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

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# International investment positions revisited: Investor heterogeneity and individual security characteristics*

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## Abstract

In this paper we show empirically how international investment positions are determined by investor heterogeneity and individual security characteristics. We do so by estimating a gravity model with newly available data that contains both domestic and international holdings of individual sectors from euro area countries in individual bonds and stocks. The five holding sectors (banks, insurers, pension funds, investment funds and households) all face barriers to international investments, but these differ both across sectors and between their bond and stock holdings. Furthermore, individual security characteristics affect portfolio choice across investors differently. For bonds we find that currency denomination, coupon type, maturity and eligibility as collateral for ECB transactions stand out. For equities we find that market values, currency denomination and dividend payments are important. Since holder sectors vary in size across countries we posit that cross-country differences in sectoral composition may lead to different transmission effects of financial shocks.

**Keywords**: international investment patterns, investor heterogeneity, securities holdings statistics.
**JEL classifications**: F36, G11, G15, G20.

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# 1 Introduction

The academic literature has devoted much attention to the importance of cross-border frictions in explaining why investors deviate from holding internationally well-diversified portfolios. Major stylized facts emerged showing *inter alia* how home bias, bilateral distance, trade relations, language, cultural barriers and institutional differences drive investment patterns. The relevance of these factors has empirically been well-established for the aggregate portfolio holdings of investors from a single country (Ahearne et al., 2004; Karlsson and Nordén, 2007; Forbes, 2010), a panel of countries (Aviat and Coeurdacier, 2007; Lane and Milesi-Ferretti, 2008; Coeurdacier and Rey, 2013) and studies on the international holdings of a single sector (e.g. Ivković and Weisbenner, 2005; Gelos and Wei, 2005; Chan et al., 2009; Christelis and Georgarakos, 2013; Didier et al., 2013). However, these studies are unable to explore how investor heterogeneity affects international asset allocations, because they analyze either a representative investor or a single investor sector.

A parallel literature in finance shows the importance of investor heterogeneity for the portfolio choice decisions across different types of investors. For example, Grinblatt and Keloharju (2000) present differences between the trading behavior of households and institutional investors. Broner et al. (2006) describe how variations in risk aversion explain the international portfolio allocations of mutual funds. Cella et al. (2013) find that investors with different horizons trade differently during crisis periods. In general, this literature does not specifically focus on the barriers of international portfolio allocations nor does it pay much attention to the countries where investors hold assets. Furthermore, several studies show theoretically (Vayanos and Vila, 2009) and empirically (Hau and Rey, 2011) that the assumption that investors hold a representative asset in a country may be too restrictive. In fact, a growing number of studies highlight that individual bond and equity characteristics are important for investment decisions (Ellul et al., 2011; Hildebrand et al., 2012; Manconi et al., 2012; Becker and Ivashina, 2015; Abbassi et al., 2016). Examples include whether a bond is issued by a non-financial corporation, consists of securitized loans (Manconi et al., 2012), or if a bond is eligible as collateral at the central bank for liquidity (Hildebrand et al., 2012). The importance of individual security characteristics warrants a more disaggregated view of cross-country portfolio holdings.

We combine both strands of the literature by being, to the best of our knowledge, the first study to jointly analyze investor heterogeneity in international portfolio allocations at the individual security level in a multi-country setting. We use security-by-security holdings data compiled by central banks

that contains the securities holdings of euro area investors. With this granular data we are able to include individual bond and stock characteristics. This has several advantages. First, we pick up an extensive set of security level variables that are relevant for investment decisions, including currency denomination, eligibility for collateral in central bank transactions, yield to maturity and dividend payout. Second, it allows us to identify barriers specific to investing and issuing sectors across different countries. Here we capture the fact that for example the cross-border frictions and information asymmetries between Spanish banks and US banks might be different from Spanish insurers and US insurers.[1] Third, and in contrast to studies that rely on the IMF's CPIS data which contains only foreign investments, we are able to include domestic holdings in the analysis as our dataset contains both domestic and foreign investments. In this respect we argue that the combination of investor heterogeneity and granularity in our data allows us to provide new empirical evidence on international investment patterns.

We identify the determinants of international asset holdings by estimating a gravity model for both bond and equity holdings using end-2014 data as a benchmark. We include commonly used variables in the open economy macroeconomics literature such as the distance between country of the investor and country of the security's issuer, bilateral trade between these countries and whether the countries share a common border. We complement existing research by not only focusing on investors at the country level, but on different investor types at the sector level within a country. We distinguish between five investor sectors, namely banks, insurers, pension funds, investment funds and households across euro area countries. This approach of allowing investor heterogeneity at the holder sector level within a gravity model is not new by itself, however, it has received surprisingly little attention.[2] In contrast to other papers, our data also contain the investors' domestic holdings in addition to their foreign investment positions. We complement these standard gravity variables with security-specific variables such as the residual maturity and currency denomination of a security.

Our main results show important differences in the determinants of international portfolio holdings across different investor types. For bonds the results show that the distance between the home country of the investor and that of the security's issuer is a larger barrier to international investments

[1] Hence, we assume that bilateral financial frictions are asymmetric across investor sectors and destination sectors for portfolio investments, i.e. there is a geography to the barriers at the investor sector - issuer sector level. This approach is in line with recent empirical work by Schumacher (2015) that shows that mutual funds' location affects the preference to invest in foreign sectors that are also highly prevalent in the domestic market of the investor.

[2] See Balli et al. (2013); Giofré (2013); Roque and Céu Cortez (2014); Galstyan et al. (2016) for studies on investor heterogeneity in a gravity model with aggregated sector data.

for households compared to other investors. For insurers and pension funds we find a significantly positive demand for domestic bonds, but not for other sectors. However, in terms of coefficient size the demand for domestic bonds is largest for the banking sector, albeit insignificant. We also find that all investors have a strong demand for euro denominated bonds, but this demand is especially strong for insurers and investment funds. Interestingly, there is a high demand among insurers for longer maturity bonds, while we do not find this strong demand for pension funds. This is surprising because the duration of pension fund liabilities is in general longer than the duration of the liabilities of insurers. The results show a strong preference for floating coupon bonds from banks and households while insurers tend to dislike floating coupon bonds and prefer fixed coupon payments. In addition, we find that financial sectors tend to invest more in covered bonds compared to households. Finally, we see a very strong demand among banks for assets that are eligible collateral for ECB transactions, which is completely absent for pension funds and households.

Turning to equities we find that investors closely track the classic Capital Asset Pricing Model (CAPM). Especially banks, pension funds and investment funds follow the benchmark weights based on the individual stock's market capitalization. The results suggest that the home bias is stronger for equities compared to bonds. For equities, home bias is strongest for households, yet seems almost absent for insurers. Finally, we find that insurers, pension funds and to lesser extent banks prefer stocks that pay dividends, while this demand for dividend-yielding stocks is weaker for investment funds and households.

A battery of robustness tests confirms the main results. First, the main results remain intact when using mid-2012 data to estimate the regressions. Compared to the relatively calm end-2014 period it is assuring that the results also hold during the peak of the European sovereign debt crisis. Second, with a few exceptions the estimated coefficients are very similar when we consider subsamples consisting of either only domestic or only foreign assets. Third, including or excluding gravity-specific variables such as distance, common border or a home dummy affects the coefficients of other variables. However, it is reassuring that the results for the security-specific variables are not sensitive to the exact selection of gravity variables included in the model. Fourth, the main results are not affected by the exclusion of bonds that mature in one year or by only considering bonds that have been issued during the past twelve months. Fifth, estimating the regression for different samples of holder countries yields broadly similar outcomes. Finally, the results are not driven by holdings of sovereign debt and remain quite

stable when excluding government bonds from the regressions.

By showing the importance of investor heterogeneity and security characteristics to explain international investment positions this study provides new insights for researchers and policy makers. For policymakers a better understanding of who holds what and the drivers of portfolio investments at the sector level help to assess the resilience and fragility of the financial system when shocks emerge. In particular, when a price shock hits securities with certain characteristics, we can better identify which sectors are likely to be most affected. On the other hand, if certain sectors are hit by a shock we can better identify which securities potentially come under stress. For researchers our results confirm the increased attention to modeling heterogeneous agents in macroeconomic models and provide guidance on how to model the behavior of different market participants in open economy models.

The paper proceeds as follows. Section 2 discusses several sector characteristics that suggest heterogeneity in portfolio holdings. Section 3 outlines the empirical methodology and provides details on the investor holdings data and security characteristics in the Securities Holdings Statistics (SHS). Section 4 discusses the empirical results for bond and equity holdings and Section 5 presents several robustness exercises. Section 6 sets out the conclusion.

## 2 Investor heterogeneity at the sector level

The five investor sectors that we analyze are the largest holders of bonds and equities in the euro area. Each sector has its own characteristics that will affect investment decisions. We will shortly review several key factors that shape the investment decisions of each sector, since a full discussion on each investor sector is beyond the scope of this paper.

First, for banks capital requirements are an important determinant of portfolio holdings. Equity holdings, for example, are relatively unattractive due to strict capital requirements and high risk weights. These regulatory requirements also strongly favor holdings of certain types of bonds, including those issued by central governments in Europe (zero risk weight) and those denominated in euro (Acharya and Steffen, 2015; Buch et al., 2016). Another important aspect that affects portfolio choice of banks is their overall leverage. Typically, banks' balance sheets are much more leveraged compared to other investors such as insurers and pension funds. Moreover, banks are typically subject to liquidity risk, as they face a maturity mismatch between their assets and liabilities. Bank deposits

can be withdrawn easily. This increases the banks' desire to hold liquid assets. In addition, the recently implemented liquidity requirements under Basel III also force banks to hold high quality liquid assets against their expected cash outflows. Hildebrand et al. (2012) argue that the availability of eligible assets that can be used for liquidity operations through the central bank are especially important for the banking sector. In addition to these security level characteristics, gravity factors affect bank's investment patterns (Aviat and Coeurdacier, 2007).

Second, insurers invest in assets to cover the company's long-term liabilities to policy holders. Hence, insurers are presumably stable long-term investors with a preference for safe long-term assets to cover their liabilities. Under normal circumstances, insurers are little exposed to liquidity shocks. However, as solvency deteriorates during crisis periods, insurers can change their general trading behavior (see e.g. Ellul et al., 2011; Bijlsma and Vermeulen, 2016; Ellul et al., 2015). There is also evidence that regulation is an important factor in determining insurers' asset holdings (see e.g. Becker and Ivashina, 2015). Furthermore Domanski et al. (2015) show that insurers may increase their demand for long-term bonds even when long-term interest rates decrease. This effect is driven by asset-liability management considerations and the "hunt for duration" in such circumstances. The new regulatory regime for insurers in Europe, Solvency II, puts more emphasis on asset-liability management and provides stronger incentives for insurers to match their long-term liabilities with longer maturity bonds.

Third, pension funds invest in assets to cover the future pension incomes of the funds' participants. Pension contracts in defined benefit schemes are often stated in real terms, which introduces inflation risk as an important risk factor. The liabilities of banks and insurers are generally in nominal terms. Pension funds also face legal restrictions to borrowing, except for liquidity operations. Compared to banks and even insurers a pension fund's liability duration is much longer, typically around 20 years. Hence, pension funds have a natural tendency to seek long-term investments and because of their long-term investment horizon, they are typically considered as stabilizing financial market participants. Changes in the asset-liability ratio may alter a pension fund's investment policy, especially when the asset-liability is close to the regulatory constraint (De Dreu and Bikker, 2012; Van Binsbergen and Brandt, 2016). For banks and insurers the equity holders take the first hit when reaching the regulatory constraint, but for pension funds this is less clear. For example, many occupational pension funds have a sponsor who can restore a mismatch between assets and liabilities. However, in the absence

of a sponsor either premiums or future benefits need to be adjusted. Taking a closer look at pension funds' actual trading behavior during the recent crisis, Duijm and Steins Bisschop (2015) find that pension funds kept buying equities when stock prices decreased. However, similar to insurers, pension funds sold government bonds of crisis-affected sovereigns before these received an actual downgrade during the sovereign debt crisis. Overall there is no clear evidence of pension funds trading pro- or countercyclical.

The fourth sector we consider are investment funds, for which bond and equity holdings are the subject of many papers. The main reasons for this attention are the enormous size of the funds and their potentially large impact on asset markets when facing redemptions (IMF, 2015), but also the wide availability of (granular) data (Gelos and Wei, 2005; Chan et al., 2009; Jotikasthira et al., 2012; Manconi et al., 2012; Raddatz and Schmukler, 2012; Cella et al., 2013; Didier et al., 2013; Goldstein et al., 2016). Investment funds differ from the above sectors in that their assets are fully covered with fund shares, which are risk-bearing but redeemable. Investment funds also differ from other sectors because they often have a predefined mandate to target certain securities, e.g. defined by the sector of the issuer, the geographical location or maturity. In this sense investment funds mirror the preferences of the investors in their funds, which can be households, but also insurers and pension funds. So, many investment funds may face constraints to move investments across broad ranges of securities. Because of the narrow focus of many fund portfolio managers and generally large size of the asset pool, investment funds tend to have good information on their investments, making them relatively sophisticated investors.

