International Portfolio Rebalancing under the Microscope – Evidence from the ECB's Asset Purchase Programme*

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Abstract

We analyse euro area investors' portfolio rebalancing during the ECB's Public Sector Asset Purchase Programme (PSPP) at the security level. Using data on net purchases and net sales of domestic and foreign debt securities, we can observe actual capital flows data into individual securities, cleaned from valuation effects. Our descriptive evidence shows that euro area investors have adjusted their portfolios of debt securities in response to the ECB's PSPP by selling both euro area sovereign and non-sovereign debt instrument, while rebalancing into extra-euro area non-sovereign and sovereign debt securities. Euro area investors mostly sold those debt securities issued in their country of residence, thereby reducing the 'home bias'. This pattern was most pronounced for the euro area banking sector, while mutual funds were the largest net buyers of debt securities issued outside the euro area. The overall rebalancing patterns evolved in line with bilateral international trade, thereby confirming the validity of gravity-type models in explaining international capital flows. The gravity-type regression analysis shows evidence for a 'reversion-to-the-mean-effect' in net transactions of individual debt securities over the PSPP period, indicating that euro area investors rebalanced disproportionately away from those securities of which the pre-PSSP holdings were the largest. Marked differences across sectors appear in our analysis, suggesting that the PSPP has induced heterogeneous portfolio shifts across sectors. In particular, the preference for net purchases of euro denominated securities differed across sectors, with insurance companies and mutual funds showing a continued preference for euro, while non-financial corporations and households rebalanced significantly away from euro-denominated securities.

Keywords: International Investment Patterns, Capital Flows, Sovereign Debt, Investor Heterogeneity, Quantitative Easing

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1 Introduction

Large scale asset purchase programmes (LSAPs) have become an increasingly popular tool of unconventional monetary policy since the Global Financial Crisis. One of the transmission mechanisms of these measures to the real economy is portfolio rebalancing, induced by a decrease in long-term bond yields leading market participants to change their investment patterns. This can happen as investors (i) search for higher yields or (ii) as they record an increase in capital and/or liquidity, especially when they held assets eligible to be bought under such a programme. According to estimates by the ECB (2017a), its unconventional monetary policy measures have contributed to reducing euro area long-term risk-free rates by around 80 basis points since June 2014. In an integrated financial system, this will not only affect domestic investment decisions but also international capital flows and their determinants. While static investment behavior and phenomenons, such as the home bias, have been studied extensively (see e.g. Lewis (1999)), dynamics and determinants over time have gained less attention. Existing empirical evidence analyses financial market aspects such as return chasing (Bohn and Tesar (1996)) and the effects of information asymmetries (e.g. Brennan and Cao (1997)) on international portfolio flows. However, these studies use macro data which - when looking at the effects of monetary policy - could be plagued by omitted variable biases. To the best of our knowledge, the literature on portfolio rebalancing using microdata is rather scarce. Calvet et al. (2008) use Swedish data to examine portfolio rebalancing of households where they find that especially educated and wealthy households are more likely to sell securities after asset prices increased. Using quarterly fund holdings for over 8000 internationally invested equity funds, Hau et al. (2017) show how differential returns on the foreign and domestic proportion of their portfolios determine the rebalancing behavior and capital flows. The authors find that institutional investors managing international equity portfolios repatriate capital after making an excess return on their foreign portfolio share relative to their domestic equity investment.
Our paper also contributes to the literature on transmission channels of quantitative easing adopted by policy makers around the world.

Analysing the international dimension of the FED's LSAPs, Neely (2010) show that the Fed's QE significantly reduced not only domestic yields but also long-term foreign bond yields. Using panel data from a broad array of EMEs, Moore et al. (2013) analyse international capital flows and show that the reduction in long-term U.S. Treasury yields during the LSAPs resulted in a significant increase in the foreign ownership share of emerging market debt. Rogers et al. (2014) compare unconventional monetary policies across countries and show their effectiveness in easing financial conditions by reducing term premia when policy rates are haltered at the zero lower bound.

Evidence of portfolio rebalancing as an effect of the ECB's Asset Purchases Programme (APP) and its main component the Public Sector Purchases Programme (PSPP) is more sparse although the program has been shown to impact asset prices sizeably and persistently (Altavilla et al. (2015), Andrade et al. (2016), and Fratzscher et al. (2016)). Albertazzi et al. (2016) find that this transmission channel has only been an active in those euro area economies which were more affected by the crisis, as wealth effects from higher asset prices translated into increased lending activity. Examining the impact of monetary policy surprises associated with the ECB's APP Bubeck et al. (2017) consider high-frequency evidence on the investment behaviour of mutual funds based in Luxembourg. They distinguish between an active channel

