Pension funds	Non-core	-0.015*** (0.003)	0.022*** (0.003)	0.006** (0.003)
	Core	-0.035*** (0.013)	0.075*** (0.012)	0.040** (0.016)
Other financials	Non-core	-0.047*** (0.007)	0.028*** (0.004)	-0.019*** (0.005)
	Core	-0.002 (0.004)	0.004** (0.002)	0.002 (0.003)
Governments	Non-core	-0.002 (0.010)	0.009* (0.004)	0.007 (0.009)
	Core	0.071*** (0.018)	-0.010 (0.008)	0.061*** (0.014)
Households	Non-core	-0.062*** (0.014)	0.046*** (0.008)	-0.016** (0.007)
	Core	0.001 (0.001)	0.001* (0.001)	0.002*** (0.001)
Non-financial corporations	Non-core	-0.046*** (0.010)	0.025*** (0.004)	-0.021*** (0.007)
	Core	0.002 (0.001)	0.001 (0.001)	0.003** (0.001)
Rest of World	Non-core	-0.313*** (0.028)	0.227*** (0.018)	-0.086*** (0.019)
	Core	-0.638*** (0.031)	0.583*** (0.036)	-0.055* (0.030)
Bond-Quarter FE		Yes		
Sector-Quarter FE		Yes		
Adjusted R^2		0.967		
Observations		407,529		

*, ** and *** indicate significance at the 10%, 5%, and 1% levels. Standard errors are clustered at the bond-investor-region level. Core and non-core refer to euro area countries defined in Section 3.5. Each sector includes results for both core and non-core regions presented consecutively for clarity.

TABLE 7 – DISSECTING FOREIGN OFFICIAL INVESTORS

Sector	(A) Regression outcome		(B) Linear combination
	β^{ECB}	β^{A0}	$\hat{\beta}^{ECB} + \hat{\beta}^{A0}$
Banks	-0.201*** (0.014)	0.176*** (0.011)	-0.025*** (0.010)
Investment funds	-0.159*** (0.008)	0.111*** (0.005)	-0.048*** (0.007)
Insurance companies	-0.077*** (0.016)	0.145*** (0.021)	0.067*** (0.017)
Pension funds	-0.028*** (0.009)	0.060*** (0.009)	0.032** (0.014)
Other financials	-0.018*** (0.004)	0.012*** (0.002)	-0.006** (0.002)
Governments	0.031** (0.011)	0.003 (0.005)	0.034*** (0.009)
Households	-0.021*** (0.006)	0.015*** (0.003)	-0.006* (0.003)
Non-financial corporations	-0.014*** (0.005)	0.009*** (0.002)	-0.005* (0.003)
Rest of World (private)	-0.404*** (0.023)	0.242*** (0.014)	-0.162*** (0.017)
Rest of World (official)	-0.104*** (0.027)	0.227*** (0.024)	0.123*** (0.021)
Bond-Quarter FE		Yes	
Sector-Quarter FE		Yes	
Adjusted R^2		0.944	
Observations		451,040	

*, ** and *** indicate significance at the 10%, 5%, and 1% levels. Standard errors are clustered at the bond-investor level. Rest of World is divided into private and official investors, with official investors including central banks and governments. Both Rest of World sectors are presented at the end for clarity.

Appendix A Data Preparations

The Securities Holdings Statistics Sectoral (SHS-S) module contains bond-level holdings denominated in both nominal and market values. In this paper, we use market values because, for a given period, the cross-sectional variation in price movements across bonds may induce investors to rebalance their portfolios.

We focus on holders from all 19 euro area countries.⁹ There are two reasons for this. First, the coverage of the euro area portfolios is ensured by the ECB SHS regulation, which stipulates 95% coverage at the security level for most investor sectors. Second, the ECB asset purchases are exclusive to euro area bonds. When selecting bond holdings from the euro area, we exclude so-called third-party holdings, except for households, to avoid the potential for double counting.

We also apply several cleaning steps (see [Boermans, 2022](#)), specifically excluding portfolio holdings of bonds with investments below EUR 100,000 at the country*sector level of the investor at a given period, thus excluding short positions, retaining bonds with quotation basis in PCL only, and disregarding non-active bonds, such as those in default but retained at the balance sheet of the investor until final resolution.

Regarding the different *InvestorSector* information from the SHS-S dataset, we retain the following eight investor sectors based on the following mapping Table A.1 for European System of Account (ESA) 2010 sector (sub) classification codes.

Furthermore, we complement the SHS-S dataset with cumulated ECB purchases at the bond-quarter level, obtained from the ECB's Monetary Policy Operations Database. This data contains transaction-level information of the purchases made by the central bank under the monetary policy bond portfolio. We aggregate this data to quarterly observations to match the frequency of SHS-S.

Finally, to calculate the Rest of the World (ROW) positions, we subtract the sum of ECB holdings of a given bond on a given quarter and the sum of the holdings from the different SHS-S *InvestorSector* from the bonds' amount outstanding. Note that minor data quality issues in either the holdings, issued volumes, or the price can lead to few cases in which the ROW positions are negative. In those instances, we amend the error by setting the observation to zero.

⁹During our sample period, Croatia was not yet a member of the euro area.

TABLE A1 – SHS-S INVESTOR SECTOR DETAILS

<i>InvestorSector</i>	ESA 2010 (sub)sectors
Banks	S_122
Investment funds	S_123+S_124
Insurance companies	S_128
Pension funds	S_129
Other financials	S_125+S_126+S_127
Government	S_13
Households	S_14
Non-financial corporations	S_11

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