Finally, households are generally considered to be the least sophisticated investor group compared to other sectors. Most households do not directly hold securities, and typically, if they do they concentrate their holdings in only a few stocks (Goetzmann and Kumar, 2008; Christelis and Georgarakos, 2013). Furthermore, in their direct holdings households appear to be sensitive to barriers and frictions to international investments (see e.g. Grinblatt and Keloharju, 2001; Ivković and Weisbenner, 2005; Van Nieuwerburgh and Veldkamp, 2009). While Coval and Moskowitz (1999) show that households prefer stocks close to their home town, Baltzer et al. (2013) find that households close to a border have a lower foreign investment bias in the neighboring country. This lower bias seems to be driven by holdings in foreign companies that are relatively close to the border. So, both crossing a border and distance matter for international investments. Households are in general not

leveraged and not subject to stringent regulatory constraints, so their flexibility in holding specific assets is relatively unconstrained.

The stark differences between sectors are important because they shape each sector's demand for bonds and equities. In particular, asset-specific characteristics become important as they make a security very attractive to one sector, but not necessarily so for other sectors. For example, the currency denomination of an asset may be more important to asset-liability investors such as banks, insurers and pension funds because their liabilities are denominated in the domestic currency. When considering bond investments, the preference for longer maturity bonds is expected to be higher for insurers and pension funds compared to banks. This demand is again very much driven by the liability structure of each investor type (see Domanski et al., 2015; Galstyan et al., 2016). Banks may also have a specific demand for assets that can be used as collateral to obtain liquidity from the ECB (Gennaioli et al., 2014). Banks seek liquid assets with short maturities and floating rates to match liabilities. It is obvious that the importance of these security-specific characteristics cannot be studied without the use of granular data.

# 3 Data and method

## 3.1 Empirical methodology

In order to explain the international portfolio holdings of the different investors groups we use a relatively standard gravity model similar to Portes and Rey (2005) and subsequent research explaining international investment positions (e.g Lane and Milesi-Ferretti, 2008).[3] There are some differences in our approach compared to earlier studies on international investment positions because of the granular nature of our data. Formally, we specify the following model:

$$log(Holdings_{s,j,a}) = \beta_s^1 * x_a^1 + ... + \beta_s^k * x_a^k + \gamma_s^1 * z_{j,a}^1 + ... + \gamma_s^m * z_{j,a}^m + hsc_{s,j} + isc_a + \epsilon_{s,j,a}, \quad (1)$$

where $log(Holdings_{s,j,a})$ represents the log of the value of the investments by holding sector *s* from country *j* in asset *a* measured in euros. The holdings of sector *s* from country *j* are explained by $k$ asset specific characteristics $(x_a^1, ..., x_a^k)$ and $m$ bilateral characteristics of the country of the

[3] Theoretical underpinnings for using the gravity model to explain international investment positions are outlined in Okawa and Van Wincoop (2012).

holder and the country where asset *a* is issued $(z_{j,a}^1, ..., z_{j,a}^m)$. We also add dummy variables that capture unobserved holder sector-country characteristics $(hsc_{j,s})$ and unobserved issuer sector-country characteristics $(isc_a)$. This is to capture multilateral resistance or financial frictions that differ across countries and within countries between different holder sectors and issuer sectors. In order to assess the heterogeneity between different holding sectors we allow the coefficients in $\beta_s^1, ..., \beta_s^m$ and $\gamma_s^1, ..., \gamma_s^m$ to differ by sector. By estimating the coefficients for all holding sectors in a single regression we are able to infer statistical differences between coefficients.

One of the asset characteristics included in the regressions is the market value of an individual security *log(market value)*. One interpretation of this variable is that if there were no financial frictions and all assets are priced efficiently, then rational investors with identical preferences would hold the market portfolio, which contains all worldwide assets weighted by their market value. This benchmark gives us an important indication of the extent to which investors follow the predictions from the CAPM. If there are no financial frictions and investors hold the benchmark portfolio, then we expect an estimated coefficient equal to unity.

We estimate the regressions separately for bond and equity holdings using ordinary least squares. Only a small number of papers in the international investment positions literature analyze different asset classes in a single study (Fidora et al., 2007; De Santis and Gérard, 2009; Coeurdacier and Rey, 2013). Here, separation between bonds and equity is standard in the literature as pooling could obscure interpretation.[4] For the regressions we cluster the standard errors by holding country*holding sector pairs. This clustering increases the standard errors by about a factor of 10 compared to not clustering. Furthermore, on top of the conservative standard errors we indicate only 5%, 1% and 0.1% significance level with asterisks in the regression tables.

## 3.2 Data

In order to empirically analyze the heterogeneity in international portfolio allocations, this study employs the ESCB Security Holdings Statistics (SHS), which contain the holdings of all euro area investors at the country-sector level in individual securities worldwide.[5] So, for example these data

[4] We also do not combine these two asset categories because the interpretation of individual security characteristics of bonds and equities, e.g. residual maturity or dividend (which are key explanatory variables), would become fuzzy.

[5] This study is among the first research papers using this dataset (Boermans and Vermeulen, 2016; Boermans et al., 2016; Koijen et al., 2016). The data have been extensively used for policy analysis (e.g. DNB, 2016; ESRB, 2015; ECB, 2016).

contain the total holdings of German banks in a particular Italian 10-year government bond (with ISIN code IT0004594930) that matures in September 2020 or the holdings of Apple shares (with ISIN code US0378331005) by Spanish households. These securities holdings statistics have been collected since the start of 2014 under a mandatory reporting framework (see ECB, 2015).[6] Because of the mandatory reporting framework, data collected by each euro area national central bank is based on the same data definitions and procedures ensuring cross-country comparability as well as data quality.

The data provide information on the portfolio bond and equity holdings at market values for investors from all 19 euro area countries at the level of the end-investor sector per holding country. We group the data by five holding sectors: banks, insurance corporations, pension funds, investment funds and households.[7] In total we observe investments in almost 150 issuer countries disaggregated in the following issuer sectors: banks, insurers, investment funds, other financial intermediaries, non-financial corporations and governments. While it is possible to introduce a residual foreign sector as in Koijen et al. (2016) for the holdings we do not observe it will not be informative in our setting. When estimating the gravity model we need information on bilateral characteristics between the foreign sector and the country of the issuer of bonds and stocks. Since the composition of the foreign sector is not known we cannot pursue such a strategy.

The main advantage of this database compared to the widely used IMF Coordinated Portfolio Investment Surveys (CPIS) data is the ability to study the importance of individual bond and equity characteristics for international portfolio investments. For example, whereas many studies use a country's GDP or stock market capitalization as key variable that attracts foreign investors, we use a company's stock market capitalization or the market value of an individual bond as the attractor variable. Another example is that we can more accurately identify the holdings in domestic currency assets, because we observe if a German bond is issued in e.g. euros, US dollars or British pounds.[8] Furthermore, we can observe a large variety of specific bond and equity characteristics, such as maturity, whether it is eligible as collateral for ECB transactions and pays dividends.

We use data for 2014Q4 in our benchmark regressions, but investigate the robustness of our results also using a different period. The choice for 2014Q4 is motivated by several considerations.

[6] Under Regulation (EU) No 1011/2012 (ECB/2012/24) end-investors report on a monthly or quarterly basis portfolio holdings directly to national central banks or indirectly via custodian reporting.

[7] In this study the holdings of other financial intermediaries and public investors such as governments and central banks are not considered.

[8] See Boermans and Vermeulen (2016) for recent evidence with similar data on the importance for making this distinction.

First, we are interested in the drivers of portfolio allocations in normal times. Figure 1 shows that European financial markets were relatively calm in Europe during 2014, mainly because tensions from the European sovereign debt crisis (which peaked in mid-2012) decreased significantly. Furthermore, in 2014Q4 the ECB had not started its quantitative easing operations, which might distort the private sector's holdings of certain assets. Using 2014Q4 as a benchmark also allows us to compare our data with the latest end-year CPIS data available at the moment of writing (see Appendix A). While it is possible to analyze the data in a panel setting, we are mainly interested in the cross-sectional determinants of portfolio holdings. Using a panel with fixed effects to control for unobserved time invariant heterogeneity would exclude time-invariant characteristics of bonds and equities from the regression and it is especially the importance of these characteristics that we are interested in.

[Figure 1 about here.]

The granular nature of the holdings data allows us to enrich the data with information from the Centralised Securities Database (CSDB), a large data source containing detailed information about individual securities. The SHS and CSDB data are merged using the International Security Identifier Number (ISIN). Since the CSDB contains information on around 25 million unique ISIN codes, virtually all holdings in the SHS can be matched with security information from the CSDB. For our analysis we include several key characteristics of bonds and stocks relevant to the investment decision. For both bonds and stocks the market value of a security (size attractor variable), the country of residence of its issuer and the currency denomination are included. For bonds we add information on the residual maturity, coupon information and dummies for covered bonds, perpetuals and eligibility for ECB collateral operations. For stocks we add a dividend dummy which is equal to one when the stock paid dividends during the past year.

We also use control variables from different commonly used sources in the international portfolio allocation literature. Data on the distance between the country of the investor and issuer is derived from the CEPII database. From the same data source we also use a dummy variable that indicates if the country of the investor and issuer share a common border. Finally, bilateral import and export data from the IMF's Direction of Trade Statistics is used to include the effect of trade flows on international portfolio allocations. These bilateral trade variables measure both the economic ties between countries and reduced information asymmetries when trading intensively (Aviat and Coeurdacier, 2007; Okawa and Van Wincoop, 2012).

Some data cleaning is in order for our research purposes, see also Table B.1 in Appendix B. As standard in the literature on international investment positions we drop security holdings in major financial centers and offshore destinations from the empirical analysis, because investors may channel investments to third-countries via financial centers. Most notably we exclude the holdings of and investments in assets issued by Irish and Luxembourg residents. Inclusion of financial centers would create a distortion as the issuer country is not the ultimate recipient of the investment, the well-known third-country problem (Lane and Milesi-Ferretti, 2008). We drop all short positions because for smoothing the dependent variable we wish to take the log which is not possible with negative values. Note that short positions comprise only a very small number of observations, in part because for each security data is aggregated at the sectoral level. We do not include the so-called third-party holdings because of possible custodian bias which would create double counting, except for households. Some positions are too large to classify as portfolio investment and should be considered as direct investments. These observation are excluded from the sample. Securities that are matured but in distress are also reported, but we discard them. Note also that we cannot account for derivative positions and thus are not able to fully measure exposures on currencies, interest rates and duration risks with security-by-security holdings data. Finally, we do not observe securities lending and repos because the holdings statistics only consider the economic ownership of assets.

### 3.3 Descriptive statistics

The final sample contains about 430,000 bond holdings and 194,000 equity holdings observations. This covers around 190,000 unique individual bonds and 30,000 unique individual stocks. Panel A in Table 1 shows that our sample contains over EUR 9 trillion in bond holdings of euro area investors. The size of a country's investors' bond holdings closely tracks the size of each economy. The largest investors in terms of investment positions by country are France and Germany (each around EUR 2.3 trillion). In terms of domestic holdings, we observe that across euro area investors on average 59% of the bonds issued by residents from that country are held by domestic investors. The domestic share in bond holdings differs strongly across holder countries. Domestically-issued bonds comprise over 85% of Italian and Spanish bond holdings. It is interesting to note that the domestic bond holdings of German investors are 'only' around 42% and for the Netherlands this percentage is 38%.

[Table 1 about here.]

Panel B in Table 1 also presents some details on the equity holdings by country of the holder. Our sample contains over EUR 2 trillion in stock holdings from euro area investors worldwide. Similar to bonds, French and German investors have the largest positions in equity (around EUR 600 billion each). The third largest holder country is the Netherlands (over EUR 400 billion), which can partially be explained by the large size of Dutch pension funds. The equity holdings of Italian and Spanish investors are relatively small compared to the countries' size. Similar to the bond holdings, we find a large degree of heterogeneity in the domestic holdings between countries. Spanish investors hold relatively the largest amounts in domestic equity (78%). The lowest domestic share for equities is in the Netherlands (8%).

In terms of heterogeneity by investor type, Panel A in Table 2 presents another breakdown of bond and equity holdings by sector of the holder. The largest investors are banks with nearly EUR 4 trillion in bond holdings, followed by insurers with around EUR 2.5 trillion. Pension funds, investment funds and households hold somewhat smaller amounts in their portfolios. Again, we find interesting differences in terms of domestic holdings. Domestic bonds comprise 85% in households' bond holdings and 72% in banks' bond holdings. On the other hand, investment funds hold 27% of their portfolio in domestic bonds.

[Table 2 about here.]

Turning to equities, investment funds are by far the largest investor in stocks (over EUR 1 trillion), with households being the second largest investor with close to EUR 600 billion (Panel B in Table 2). The collective equity holdings of banks, insurers and pension funds together are smaller than of investment funds. Pension funds and investment funds hold a relatively low share of domestic equities in their portfolio, around 7% and 25%, respectively. In contrast, households have the largest fraction of domestic holdings, at over 75%.

Panel C in Table 2 highlights that each investor sector allocates different shares of their portfolios to investment in bonds and equity. In particular, of the domestic holdings households and investment funds have the highest shares in equity (39% and 38%) while banks, insurers and pension funds have relatively low shares (between 4% and 7%). A similar pattern is found for foreign holdings, except that pension funds allocate 32% of their foreign portfolio to equities.

We now turn to the descriptive characteristics of the dependent variable and control variables. Panel A in Table 3 shows the summary statistics of the bond holding data. The average holding is

EUR 575,000 and the average market value of a bond is EUR 22 million.[9] Note that there is a large variety in holdings. Around 40% of the observations are holdings in domestic bonds (home) and close to 80% of the observations are holdings in euro-denominated bonds. These percentages are counted in terms of observations in the sample and not in value terms. Including domestic investments, the average distance between holders and issuers of bonds is merely 70 km, of which 58% is invested domestically (distance equals zero) and around 16% is invested in a bordering country. Dropping the domestic investments gives us an average distance of 1,500 km. The average residual maturity is 2.5 years. Of the holdings, 18% are bonds with a floating coupon rate and 17% are covered bonds. Only very few bonds are perpetuals (2%). Around 28% of the holdings are bonds being eligible for collateral at the ECB. The vast majority of eligible collateral consists of government bonds, but note that not all government bonds in the data are eligible. Finally, Appendix C (Panel A in Table C.1) presents the correlation matrix.

[Table 3 about here.]

Panel B in Table 3 shows the summary statistics of the equity holding data. The average market capitalization of stocks is around EUR 390 million, while the average investment per investor sector is around EUR 50,000. In terms of domestic equity holdings we observe large variations with an average share of domestically held stock of just 5%. Note that these numbers are unweighted. As Table 2 shows, in weighted terms, the equity holdings in domestic firms are larger (43%). Compared to bonds, the average distance is much larger for equity than for debt; around 2500 km, with only 8% invested in a neighboring country. Not considering home investments for stocks increases the average distance to 3,700 km. This is due in part to large equity holdings in the United States. Also notice that compared to bonds a much smaller share of equity holdings are denominated in euros (20%). Of the stocks held by investors, 56% paid out a dividend in the past year. Appendix C provides a correlation table (Panel B in Table C.1).

Finally, we present the descriptive statistics of the independent variables by holder sector. Figure 2 shows the weighted averages of variables across sectors using the euro holding amounts as weights. The domestic holdings have already been discussed in Table 1 but clearly show the largest share of domestic bond holdings for banks and households. Next, all investors have a strong preference for holding euro-denominated bonds, although given the large number of observations the demand for

[9] We take logs so that EUR 575,000 = exp(13.26) and EUR 22 million = exp(16.9).

euro denominated debt appears somewhat smaller for pension funds and investment funds. The third figure (row 2, left figure) shows that of the total bond holdings by banks, insurers and pension funds, over 80% is eligible as collateral for ECB liquidity operations. The large numbers for insurers and pension funds may be related to the generally low risk profile of eligible assets. Note that households own a relatively small portion of eligible collateral bonds in their portfolio.

The right-hand side figure in the second row shows important differences in the holdings of floating interest rate bonds. These bonds comprise over 35% of the banks and household portfolio, while they are less than 15% in the other sectors' bond holdings. With regard to the holdings of covered bonds there are mainly differences between insurers, pension funds and investment funds (over 50%) and households (less than 30%). The share of perpetuals is small for all investor types, but largest for households and smallest for banks and pension funds. The median distance between the investor and a bond is zero for banks, insurers and households because over 50% of the bonds they hold are domestically issued. For investment funds, the median distance is largest at around 400 km. Finally, the median maturity of bonds is lowest for households and highest for insurers and pension funds.

[Figure 2 about here.]

We now turn to descriptive statistics by sector for equities. The first graph in Figure 3 shows the domestic allocation as presented in Table 2 by investor type. Here pension funds have a relative small share of domestic holding (around 7%) while insurers and households have a relative large share of domestic bonds in their portfolio (67% and 76% respectively). The top right graph shows some heterogeneity in the holdings of euro-denominated equities, which comprise over 80% of the equity holdings of insurers and households, but are less than 30% for pension funds. At first inspection, we do not observe large differences in the holdings of dividend paying stocks, which seem to be the largest for insurers and smallest for households. Note that the average dividend payout rate of about 90% appears somewhat higher than in other studies (e.g. Desai and Dharmapala, 2011), but after weighting by total holdings the rate is 68% and comparable to other studies. Finally, similar to bond holdings the median distance between an investor an the country of stock issuer is zero for banks, insurers and households. It is however much larger for pension funds and investment funds.

[Figure 3 about here.]

# 4 Results

## 4.1 Bond holdings

Table 4 presents the estimated coefficients for Equation (1) using bond data. All coefficients are estimated in a single regression and the columns represent the estimates for each of the investor sectors. The results show sizable differences between investor sectors and the importance of bond-specific characteristics for portfolio choice.

[Table 4 about here.]

According to the CAPM investors should allocate their funds based on the market value of each asset. This implies a coefficient of one on log(market value) in order to track the benchmark portfolio with optimal diversification under the assumptions of the CAPM. It turns out that this relationship is relatively weak for bond allocations. In fact, the coefficients range between 0.13 for pension funds/insurers and 0.55 for households. One interpretation of these differences can be that they are explained by the liabilities of the different investors. Since insurers and pension funds are asset-liability managers the diversification motive may play a smaller role. Another explanation may be that individual bonds can have close substitutes, i.e. correlations close to one, which decreases the diversification potential of holding multiple bonds.

Turning to the variables that proxy for bilateral frictions and other barriers, we find that the coefficients on home are all positive, indicating a preference for bonds issued by residents of the home country even after controlling for the effect of distance. This home bias effect for bonds is well-documented (see e.g. Fidora et al., 2007). However, our results show that only the coefficients for insurers and pension funds are significantly positive. The fact that we do not find a significant home bias effect for banks appears surprising given the attention to the sovereign-bank nexus in the literature (see Acharya and Steffen, 2015; Altavilla et al., 2016; Ongena et al., 2016). In terms of economic magnitude, the estimated home bias is the largest among banks, yet not significantly different from zero. Hence, it could well be that other factors such as asset eligibility for collateral operations explain why banks mostly hold domestic bonds, typically sovereigns. We find that investment funds and household have no significant preference for domestic bond holdings, ceteris paribus, and the estimated coefficients for these investors are the smallest compared to other sectors.

With regard to distance, the large and significantly negative coefficient for households stands out. However, also for pension funds and investment funds we find a significantly negative coefficient. The very strong negative coefficient of households may be related to a stronger familiarity bias for households compared with institutional investors. These findings are in line with several country-level studies (Grinblatt and Keloharju, 2001; Goetzmann and Kumar, 2008). Balli et al. (2013) explore the distance effects using CPIS data for a sample of 33 developed economies from 2003 to 2009 for a few holder sectors and find an insignificant effect for households and insurers, while for 'financial sectors' the distance effect is significant. We will discuss the sensitivity of our results to including or excluding the home dummy, distance or trade in more detail in Section 5.3. In general, after controlling for bond characteristics we confirm the negative role of geographical distance of international portfolio allocations (Fidora et al., 2007; Daude and Fratzscher, 2008; Lane and Milesi-Ferretti, 2008; De Santis and Gérard, 2009).

Trade has a positive effect for each sector, indicating that investors hold more bonds in countries with which their home country has strong trade ties. The relatively small differences between investor groups are interesting. The estimated coefficients are within the range of 0.17 for households and 0.28 for insurers and pension funds. Aviat and Coeurdacier (2007) argue that the effects of distance are largely explained by trade relations. However, we find that for certain investors home bias and distance matter even after accounting for trade. Moreover, investors prefer holding assets in neighboring countries. This preference is positive across all investor types except pension funds and seems to be strongest for banks.

Let us now discuss the non-gravity type of variables that explain portfolio investment in bonds related to security level characteristics. For the currency denomination of bonds we find that all investors have a strong preference for holding euro-denominated bonds. These results are compatible with Bénétrix et al. (2015) and Boermans and Vermeulen (2016). Our findings suggest that this euro preference is strongest for insurers, with a coefficient of around 1.6. Ceteris paribus, insurers will hold 158.7% more of a bond if it is denominated in euros compared to an identical bond that is not euro denominated. Even though the effect is weaker for banks and households we still find that they hold 95% and 80% more of a bond when it is denominated in euros. One explanation for the overall tendency to hold euro-denominated bonds is that it provides a natural hedge to any currency

movements.[10]

The results further show that both insurers and households prefer bonds with a longer residual maturity compared to the other investor types. For insurers the preference for longer maturities may stem from the desire to match their assets with their long-term liabilities. However, we would expect to find a similar result for pension funds. Even though the coefficient of pension funds is positive, it is much smaller in magnitude compared to insurers and not significantly different from zero. One reason for the difference between insurers and pension funds may be related to the fact that the pension fund sector consists of both defined benefit and defined contribution pension funds. Still, the maturity distribution shows that pension funds hold bonds with a similar average residual maturity as insurers but with a much wider maturity distribution (see Figure 2), which could reflect the large difference between the two types of pension funds. For defined benefit pension funds in particular inflation risk is a more important risk factor compared to insurers. Short maturity bonds are a better inflation hedge than long maturity bonds so this may explain the insignificant result. Another reason is put forward by Opazo et al. (2015) who find that Chilean pension funds invest in much shorter maturity bonds than Chilean insurers. They show that pension funds are more affected by short term monitoring and performance evaluation, which decreases their incentives for long term investments.

Banks and households exhibit a significant preference for floating rate bonds, while insurers, pension funds and investment funds dislike floating rate bonds. Insurers often guarantee a minimum return on a life insurance policy. Therefore insurers prefer a predictable income stream from a bond. On the other hand, banks have a strong exposure to floating interest rates, for example when attracting savings accounts that pay a variable interest rate. This can explain the demand for floating rate debt by banks.

Institutional investors have a preference for covered bonds while households seem to have a lower demand for covered bonds. These institutional investors face preferential regulatory treatment for bonds with underlying collateral and thus are more inclined to hold these assets than households that do not have such incentives and may find covered bonds complex investment products that are difficult to access or are unattractive because of lower returns. The coefficient on covered bonds is especially large for pension funds.

[10] Coeurdacier and Gourinchas (2016) show that investors hold foreign bonds to hedge real exchange rate risks and use stocks to hedge against other sources of risk. They identify this channel as a possible explanation of the equity home bias.

In general we find that all investor types except investment funds reduce their holdings of a bond when it is a perpetual, ceteris paribus. Investors in a perpetual are in principle mainly interested in coupon payments as a stable income stream. However, for many investors receiving the principal at some point in the future is also important, for example to pay out pension or insurance liabilities. Even though perpetuals can be traded, we find that perpetuity is not a desirable characteristic for most investors. Banks have the strongest aversion to perpetuals, which combined with the finding that they display no effect of holding longer remaining maturities suggests that banks strongly demand short term (liquid) assets.

Finally, the results show that banks in particular have a strong desire to hold bonds that are eligible assets as collateral at the ECB. In fact, only banks are allowed to use this facility so we also expect to find that eligibility is relevant for banks' portfolio choice decisions. Economically the possibility of using the bond as collateral increases bank holdings by 132% compared to an otherwise identical bond. Again, this shows the importance of the banking sector's demand for liquid assets. As Gennaioli et al. (2014) explain, banks hold bonds as a buffer against shocks. Because these bonds qualify as ECB collateral, banks can use them for interbank lending or repos. For example, Hildebrand et al. (2012) find that this channel is especially important during crisis moments, when eligible assets made up 80% of German bank's bond positions.

## 4.2 Equity holdings

Table 5 presents the regression results when estimating Equation (1) using the sample of equity holdings. The columns represent the coefficients for each of the five investor classes. Similar to Table 4 all coefficients are again estimated simultaneously in a single regression.

[Table 5 about here.]

The first row shows that equity investments follow the CAPM more closely compared to bond investments across all investor types. The coefficients on log(market value) are not significantly different from one for banks, pension funds and investment funds. So, these equity investors follow the predictions of CAPM quite closely, i.e. if the market value of a stock increases by one percent, these investors increase their holdings by about one percent. The coefficients for insurers and households are smaller but still economically large in magnitude.

While accounting for distance, the home bias is much larger for equity than for bonds across all investor types, except for insurers. Meanwhile, the distance coefficient is only significantly negative for insurers, while it is insignificant for all other investors. This may be explained by the strong home bias effect for the other investor sectors. Other studies have also documented a stronger home bias for equity than for bonds (see Fidora et al., 2007; De Santis and Gérard, 2009). Roque and Céu Cortez (2014) find that institutional investors are less affected by distance than households. The fact that the direct effect of distance is insignificant for households may be explained by the very strong preference for domestic stocks. A similar pattern may account for the absence of a distance effect for pension funds, which display a very large home bias. The home bias for insurers is insignificant, yet they display a strong negative distance effect for equity investments.

Regarding trade, the equity portfolios of all investors except insurers are affected by trade relations. As expected, for stocks this trade effect appears to be larger than for bonds (Fidora et al., 2007). For example, when trade between the investor's country and the country of residence of the firm with the stock listing increases by 10%, pension funds increase their holdings with 4.8% ceteris paribus. The positive signs are very much in line with the results for bond holdings. This confirms the importance of economic links between countries in explaining cross border asset holdings. Some authors such as Lane and Milesi-Ferretti (2008) include both distance and trade in the regression while others such as Aviat and Coeurdacier (2007) include only trade because of multicollinearity concerns. Section 5.3 discusses how the regression results are affected when opting for one strategy or the other.

For equities, the common border effect is absent for most investors. However, for households and insurers equity investments are driven by common borders, which might explain the insignificant coefficient for distance. It could be argued that euro area insurers and households invest very much locally compared to other sectors. One explanation for the higher coefficient of households are information asymmetries. It is conceivable that for households it is more difficult to obtain information on equities in distant countries compared to banks and investment funds for which distance and common borders are less important. This may explain the strong preference for equities in neighboring countries by households as proposed by *inter alia* Ivković and Weisbenner (2005), Van Nieuwerburgh and Veldkamp (2009) and Coeurdacier and Rey (2013). Overall, we conclude that distance-related gravity variables are less of an issue for equity investors compared to bond investors, with an exception for households.

We find that the coefficient on the euro currency dummy shows that euro area investors have a preference for holding euro-denominated equities. This effect is especially large for insurers, which can be related to the negative and large effect of distance for insurers. Investment funds and households have a significantly positive coefficient, but this does not differ too much from the coefficients of banks and pension funds in terms of economic magnitude.

Finally, we find that both insurers and pension funds have a strong preference for stocks that pay out dividends. These type of investors may require a steady income stream. For banks, investment funds and households it is less important whether a company pays dividends. Graham and Kumar (2006) argue that less sophisticated investors, in particular households, tend to exhibit a preference for stock with high dividends. Our results for euro area investors tend to go against this notion. Our findings support the tax clientele argument, which suggests that for pension funds and insurers there are possible tax advantages to receiving dividends that are not available to banks, investment funds and households (Desai and Dharmapala, 2011). Our results also favor studies that show that institutional investors tend to invest more in dividend yielding stocks (Short et al., 2002). In general, we show that there is large variation in the preference for dividend payouts among different investors.

# 5 Robustness

This sections documents several further robustness tests. Regression tables can be found in the Appendix.

## 5.1 Portfolio allocations during the 2012 European sovereign debt crisis

One major question regarding the generalization of the findings is whether the results are influenced by the sample period used. Recently, several studies have also explored the stability of the determinants of international portfolio allocations (Forbes and Warnock, 2012; Galstyan and Lane, 2013). These studies suggests that differences may exist between types of investors in their response to crisis periods. The European banks' home bias increased during the recent financial crisis (Hildebrand et al., 2012). However research on Dutch insurers does not reveal a similar trend during this period (Bijlsma and Vermeulen, 2016). Our benchmark results take the period 2014Q4 because it is considered a relatively calm and stable period in the European financial markets. To test the stability of the estimated coefficients we investigate the extent to which the determinants of international portfolio positions

are comparable during the peak of the sovereign debt crisis. We estimate the same models as in Tables 4 and 5 using holdings data for 2012Q2, which is arguably a peak crisis moment of the euro area sovereign debt crisis and was around the time of the ECB announcement of the Outright Monetary Transactions (OMT) and the famous "whatever it takes" speech, see also Figure 1.[11] Note that pre-2013Q4 data are of an experimental nature since the holdings data were mainly collected to construct balance of payments statistics. This implies that the coverage of home asset holdings may be lower and not as complete as data on the holdings abroad. If anything, our estimate for the home bias is a lower bound.

First consider bond holdings. In general, the results for the crisis period 2012Q2 are very similar to the benchmark period 2014Q4 (see Table D.1). In particular the results for both the gravity and asset characteristics are similar across sectors with a few notable exceptions. We do find smaller and insignificant coefficients on trade for institutional investors in the bond regression. Also, for households we find that in the bond market the home effect becomes significant. Finally, in 2012Q2 we find that the eligible collateral indicator has become significant for pension funds. It is not clear what is driving these differences, but one may argue that risk aversion may be more important during this period.

For equity holdings the results are mostly in line with the benchmark results, with some differences. During mid-2012 we find no evidence of a home bias for banks, while the results for the other sectors are the same. The apparently strong correlation between trade and distance changes in some cases the significance of a variable when using 2012 instead of 2014 data. For insurers we find that the strong preference for dividend paying companies was not present during 2012. This finding may be explained with the de-risking of insurance companies, which decreased their equity holding and may have shifted their portfolio to the generally safer dividend paying companies.

## 5.2 Are the drivers of portfolio investments similar for domestic and foreign holdings?

One major difference between our work and the majority of studies in the international portfolio investment literature is that we include domestic holdings. Here, we are interested to what degree the determinants of domestic and foreign holdings are comparable, as it has been suggested that

[11] For this period we have no information on covered bonds. We tested the model both with and without Latvian holdings as the country adopted the euro in 2014; the results are unaffected by this inclusion or exclusion.

the factors driving both may differ (Grinblatt and Keloharju, 2000; Chan et al., 2009). Excluding the domestic holdings also allows us to better compare the results with papers that only have foreign holdings. In addition, we can compare the split sample results with the main results. We now estimate the regressions separately for domestic and foreign bond and equity allocations.[12]

The results are quite similar to our main findings (see Tables E.1, E.2, E.3 and E.4 in Appendix E.). For both domestic and foreign holdings the estimated coefficients and significance are comparable to Tables 4 and 5, yet some exceptions are worth noting. For pension funds we find a significant effect of residual maturity for domestic holdings. For banks and insurers, the size of the eligible collateral variable is much larger for domestic holdings than for foreign holdings, although still significant in the latter. Some comparisons are more difficult to interpret because of sample issues. For example, in the domestic equity holdings setup, the euro currency dummy is not significant anymore for banks, insurers and pension funds. This can be explained because there are only few domestic equities listed in a non-euro currency in euro area countries. When estimating the regression for only foreign equities we do find that the euro currency dummy is significantly positive for all sectors and in line with the main findings.

### 5.3 Better understanding of gravitational forces and home bias

The main results separate the effects of home, distance, and trade. However, these variables are intricately linked (see the correlations between the variables in Table C.1), hence estimating their impact while dropping the others could be interpreted as a further robustness test as well as a horse race among them. In this way we contribute to the large body of literature on home bias (e.g. Sörensen et al., 2007; Fidora et al., 2007; Coeurdacier and Rey, 2013). Due to space considerations we do not present all regression results. We first include only the home indicator to test for the presence of a home bias. As expected, we find strong home bias effects both for bonds and equities, with the exception of insurers for bonds, even though the estimated sign is positive (p-value $<0.10$). Note that the size of the estimated coefficients is generally comparable, thus suggesting that confounding factors in the main regression are not an issue. We find that the home bias is largest among households for both bonds and equities.

Next, we study the role of distance separately. As expected, we now find that for all sectors

[12] For the domestic holdings regressions we must drop all gravity related variables except for log(market value), the size attractor. For the foreign holdings we exclude only the home indicator.

distance plays a negative and significant role for bond and equity allocations. This outcome suggests that in the main results, part of the distance effect is picked up by other gravity variables like the dummy home. We find again that households display the largest effect of distance for bond and equity investments. For the other sectors, the effect of distance is generally much larger for equities than for bonds.

We now drop the trade variable while keeping home and distance. Doing so gives many insignificant home bias effects, with a surprising negative and significant effect for pension and investment funds for bonds. This can only be explained by the fact that the trade variable is important for these sectors. For households we find both a positive home effect and significant distance effect for equities. For all other sectors the distance effect is negative. In line with Aviat and Coeurdacier (2007) the coefficients of distance are much smaller in our main regressions because they include trade.

It is reassuring that the coefficients are comparable to our main findings, suggesting that the geographical distance effect on top of trade is relevant for international portfolio investments. Including only a home dummy and trade gives a similar pattern. It is worth noting that when we only exclude distance, both home and trade effects are comparable to Tables 4 and 5. As expected however, the home effect becomes much larger as it picks up part of the distance effect. Households have the largest home bias, followed by pension funds. For bonds, investment funds and insurers show relatively the smallest home bias, while for equities it is the insurers. These outcomes are in line with the main results. Finally, changes to the composition of gravity forces in the estimation has relatively minor effects on the estimated coefficients of the individual security characteristics.

### 5.4 Bond maturity, yields and new issuances

Using information on bond prices and coupons, we also test for the effect of the yield to maturity on bond positions. Here we need to drop the residual maturity variable and combine it with coupons and prices. For a subsample of 303,857 observations, we estimate the role of yield to maturity for each investor sector. As it turns out, all investors show a negative preference for higher yields to maturity, although the estimated effects are only significant for banks and households with estimates of -0.12 and -0.05 respectively. For pension funds, the yield to maturity effect appears the smallest (with an estimated coefficient of -0.01) suggesting that pension funds are most willing to hold higher yielding bonds, ceteris paribus.

Another relevant test is to investigate whether the results for bonds are affected by bonds with a residual maturity of less than one year as investors may have a habit for securities with a particular maturity (Vayanos and Vila, 2009). Arguably, from an investor's perspective these bonds are money market paper which are useful for liquidity purposes. In this part we excluded all bonds that have a residual maturity date of 31/12/2015 or earlier, leaving us with around three quarters of the sample (312,652 observations). The results are barely affected by the presence of shortly maturing debt that was long-term debt when issued, except that we find a positive effect of residual maturity on the positions for banks now. To investigate if banks have a preference for short-term debt we reran the model using *only* bonds that mature within one year. Interestingly, we find a significant negative effect for banks, thus suggesting that banks have a non-linear maturity preference, keeping other factors constant. That is, in the short end, banks prefer very liquid and quickly maturity debt, whereas in the long end they wish to hold bonds with a longer remaining maturity. We do not observe this effect for any other investor sector.

In the baseline regression we assume a monotonic relationship between bond holdings and yield to maturity. By replacing the residual maturity variable with five residual maturity categories we allow for a potentially non-linear relationship between residual maturity and bond holdings. The five residual maturity categories are less then one year, between one and five years, between five and ten years and more than ten years. The category less than one year is used as base category. For insurers we confirm the strong monotone increase in demand as maturities increase. Interestingly, for pension funds we find a stronger demand for intermediate maturities (1-10 years) relative to the base category, but not for long maturities. Investment funds do not prefer any of the maturity brackets over the base category. Households have a strong aversion to very short residual maturities and prefer intermediate maturities strongest, but their demand for very long maturities (>10 years) is high as well. Finally, for banks we find no significant differences between demand for intermediate and short maturities. However, banks do have a demand for long maturities, confirming the possible non-linear demand for maturity suggested by the results in the previous paragraph.

Next, we investigate the role of hold-to-maturity strategies in explaining results in the international portfolio investment literature. An interesting feature of the granular data is that we can exclude bonds that have been issued long ago and therefore might not have recently changed hands among investors

[13] Hence, we can investigate whether portfolio choice determinants are driven by changes in market composition. We are interested in the factors that drive investments, so by studying a subsample of newly-issued bonds we would pick up recent buy decisions at the level of the investor sector. In this way we also test whether legacy and lack of trading (i.e. hold-to-maturity strategies) play a role in existing positions. By reducing the sample to those bonds issued in 2014 ($n$ = 116,847) we find that the coefficients are quite similar to the main regression results in Table 4. An interesting difference is that we no longer see a significant preference for covered bonds by insurers, pension funds and investment funds. Overall, the results show that any potential legacy factors or little trading do not drive the general results.

### 5.5 Further sensitivity analysis

We ran several other tests not presented here. First, we reran our estimates with only asset characteristics, thus excluding the bilateral gravity type variables while keeping log(market value) as it is an individual security characteristic. The estimated coefficients are similar and thus not confounding with gravity variables. When we only include bond characteristics and a constant, i.e. no country-sector fixed effects or gravity related variables the explanatory power of the individual security characteristics is still high ($R^2$=0.51). Next, the main regressions exclude holdings and assets issued by residents from Ireland and Luxembourg. However, including these countries both as a holder and issuer country does not lead to different results for bonds and equities, with the exception of the home variable, whose coefficients are - not surprisingly - lower for all holder sectors when including Ireland and Luxembourg in the sample.

The main results suggest that investors have a strong preference for euro-denominated assets, in particular for bonds. However, we did not distinguish between different currencies. Once we use the euro as the reference category and include dummies for non-euro area currencies (US dollar, UK pound, Japanese Yen, Swiss Franc and other non-euro currencies) virtually all estimates give negative and in most cases significantly negative coefficients for non-euro area currencies, thus confirming the strong preference for euro-denominated assets.[14]

When dropping all sector-country positions that are less than EUR 1 million on an individual

[13] See e.g. Ongena et al. (2016) who explain why for instance the holders of newly issued sovereign debt are different from those that bought such securities a long time ago in the secondary market.

[14] The results do not show a much stronger preference for one foreign currency at the expense of another, with the exception of significant preference by banks for Yen-denominated bonds, conditional on the other variables.

security we examine if the results are driven by relatively small positions. This exercises implies that we drop a significant number of observations and we are left with 203,015 observations for bonds and 46,130 for equity. After dropping small positions, most of the main findings remain intact, with some exceptions. For bonds, the home bias of banks becomes significant while it loses significance for pension funds. The preference for euro-denominated bonds disappears for banks and households. Pension funds show a tendency to hold bonds with longer residual maturity. For equities, we find that when including only large positions, the market value effect becomes much weaker across all holder sectors. Insurers show a significant preference for euro-denominated equities, just like banks. Among households that have at the country level a position of at least EUR 1 million in a single stock, paying out dividend negatively affects the holdings.

In the above analysis we estimate the regression for bonds issued by all sectors. In a robustness check we take a subsample of bonds issued by the private sector, hence excluding all bonds issued by sovereigns and government related entities. The reason to drop governmental debt is that these bonds face various preferential regulatory treatment conditions (e.g. zero risk weight for banks for European sovereign debt) which may distort the demand for these bonds and thus affect international investment allocations. When excluding government bonds the results are very similar to the benchmark results across all variables with one exception (Table F.1). The CAPM coefficient of market value increases across all holder sectors, which suggest that the holdings of private sector bonds are to a larger extend driven by diversification motivations compared to government bond holdings.

Finally, we investigate the role of the multilateral resistance variables, i.e. the holder country-sector and issuer country-sector dummies. In principle these terms pick up unobserved fixed effects, e.g. a holder sector preference to invest in sectors in countries that have correlated returns with the home market (Okawa and Van Wincoop, 2012; Bergin and Pyun, 2016). In a robustness exercise we only include holder country and issuer country dummies similar to existing literature. Many of the main results remain intact, but there are also large differences in some cases. Many more variables are now significant, which can be due an omitted variable bias. So, we prefer the inclusion of holder country-sector and issuer country-sector dummies to control for unobserved heterogeneity and minimize a potential omitted variable bias.

# 6 Conclusion

This paper advances the literature on international investment patterns by studying asset holdings of individual securities and distinguishing between different investor sectors instead of taking a country level perspective. We successfully estimate a gravity model with security-by-security data that has large explanatory power and allows us to capture possible unobserved bilateral frictions between issuer and investor sectors more closely. Our results demonstrate that individual security characteristics have a large and heterogeneous impact on the portfolio choices across investors. For example, banks prefer floating rate bonds, while insurers and pension funds seek bonds with fixed coupon payments. Compared to other investors, insurers show a particularly strong and consistent tendency to hold bonds with a long residual maturity. For equities, only insurers and pension funds have a significant preference for stocks that pay dividends.

Besides individual security characteristics we confirm the importance of well-studied barriers to international investments such as market size, bilateral distance, trade relations and common borders. However, these factors are not equally relevant across different investors. For instance, bilateral distance between countries significantly shapes bond holdings of households, and to a lesser extent pension funds and investment funds, while distance does not affect banks' and insurers' bond holdings. For equity by contrast, distance affects banks and insurers more than other investors. Regarding home bias, insurers and pension funds display the strongest preference for domestic bonds compared to other investors. The home bias is generally larger for equity than for bonds. Here, households and pension funds have the strongest tendency to hold domestic shares.

The results in this paper fit well into the growing theoretical open economy financial macroeconomic literature. As outlined by Coeurdacier and Rey (2013), incorporating heterogeneous agents in DSGE models is a top research priority to move this literature forward. Our results may provide guidance on the calibration of heterogeneous agents in these models. The emphasis on investor heterogeneity is also highly relevant for the empirical literature on international investment positions. As pointed out by Galstyan et al. (2016), granular data is necessary to better understand international portfolio holdings in addition to standard gravity variables. In particular, our results show that individual bond and stock characteristics matter to explain which investors hold a certain security. Hence, assuming that a representative investor holds a representative asset (bond or stock) seems too restrictive.

Our findings also stress the need for a differentiated approach when regulators supervise different financial market participants. One size does not fit all. Taking investor heterogeneity seriously is important as cross-country differences in sector composition may lead to different macroeconomic transmission effects in financial markets. The underlying sectoral market shares within different countries could potentially explain how risks are borne and shocks are mitigated or exacerbated within the financial system. When different investors react dissimilarly to market adjustments, this could affect the funding of various issuer sectors asymmetrically. As Cerutti et al. (2015) point out that it is crucial to 'know your investors', we argue that it is equally important to know which drivers determine portfolio choice decisions in the first place.

This paper provides several avenues for future research. First, researchers can explore investor heterogeneity more broadly by using firm level holdings of individual bonds and equity instead of relying on the investor positions at the sectoral level. Several studies highlight the importance of investor heterogeneity within sectors (see e.g. Hildebrand et al., 2012; Buch et al., 2016). We find that European banks have a high demand for eligible bonds, which can be used as collateral at the ECB for liquidity. Still, this effect may well differ across individual banks and could be shaped by the demand arising from relatively few, possibly weaker banks.

Second, both academics and researchers have a great interest in the effects of monetary policy decisions on international asset allocations. Our results show that the eligible asset requirements leads to an increased holding of specific bonds by banks. While holding bonds that are eligible for ECB collateral raises liquidity for banks, it could decrease the liquidity of the bond in the secondary market. When many banks hold eligible assets as collateral and therefore are reluctant to sell these bonds this may lead to price distortions due to illiquidity. While beyond the scope of this paper future research can investigate the effects of eligibility on liquidity.

Third, central bank asset purchase programs can lead to potentially far-reaching market distortions. Models with a heterogeneous investor approach (e.g. Vayanos and Vila, 2009) show that central bank asset purchases can displace certain investors though a portfolio rebalancing channel, leading to lower yields and credit expansion in the wider economy.[15] Our findings highlight that different investors hold different preferences for certain individual security characteristics that, in turn, may be asymmetrically

[15] An early DSGE model by Eggertsson and Woodford (2004) shows that asset purchases by monetary authorities have no macroeconomic effects. This results relies strongly on a representative agent assumption in their setup with homogeneous preferences and expectations.

affected by asset purchases from central banks. These analyses could be further applied to extend recent studies on the effects of the ECB unconventional monetary policies such as Fratzscher et al. (2016) and Koijen et al. (2016).

As for policymakers and central banks in particular, our results help to monitor the stability of the financial system. For example, when a price shock hits securities with certain characteristics we can better identify which sectors are likely to be most affected. From a macroprudential perspective it is then important to ensure that shocks do not spill over from one sector to other sectors in the economy. On the other hand, when shocks hit a certain sector our results help to assess which securities are likely to be more affected. For example, investment funds have grown substantially during the past years. If these funds hold many bonds from a single issuing sector, then redemptions at the investment funds will affect the financing of this sector. In fact, herding is a serious risk when multiple investors sell shares in investment funds at the same time en masse. Hence, a better understanding of who holds what and the drivers of portfolio investments at the sector level helps to assess the resilience and fragility of the financial system when shocks emerge.

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Appendix

# A Comparison of SHS with CPIS

As the majority of papers studying international bond and equity holdings use data from the IMF Coordinated Portfolio Investment Surveys (CPIS), a comparison with the granular securities holdings statistics (SHS) sector dataset is in order. Table A.1 shows the total non-domestic asset holdings by instrument class for euro area investors for both datasets. At the aggregated level, the two sources tend to show very similar patterns, yet the coverage of the granular SHS data appears to be slightly lower. This is expected as the security-by-security information does not include macro and integration adjustments that are commonly associated with financial accounts data from which investment pattern statistics such as CPIS are typically derived. Still, the granular data coverage is very high (around 90 percent). Another comparison between the SHS data and the euro area accounts completed by the ECB shows that the coverage in 2014Q2 was about 83%, see ECB (2015).

[Table A.1 about here.]

Several differences with CPIS are worth noting, which may also explain the differences found in Table A.1. In the CPIS there is no breakdown among quoted shares (equity) and investment fund participations. The SHS data do distinguish between these types of instruments. In addition, the SHS data are available in both nominal and market valuations while the CPIS data suffers from different valuations methods, thus creating potential issues for comparison.

Another highly relevant difference between the CPIS and SHS data is that CPIS only covers foreign holdings, while the SHS data also cover domestic holdings. This allows us to directly identify the domestic holdings of investors, whereas studies using the CPIS data have to derive proxies for domestic asset holdings. This is often done by subtracting total foreign holdings from total bond or equity market capitalization in a country. This is naturally a much less precise measure than directly observing domestic holdings, especially given the rise of cross-border listings.

Until 2014, CPIS data were only available yearly at the holder country and destination country level, hence country-level data. A number of enhancements to the CPIS were implemented from 2014 onwards for selected countries, including increasing frequency to semi-annual and expanding scope. This scope expansion includes the possibility to include the issuer sector and holder sector breakdowns.

Currently, around 30 countries report partial sector breakdowns, including some euro area countries. These enhanced CPIS data were used by Balli et al. (2013), Giofré (2013), Roque and Céu Cortez (2014) and Galstyan et al. (2016).

The SHS data are quarterly data and available on an experimental basis from the reference period March 2009 and updated after about 100 calendar days after the end-quarter reference period. Hence, compared to the CPIS the SHS data have a higher frequency and timeliness. In addition, sectoral breakdowns are available over a longer time period with more breakdowns than the new semi-annual CPIS series. In SHS the sector breakdowns cover the full sample instead of selected countries that provide a sector breakdown in CPIS.

The granular nature of the SHS data allows researchers in international economics to include more detailed cross-country barriers at the holder and issuer sectors for international investments compared to the more-aggregated CPIS. The security-by-security reporting ensures higher data quality as checks can be completed at the lowest possible level, while in the CPIS much information is taken from aggregate reporting.[16] Most obviously and emphasized in this study, the security characteristics are highly relevant for international portfolio choice decisions and are omitted in more aggregated analyzed such as those relying on CPIS.

Although the IMF encourages harmonized practices among reporting countries, for instance by promoting the Balance of Payments Manual (BPM6), not all countries adhere fully to these practices given that they are non-binding. This increases measurement errors in the CPIS data.[17] In the SHS data, reporting requirements, definitions, coverage requirements and data quality practices are all harmonized and mandatory, which facilitates the cross-country comparison and avoids double counting. Nevertheless, the number of countries included in the CPIS is much higher, covering practically all countries globally, whereas SHS is limited to euro area investors. However, despite including more countries, CPIS data contain many missing observations due to confidentiality reasons.

[16] For instance consider the US, where *no* security-by-security reporting for the portfolio holdings of the total economy is in place. For the holdings of government debt, the US relies on indirect reporting via custodians, giving rise to the strange outcome that in 2014 Belgium is the third largest investor in US Treasury Bills with positions of nearly USD 400 billion because of its key role in custodian services via Euroclear Belgium (Financial Times, 2014). US custodians were unable to "look-through" to positions held in the custodian chains abroad. The SHS data do not suffer from this as it relies mainly on direct reporting.

[17] For example, various countries use different data collection methods, either directly or by custodians or rely on partial sector reporting and impute macro statistics. The reporting by custodians can lead to well-known issues of double counting as it is nearly impossible for custodians to know whether their client is an end investor or invests on behalf of a third party from another country.

## B Cleaning steps

[Table B.1 about here.]

## C Correlation tables

[Table C.1 about here.]

## D Benchmark regressions using 2012:Q2 data

[Table D.1 about here.]

[Table D.2 about here.]

## E Demand for domestic and foreign bonds and equities

[Table E.1 about here.]

[Table E.2 about here.]

[Table E.3 about here.]

[Table E.4 about here.]

## F Excluding sovereign bond holdings

[Table F.1 about here.]

**Table 1:** Euro area asset holdings by region

| Panel A: Bonds | | | | | | |
|---|---|---|---|---|---|---|
| | Total | of which: | | | | % home |
| | | Home | Foreign | of which: | | |
| | | | | Euro area | ROW | |
| Germany | 2240 | 950 | 1290 | 825 | 465 | 42% |
| France | 2380 | 1290 | 1090 | 729 | 361 | 54% |
| Italy | 1850 | 1630 | 220 | 141 | 79 | 88% |
| Spain | 1011 | 860 | 151 | 110 | 41 | 85% |
| The Netherlands | 909 | 348 | 561 | 394 | 167 | 38% |
| Other | 1074 | 522 | 551 | 351 | 200 | 49% |
| Total | 9464 | 5600 | 3863 | 2550 | 1313 | 59% |

| Panel B: Equities | | | | | | |
|---|---|---|---|---|---|---|
| | Total | of which: | | | | % home |
| | | Home | Foreign | of which: | | |
| | | | | Euro area | ROW | |
| Germany | 610 | 304 | 306 | 91 | 215 | 50% |
| France | 577 | 281 | 296 | 147 | 149 | 49% |
| Italy | 128 | 73 | 55 | 21 | 34 | 57% |
| Spain | 203 | 159 | 44 | 24 | 20 | 78% |
| The Netherlands | 429 | 34 | 395 | 59 | 336 | 8% |
| Other | 220 | 87 | 133 | 56 | 77 | 40% |
| Total | 2167 | 937 | 1229 | 398 | 832 | 43% |

Source: ESCB SHS-S data 2014Q4, positions in billion euro's at market values. ROW denotes the rest of the world.

**Table 2:** Investor heterogeneity in asset holdings

| Panel A: Bonds | | | | | | |
|---|---|---|---|---|---|---|
| | Total | of which: Home | Foreign | of which: Euro area | ROW | % home |
| Banks | 4140 | 2990 | 1150 | 771 | 379 | 72% |
| Insurers | 2530 | 1370 | 1160 | 812 | 348 | 54% |
| Pension funds | 380 | 138 | 242 | 167 | 75 | 36% |
| Investment funds | 1641 | 441 | 1200 | 738 | 462 | 27% |
| Households | 773 | 658 | 115 | 62 | 53 | 85% |
| Total | 9464 | 5597 | 3867 | 2550 | 1317 | 59% |

| Panel B: Equities | | | | | | |
|---|---|---|---|---|---|---|
| | Total | of which: Home | Foreign | of which: Euro area | ROW | % home |
| Banks | 259 | 134 | 125 | 43 | 83 | 52% |
| Insurers | 143 | 97 | 47 | 32 | 15 | 67% |
| Pension funds | 121 | 8 | 113 | 24 | 90 | 7% |
| Investment funds | 1075 | 269 | 806 | 254 | 552 | 25% |
| Households | 567 | 429 | 138 | 45 | 93 | 76% |
| Total | 2165 | 937 | 1229 | 397 | 831 | 43% |

Source: Source: ESCB SHS-S data 2014Q4, positions in billion euro's at market values, excluding investment fund participations (F.52). ROW denotes the rest of the world. Share of equity is calculated as sector holdings in equity over sector holdings in bonds and equity (total). Totals are affected by rounding.

**Table 3:** Descriptive statistics bond and equity samples

| Panel A: Bonds | | | | | |
|---|---|---|---|---|---|
| Variable | # Obs. | Mean | Std. Dev. | Min | Max |
| log(holdings) | 430,679 | 13.26 | 3.14 | -4.61 | 24.57 |
| log(market value) | 430,679 | 16.90 | 4.57 | -5.75 | C |
| home | 430,679 | 0.42 | 0.49 | 0.00 | 1.00 |
| log(distance) | 430,679 | 4.22 | 3.73 | 0.00 | 9.88 |
| log(bilateral trade) | 430,679 | 5.98 | 5.30 | 0.00 | 12.48 |
| common border | 430,679 | 0.16 | 0.36 | 0.00 | 1.00 |
| euro denominated | 430,679 | 0.77 | 0.42 | 0.00 | 1.00 |
| log(residual maturity) | 430,679 | 6.79 | 1.44 | 0.69 | 9.90 |
| floating coupon | 430,679 | 0.18 | 0.38 | 0.00 | 1.00 |
| covered bond | 430,679 | 0.17 | 0.38 | 0.00 | 1.00 |
| perpetual | 430,679 | 0.02 | 0.12 | 0.00 | 1.00 |
| eligible collateral | 430,679 | 0.28 | 0.45 | 0.00 | 1.00 |

| Panel B: Equities | | | | | |
|---|---|---|---|---|---|
| Variable | # Obs. | Mean | Std. Dev. | Min | Max |
| log(holdings) | 194,269 | 10.78 | 4.12 | -4.61 | 24.16 |
| log(market value) | 194,269 | 19.78 | 3.46 | -2.17 | 26.51 |
| home | 194,269 | 0.05 | 0.21 | 0.00 | 1.00 |
| log(distance) | 194,269 | 7.83 | 2.05 | 0.00 | 9.88 |
| log(bilateral trade) | 194,269 | 9.24 | 2.72 | 0.00 | 12.48 |
| common border | 194,269 | 0.08 | 0.28 | 0.00 | 1.00 |
| euro denominated | 194,269 | 0.20 | 0.40 | 0.00 | 1.00 |
| pays dividend | 194,269 | 0.56 | 0.50 | 0.00 | 1.00 |

Note: This table presents summary statistics of the bond and equity holdings in the estimation samples. A 'C' means the cell is confidential.

**Table 4:** Bond holdings

| | banks | insur | pfund | invfd | hhold |
|---|---|---|---|---|---|
| log(market value) | 0.294*** | 0.132*** | 0.127** | 0.208*** | 0.549*** |
| | (0.057) | (0.020) | (0.042) | (0.034) | (0.102) |
| home | 3.211 | 2.898** | 2.801* | 1.732 | 2.103 |
| | (1.634) | (1.019) | (1.107) | (0.900) | (1.329) |
| log(distance) | -0.071 | -0.087 | -0.133* | -0.189** | -0.451*** |
| | (0.104) | (0.072) | (0.057) | (0.071) | (0.099) |
| log(bilateral trade) | 0.205* | 0.279*** | 0.281*** | 0.202*** | 0.170* |
| | (0.096) | (0.077) | (0.081) | (0.054) | (0.077) |
| common border | 0.441*** | 0.095 | -0.025 | 0.050 | 0.396 |
| | (0.089) | (0.103) | (0.100) | (0.124) | (0.209) |
| euro denominated | 0.955*** | 1.587*** | 0.977*** | 1.248*** | 0.804*** |
| | (0.205) | (0.352) | (0.113) | (0.140) | (0.199) |
| log(residual maturity) | 0.024 | 0.248*** | 0.068 | 0.026 | 0.077** |
| | (0.029) | (0.059) | (0.068) | (0.062) | (0.027) |
| floating coupon | 0.493** | -0.315** | -0.093 | -0.263 | 0.629** |
| | (0.150) | (0.097) | (0.180) | (0.184) | (0.201) |
| covered bond | 0.518*** | 0.552** | 0.738*** | 0.407* | -1.032** |
| | (0.102) | (0.207) | (0.157) | (0.179) | (0.380) |
| perpetual | -0.984*** | -0.514** | -0.474* | 0.077 | -0.503 |
| | (0.287) | (0.169) | (0.192) | (0.185) | (0.263) |
| eligible collateral | 1.323*** | 0.738*** | 0.112 | 0.444** | -0.208 |
| | (0.210) | (0.204) | (0.085) | (0.167) | (0.145) |
| holder country-sector FE | | | yes | | |
| issuer country-sector FE | | | yes | | |
| R2 | | | 0.982 | | |
| Observations | | | 430679 | | |

Note: This table shows the estimation results of estimating Equation (1) using fixed effects at the holder country-sector pair level and issuer country-sector level. All coefficients are estimated in a single regression. The dependent variable is the log of sector $s$ from country $i$'s holdings in bond $a$ measured in euros. Standard errors in parentheses are corrected for heteroskedasticity and clustered at the holder country-sector level. *,** and *** denote significance at the 5%, 1% and 0.1%, respectively.

**Table 5:** Equity holdings

| | banks | insur | pfund | invfd | hhold |
|---|---|---|---|---|---|
| log(market value) | 0.898*** | 0.773*** | 1.085*** | 0.907*** | 0.688*** |
| | (0.081) | (0.062) | (0.171) | (0.069) | (0.018) |
| home | 4.074* | 0.978 | 7.272*** | 4.902** | 8.820*** |
| | (1.919) | (1.796) | (1.341) | (1.477) | (1.397) |
| log(distance) | -0.208 | -0.448*** | 0.038 | -0.184 | -0.038 |
| | (0.270) | (0.123) | (0.114) | (0.142) | (0.099) |
| log(bilateral trade) | 0.332*** | 0.171 | 0.476*** | 0.309*** | 0.338*** |
| | (0.057) | (0.096) | (0.064) | (0.060) | (0.064) |
| common border | -0.333 | 0.532* | -0.042 | 0.284 | 1.006*** |
| | (0.364) | (0.213) | (0.123) | (0.152) | (0.182) |
| euro denominated | 0.581 | 1.026*** | 0.429 | 0.413* | 0.441* |
| | (0.328) | (0.253) | (0.239) | (0.187) | (0.169) |
| pays dividend | 0.395 | 0.536*** | 0.339*** | 0.182 | 0.012 |
| | (0.245) | (0.142) | (0.057) | (0.098) | (0.057) |
| holder country-sector FE | | | yes | | |
| issuer country-sector FE | | | yes | | |
| R2 | | | 0.959 | | |
| Observations | | | 194269 | | |

Note: This table shows the estimation results of estimating Equation (1) using fixed effects at the holder country-sector pair level and issuer country-sector level. All coefficients are estimated in a single regression. The dependent variable is the log of sector $s$ from country $i$'s holdings in stock $a$ measured in euros. Standard errors in parentheses are corrected for heteroskedasticity and clustered at the holder country-sector level. *,** and *** denote significance at the 5%, 1% and 0.1%, respectively.

**Table A.1:** Comparison non-domestic asset holdings of euro area investors in SHS-S and CPIS

| | Bonds | Equities | Investment funds | Stocks+investment funds | Total |
|---|---|---|---|---|---|
| SHS-S | 6,699 | 2,101 | 1,975 | 4,076 | 10,775 |
| CPIS | 7,001 | | | 4,987 | 11,988 |
| Coverage SHS/CPIS | 96% | | | 82% | 90% |

Source: ESCB, IMF. Positions in billion euro's at market value (own calculations). *Latest available as of 6 March 2016. Note that SHS-S also covers holdings of investment funds which are not considered for further analysis in this paper. These data were included here because the CPIS does not distinguish between quoted shares and investment fund participations (all considered equity).

**Table B.1:** Cleaning steps bond and equity samples

| | Bonds | | Equities | |
|---|---|---|---|---|
| | # observations | value (EUR Bn) | # observations | value (EUR Bn) |
| Clean copy 2014Q4 (20-7-2015), only positions (LE) at market value (M) | 1,588,805 | 23,100 | 701,518 | 8,440 |
| Exclude non-euro area holders | -492,717 | -7,000 | -207,598 | -2,350 |
| Restrict holder sectors to banks, insurers, pension funds, investment funds and households | -301,647 | -1,700 | -140,170 | -1,840 |
| Restrict issuer sectors to banks, insurers, investment funds, ofi, nfc and government | -1,090 | 0 | -98 | 0 |
| Exclude Tax havens | -22,752 | -100 | -17,446 | -100 |
| Exclude short positions | -11,067 | 0 | -8,489 | 20 |
| Exclude third party holdings (except euro area households) | -36,930 | -2,100 | -23,434 | -440 |
| Exclude FDI | -18 | 0 | -142 | -60 |
| Combine functional category duplicates | -55 | 0 | 0 | 0 |
| Combine source duplicates | -1,249 | 0 | -1,057 | 0 |
| Combine ref_area duplicates | -25,960 | 0 | -48,021 | 0 |
| Drop observations if security status is not 100 | -11,750 | -100 | -6,823 | -50 |
| Exclude Ireland and Luxembourg as holder and issuer countries | -148,339 | -2,300 | -53,057 | -1,450 |
| Final sample | 535,231 | 9,800 | 195,183 | 2,170 |

Note: This table shows the cleaning steps to get from the raw data to the final sample.

**Table C.1:** Correlations between variables in the bond and equity samples

| Panel A: Bonds | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| (1) log(holdings) | 1.00 | | | | | | | | | | | |
| (2) log(market value) | 0.59 | 1.00 | | | | | | | | | | |
| (3) home | -0.20 | -0.60 | 1.00 | | | | | | | | | |
| (4) log(distance) | 0.19 | 0.61 | -0.97 | 1.00 | | | | | | | | |
| (5) log(bilateral trade) | 0.21 | 0.55 | -0.97 | 0.91 | 1.00 | | | | | | | |
| (6) common border | 0.05 | 0.08 | -0.37 | 0.22 | 0.47 | 1.00 | | | | | | |
| (7) euro denominated | -0.05 | -0.36 | 0.42 | -0.52 | -0.38 | 0.10 | 1.00 | | | | | |
| (8) log(residual maturity) | 0.30 | 0.39 | -0.32 | 0.34 | 0.29 | 0.00 | -0.25 | 1.00 | | | | |
| (9) floating coupon | 0.15 | 0.05 | 0.07 | -0.09 | -0.06 | 0.00 | 0.15 | 0.07 | 1.00 | | | |
| (10) covered bond | 0.26 | 0.32 | -0.21 | 0.20 | 0.16 | 0.07 | -0.09 | 0.14 | -0.08 | 1.00 | | |
| (11) perpetual | 0.02 | 0.08 | -0.07 | 0.06 | 0.07 | 0.03 | -0.02 | 0.27 | 0.12 | -0.05 | 1.00 | |
| (12) eligible collateral | 0.39 | 0.36 | -0.17 | 0.10 | 0.17 | 0.15 | 0.30 | 0.09 | 0.07 | 0.34 | -0.08 | 1.00 |

| Panel B: Equities | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (13) |
| (1) log(holdings) | 1.00 | | | | | | | |
| (2) log(market value) | 0.67 | 1.00 | | | | | | |
| (3) home | 0.15 | -0.07 | 1.00 | | | | | |
| (4) log(distance) | -0.19 | 0.04 | -0.85 | 1.00 | | | | |
| (5) log(bilateral trade) | -0.04 | 0.01 | -0.75 | 0.55 | 1.00 | | | |
| (6) common border | 0.09 | 0.00 | -0.07 | -0.26 | 0.23 | 1.00 | | |
| (7) euro denominated | 0.15 | 0.02 | 0.43 | -0.65 | -0.24 | 0.38 | 1.00 | |
| (13) pays dividend | 0.45 | 0.57 | -0.01 | -0.03 | -0.02 | 0.05 | 0.06 | 1.00 |

Note: This table presents the correlations between the variables for the bond holdings (panel A) and equity holdings (panel B) in the respective estimation samples.

**Table D.1:** Bond holdings 2012:Q2

| | banks | insur | pfund | invfd | hhold |
|---|---|---|---|---|---|
| log(market value) | 0.308*** | 0.127*** | 0.207** | 0.213*** | 0.444*** |
| | (0.053) | (0.021) | (0.064) | (0.034) | (0.029) |
| home | 2.730 | 1.880 | 0.376 | 0.122 | 3.100** |
| | (1.593) | (1.329) | (1.423) | (0.667) | (1.034) |
| log(distance) | -0.018 | -0.034 | -0.231*** | -0.209** | -0.328*** |
| | (0.130) | (0.109) | (0.065) | (0.075) | (0.063) |
| log(bilateral trade) | 0.132 | 0.133 | 0.088 | 0.053 | 0.175* |
| | (0.082) | (0.073) | (0.112) | (0.048) | (0.076) |
| common border | 0.509* | 0.187 | 0.010 | 0.387** | 0.309 |
| | (0.228) | (0.146) | (0.174) | (0.121) | (0.204) |
| euro denominated | 1.096*** | 2.030*** | 0.669*** | 1.192*** | 0.996*** |
| | (0.220) | (0.372) | (0.127) | (0.160) | (0.185) |
| log(residual maturity) | 0.087** | 0.154* | 0.001 | -0.065 | 0.068 |
| | (0.027) | (0.059) | (0.047) | (0.047) | (0.050) |
| floating coupon | 0.434** | -0.340* | 0.011 | -0.252 | 0.376 |
| | (0.155) | (0.141) | (0.173) | (0.137) | (0.206) |
| covered bond | | | | | |
| perpetual | -1.188*** | -0.543*** | -0.658* | -0.238 | -0.341 |
| | (0.296) | (0.136) | (0.314) | (0.164) | (0.211) |
| eligible collateral | 1.204*** | 0.913** | 0.518*** | 0.659*** | -0.188 |
| | (0.181) | (0.265) | (0.130) | (0.159) | (0.205) |
| holder country-sector FE | | | yes | | |
| issuer country-sector FE | | | yes | | |
| R2 | | | 0.981 | | |
| Observations | | | 363871 | | |

Note: This table shows the estimation results of estimating Equation (1) using fixed effects at the holder country-sector pair level and issuer country-sector level. All coefficients are estimated in a single regression. The dependent variable is the log of sector $s$ from country $i$'s holdings in bond $a$ measured in euros. Standard errors in parentheses are corrected for heteroskedasticity and clustered at the holder country-sector level. *,** and *** denote significance at the 5%, 1% and 0.1%, respectively.

**Table D.2:** Equity holdings 2012:Q2

| | banks | insur | pfund | invfd | hhold |
|---|---|---|---|---|---|
| log(market value) | 0.769*** | 0.715*** | 1.020*** | 0.896*** | 0.626*** |
| | (0.039) | (0.104) | (0.141) | (0.069) | (0.019) |
| home | -0.083 | 2.130 | 7.242*** | 4.303** | 9.335*** |
| | (1.860) | (3.041) | (1.277) | (1.399) | (1.415) |
| log(distance) | -0.399* | -0.318 | 0.027 | -0.231 | 0.041 |
| | (0.159) | (0.202) | (0.106) | (0.129) | (0.118) |
| log(bilateral trade) | 0.003 | 0.185 | 0.502*** | 0.304*** | 0.345*** |
| | (0.097) | (0.151) | (0.071) | (0.069) | (0.076) |
| common border | 0.017 | 0.506 | -0.290 | 0.141 | 0.925*** |
| | (0.132) | (0.270) | (0.145) | (0.150) | (0.220) |
| euro denominated | 0.042 | 0.702 | 0.304 | 0.218 | 0.258 |
| | (0.235) | (0.359) | (0.258) | (0.208) | (0.143) |
| pays dividend | 0.374 | 0.138 | 0.329*** | 0.199* | 0.150* |
| | (0.212) | (0.117) | (0.055) | (0.077) | (0.060) |
| holder country-sector FE | | | yes | | |
| issuer country-sector FE | | | yes | | |
| R2 | | | 0.953 | | |
| Observations | | | 178656 | | |

Note: This table shows the estimation results of estimating Equation (1) using fixed effects at the holder country-sector pair level and issuer country-sector level. All coefficients are estimated in a single regression. The dependent variable is the log of sector $s$ from country $i$'s holdings in stock $a$ measured in euros. Standard errors in parentheses are corrected for heteroskedasticity and clustered at the holder country-sector level. *,** and *** denote significance at the 5%, 1% and 0.1%, respectively.

**Table E.1:** Only domestic bond holdings

| | banks | insur | pfund | invfd | hhold |
|---|---|---|---|---|---|
| log(market value) | 0.512*** | 0.245*** | 0.138*** | 0.242*** | 0.758*** |
| | (0.075) | (0.021) | (0.015) | (0.038) | (0.046) |
| home | | | | | |
| log(distance) | | | | | |
| log(bilateral trade) | | | | | |
| common border | | | | | |
| euro denominated | 1.059*** | 0.613 | 0.894*** | 1.071*** | 1.459*** |
| | (0.293) | (0.425) | (0.103) | (0.162) | (0.225) |
| log(residual maturity) | 0.091 | 0.309*** | 0.176* | 0.042 | 0.097*** |
| | (0.076) | (0.047) | (0.083) | (0.120) | (0.015) |
| floating coupon | 0.503*** | -0.537** | -0.550*** | -0.197 | 0.321 |
| | (0.107) | (0.200) | (0.161) | (0.249) | (0.217) |
| covered bond | 0.397* | 1.088*** | 0.822*** | 0.568*** | -1.986*** |
| | (0.174) | (0.204) | (0.236) | (0.153) | (0.571) |
| perpetual | -0.718 | -0.283 | -0.477 | 0.202 | -0.711* |
| | (0.552) | (0.322) | (0.329) | (0.236) | (0.277) |
| eligible collateral | 1.546*** | 1.017*** | 0.386* | 0.503** | -0.096 |
| | (0.220) | (0.198) | (0.149) | (0.169) | (0.176) |
| holder country-sector FE | | | yes | | |
| issuer country-sector FE | | | yes | | |
| R2 | | | 0.984 | | |
| Observations | | | 182093 | | |

Note: This table shows the estimation results of estimating Equation (1) using fixed effects at the holder country-sector pair level and issuer country-sector level. All coefficients are estimated in a single regression. The dependent variable is the log of sector $s$ from country $i$'s holdings in bond $a$ measured in euros. Standard errors in parentheses are corrected for heteroskedasticity and clustered at the holder country-sector level. *,** and *** denote significance at the 5%, 1% and 0.1%, respectively.

**Table E.2:** Only foreign bond holdings

| | banks | insur | pfund | invfd | hhold |
|---|---|---|---|---|---|
| log(market value) | 0.208*** | 0.085*** | 0.123* | 0.196*** | 0.220*** |
| | (0.030) | (0.017) | (0.059) | (0.027) | (0.020) |
| home | | | | | |
| log(distance) | 0.114 | 0.058 | -0.013 | -0.042 | -0.190*** |
| | (0.105) | (0.076) | (0.058) | (0.070) | (0.055) |
| log(bilateral trade) | 0.294*** | 0.198* | 0.212* | 0.138* | 0.036 |
| | (0.079) | (0.082) | (0.099) | (0.060) | (0.076) |
| common border | 0.107 | 0.226 | 0.082 | 0.267** | 0.275* |
| | (0.117) | (0.132) | (0.154) | (0.098) | (0.109) |
| euro denominated | 1.070*** | 1.751*** | 1.057*** | 1.317*** | 0.545*** |
| | (0.245) | (0.353) | (0.099) | (0.170) | (0.138) |
| log(residual maturity) | 0.012 | 0.177** | 0.038 | 0.017 | -0.012 |
| | (0.018) | (0.054) | (0.061) | (0.054) | (0.024) |
| floating coupon | 0.611*** | -0.051 | 0.116 | -0.199 | 0.028 |
| | (0.147) | (0.094) | (0.187) | (0.232) | (0.084) |
| covered bond | 0.592*** | 0.461* | 0.730*** | 0.420* | -0.385* |
| | (0.145) | (0.187) | (0.162) | (0.165) | (0.191) |
| perpetual | -1.278*** | -0.735*** | -0.521** | 0.009 | 0.487*** |
| | (0.235) | (0.189) | (0.192) | (0.163) | (0.124) |
| eligible collateral | 0.902*** | 0.552** | 0.042 | 0.391* | 0.112 |
| | (0.145) | (0.175) | (0.082) | (0.160) | (0.215) |
| holder country-sector FE | | | yes | | |
| issuer country-sector FE | | | yes | | |
| R2 | | | 0.983 | | |
| Observations | | | 248586 | | |

Note: This table shows the estimation results of estimating Equation (1) using fixed effects at the holder country-sector pair level and issuer country-sector level. All coefficients are estimated in a single regression. The dependent variable is the log of sector $s$ from country $i$'s holdings in bond $a$ measured in euros. Standard errors in parentheses are corrected for heteroskedasticity and clustered at the holder country-sector level. *,** and *** denote significance at the 5%, 1% and 0.1%, respectively.

**Table E.3:** Only domestic equity holdings

| | banks | insur | pfund | invfd | hhold |
|---|---|---|---|---|---|
| log(market value) | 1.039*** | 1.049*** | 0.753*** | 1.013*** | 0.722*** |
| | (0.075) | (0.103) | (0.174) | (0.044) | (0.052) |
| home | | | | | |
| log(distance) | | | | | |
| log(bilateral trade) | | | | | |
| common border | | | | | |
| euro denominated | -0.329 | -0.257 | -1.734 | 1.823* | 2.005** |
| | (0.501) | (0.488) | (1.133) | (0.772) | (0.729) |
| pays dividend | -0.072 | 0.494* | 0.475* | 0.073 | 0.237 |
| | (0.156) | (0.216) | (0.215) | (0.118) | (0.249) |
| holder country-sector FE | | | yes | | |
| issuer country-sector FE | | | yes | | |
| R2 | | | 0.974 | | |
| Observations | | | 9136 | | |

Note: This table shows the estimation results of estimating Equation (1) using fixed effects at the holder country-sector pair level and issuer country-sector level. All coefficients are estimated in a single regression. The dependent variable is the log of sector $s$ from country $i$'s holdings in stock $a$ measured in euros. Standard errors in parentheses are corrected for heteroskedasticity and clustered at the holder country-sector level. *,** and *** denote significance at the 5%, 1% and 0.1%, respectively.

**Table E.4:** Only foreign equity holdings

| | banks | insur | pfund | invfd | hhold |
|---|---|---|---|---|---|
| log(market value) | 0.885*** | 0.709*** | 1.122*** | 0.905*** | 0.687*** |
| | (0.084) | (0.061) | (0.172) | (0.075) | (0.018) |
| home | | | | | |
| log(distance) | -0.149 | -0.385** | 0.090 | -0.117 | 0.034 |
| | (0.277) | (0.139) | (0.124) | (0.149) | (0.109) |
| log(bilateral trade) | 0.430*** | 0.262 | 0.542*** | 0.384*** | 0.429*** |
| | (0.069) | (0.145) | (0.076) | (0.064) | (0.069) |
| common border | -0.415 | 0.481* | -0.088 | 0.250 | 0.950*** |
| | (0.390) | (0.222) | (0.115) | (0.178) | (0.190) |
| euro denominated | 0.746* | 1.129*** | 0.553** | 0.506** | 0.496** |
| | (0.329) | (0.230) | (0.203) | (0.176) | (0.148) |
| pays dividend | 0.390 | 0.485*** | 0.326*** | 0.187 | 0.002 |
| | (0.253) | (0.131) | (0.056) | (0.098) | (0.059) |
| holder country-sector FE | | | yes | | |
| issuer country-sector FE | | | yes | | |
| R2 | | | 0.958 | | |
| Observations | | | 185133 | | |

Note: This table shows the estimation results of estimating Equation (1) using fixed effects at the holder country-sector pair level and issuer country-sector level. All coefficients are estimated in a single regression. The dependent variable is the log of sector $s$ from country $i$'s holdings in stock $a$ measured in euros. Standard errors in parentheses are corrected for heteroskedasticity and clustered at the holder country-sector level. *,** and *** denote significance at the 5%, 1% and 0.1%, respectively.

**Table F.1:** All bonds except sovereign bond holdings

| | banks | insur | pfund | invfd | hhold |
|---|---|---|---|---|---|
| log(market value) | 0.451*** | 0.399*** | 0.271*** | 0.401*** | 0.649*** |
| | (0.083) | (0.078) | (0.073) | (0.077) | (0.089) |
| home | 2.814 | 2.454 | 3.526*** | 2.542** | 2.549 |
| | (1.617) | (1.266) | (0.990) | (0.960) | (1.532) |
| log(distance) | -0.040 | -0.116 | -0.033 | -0.125 | -0.469*** |
| | (0.093) | (0.075) | (0.069) | (0.079) | (0.104) |
| log(bilateral trade) | 0.152 | 0.252* | 0.304*** | 0.235*** | 0.207* |
| | (0.105) | (0.096) | (0.063) | (0.053) | (0.089) |
| common border | 0.690*** | 0.134 | -0.040 | 0.119 | 0.414* |
| | (0.153) | (0.112) | (0.088) | (0.148) | (0.200) |
| euro denominated | 1.155*** | 1.803*** | 1.146*** | 1.338*** | 0.949*** |
| | (0.211) | (0.393) | (0.089) | (0.174) | (0.210) |
| log(residual maturity) | -0.011 | 0.244*** | 0.037 | -0.005 | 0.041 |
| | (0.041) | (0.067) | (0.083) | (0.077) | (0.028) |
| floating coupon | 0.596** | -0.090 | -0.067 | -0.117 | 0.574** |
| | (0.186) | (0.122) | (0.152) | (0.168) | (0.183) |
| covered bond | 0.500*** | 0.300 | 0.024 | 0.008 | -1.121** |
| | (0.078) | (0.275) | (0.273) | (0.218) | (0.353) |
| perpetual | -1.193*** | -0.895*** | -0.512* | -0.093 | -0.550* |
| | (0.233) | (0.200) | (0.217) | (0.210) | (0.247) |
| eligible collateral | 0.913*** | 0.257* | -0.063 | 0.169 | -0.494** |
| | (0.237) | (0.121) | (0.067) | (0.120) | (0.178) |
| holder country-sector FE | | | yes | | |
| issuer country-sector FE | | | yes | | |
| R2 | | | 0.983 | | |
| Observations | | | 378413 | | |

Note: This table shows the estimation results of estimating Equation (1) using fixed effects at the holder country-sector pair level and issuer country-sector level. All coefficients are estimated in a single regression. The dependent variable is the log of sector $s$ from country $i$'s holdings in bond $a$ measured in euros. Standard errors in parentheses are corrected for heteroskedasticity and clustered at the holder country-sector level. *,** and *** denote significance at the 5%, 1% and 0.1%, respectively.

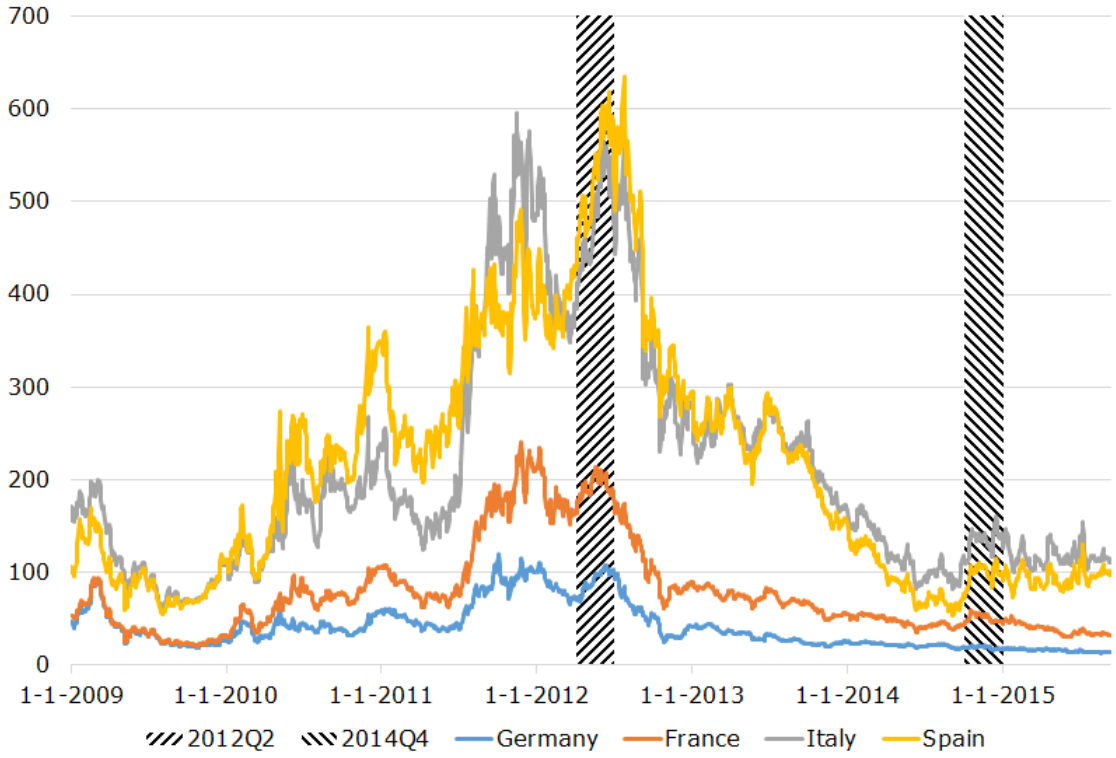


**Figure 1:** CDS spreads European sovereign bonds 2009Q1-2016Q1

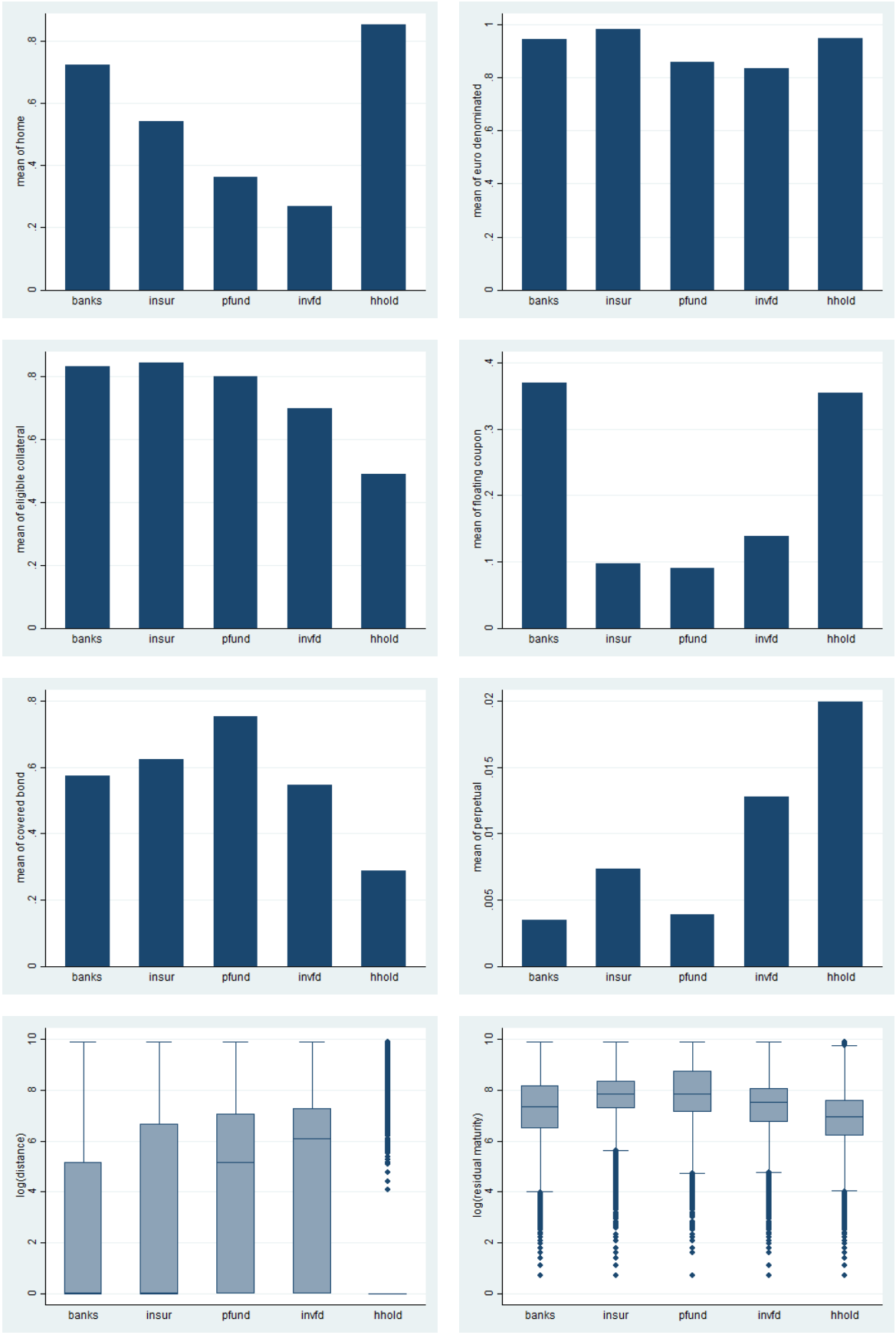


**Figure 2:** Sector heterogeneity bond holdings

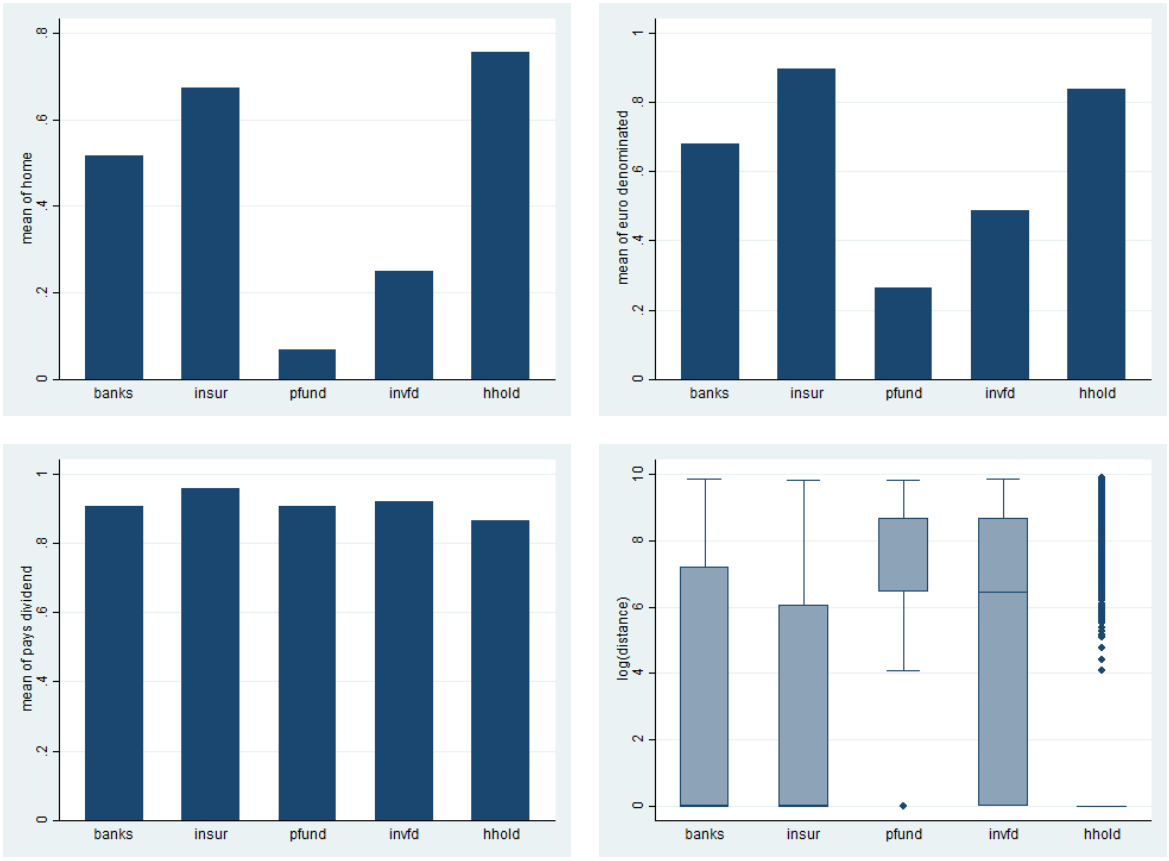


**Figure 3:** Sector heterogeneity stock holdings

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