(daily capital flows) and an passive channel (changes in the value), of which they found only the latter to be a significant driver of portfolio rebalancing. Koijen et al. (2016) find that non euro-area investors rather than domestic institutions sold most of the government bonds eligible under the ECB's APP. They suggest that this is due to the fact that euro area investors have less elastic demand for euro-area bonds than foreign investors. However, Coeure (2017) points out that euro area investors have been a major driving force of net capital outflows from the euro area since the start of the APP. The fact that these have been concentrated in purchases of foreign long-term debt securities suggests that domestic investors rebalanced their portfolios towards the closest substitute to APP eligible assets outside the euro area. Our paper contributes to this literature in several ways. First, our paper analyses uniquely – to the best of our knowledge – actual capital flows (i.e. net purchases or net sales) at the security level in a gravity model setting. While Boermans and Vermeulen (2016) use the same data source, they focus on the determinants of positions in securities, rather than flows. As such, we observe the determinants of international portfolio investment dynamics rather than in the static dimension. Secondly, by using an augmented gravity model at the security-by-security level, our approach encompasses both the international investment patterns literature as well as elements from the finance literature on portfolio reallocations. Third, our data source reports the holdings of the main economic sectors in all euro area countries, rather than singling out investment funds or the household sector. Exploiting this allows for examining heterogeneity among investors along various dimensions such as country of residence, sector etc. We argue that it is crucial to consider sectoral heterogeneity, especially when analyzing the PSPP. ECB (2017b) shows that prior to the start of the program, three sectors held almost three-quarters of all debt securities issued by euro area governments, namely foreign investors, banks, and insurance companies and pension funds. Naturally, large purchases of these securities will affect these investors more directly. Finally, using security-by-security data are study is less plagued by endogeneity concerns than previous studies using more aggregated data.

We find that euro area investors have adjusted their portfolios of debt securities in response to the ECB's PSPP by selling both euro area sovereign and non-sovereign debt instrument, while rebalancing into extra-euro area non-sovereign and sovereign debt securities. Euro area investors mostly sold those debt securities issued in their country of residence, thereby reducing the 'home bias'. This patterns was most pronounced for the euro area banking sector, while mutual funds were the largest net buyers of debt securities issued outside the euro area. The overall rebalancing patterns evolved in line with the patterns observed for bilateral international trade, thereby confirming the validity of gravity- type models in explaining international capital flows. The gravity-type regression analysis shows evidence for a 'reversion-to-the-mean-effect' in net transactions of individual debt securities over the PSPP period, indicating that euro area investors rebalanced disproportionately away from those securities of which the pre-PSSP holdings were the largest. Marked differences across sectors appear in our analysis, suggesting that the PSPP has induced heterogeneous portfolio shifts across sectors. In particular, the preference for net purchases of euro denominated securities differs markedly across sectors, with insurance companies and mutual funds showing a continued preference for euro, while non-financial corporations and households rebalanced significantly away from euro-denominated securities.

The rest of the paper is organized as follows: In Section 2, we explain the empirical framework, our dataset, and the empirical strategy. We provide extensive descriptive evidence on the (international)

portfolio rebalancing of euro area investors since the launch of the PSPP in Section 3, Section 4 shows our results which we test for robustness in Section 5. Finally, Section 6 concludes.

2 Empirical Framework

2.1 Data

We use data on security-level portfolio holdings of all 19 Member States of the euro area from the Eurosystem's Sectoral Securities Holding Statistics (SSHS) where each security is identified by a unique International Securities Identification Number (ISIN). The data are collected on a quarterly basis since 2013Q4 and we use all releases until 2016Q4 for this analysis. Investors in the data are defined by their country of domicile and the sector. We follow the European System of Accounts (1995) and aggregate the data to six sectors: monetary and financial institutions (MFI)[1], insurance companies and pension funds (ICPF), other financial institutions (OFI)[2], non-financial corporations (NFCs), general government, and households. At the end of our sample in 2016Q4, total holdings added up to 28.3 trillion EUR. Thanks to the unique ISIN number for every security, we can merge the holdings data to individual asset characteristics. For this, we use the ESCB's Centralised Securities Database (CSDB) which contains information on more than six million debt and equity securities issued globally.[3]

2.2 Empirical strategy

Our analysis is based on an augmented gravity model following Portes and Rey (2005) and subsequent research explaining international investment positions (Lane and Milesi-Ferretti (2008)). However, the granularity of the security-level data allows us to deviate from earlier studies on international investment positions. Formally, we specify the following model:

$$ln(Sec_{a,h,s}) = \beta_s^1 * x_a^1 + ... + \beta_s^k * x_a^k + \gamma_s^1 * z_{h,a}^1 + ... + \gamma_s^b * z_{h,a}^b + hsc_{h,s} + isc_a + \epsilon_{a,h,s} \quad (1)$$

where $ln(Sec_{a,h,s})$ represents (i) the ln of the amount held of security a by holder country h in holding sector s in 2014Q4 before APP or (ii) the ln of the cumulative sum of net transactions (i.e. net sales or purchases) during the PSPP period (2014Q4-2016Q4).[4] We argue that it is crucial to look at the actual transactions rather than the change in holdings to truly capture active portfolio rebalancing rather than passive investment changes, such as valuation effects stemming from prices or the exchange rate. These pre-APP holdings and the sum of transactions during APP are explained by k asset specific characteristics (x_a^1, ..., x_a^k) and b bilateral characteristics of the country of the holder and the country where asset a is issued ($z_{h,a}^1$,...,$z_{h,a}^b$). Finally, we saturate our regression with fixed effects that capture unobserved holder sector-country characteristics ($hsc_{h,s}$) and unobserved issuer sector-country characteristics (isc_a). The

[1] We will refer to them as banks in parts of the paper.

[2] This includes important intermediaries such as mutual funds which represent the largest subgroup of this sector

[3] We obtain these data by the ESCB who merge data from both public and commercial sources.

[4] If the sum of net transactions from 2014Q4 - 2016Q4 is negative, we take the ln of the absolute value of the sum and multiply it with -1 to indicate net sales.

purpose is to capture financial frictions or multilateral resistance which differs across countries but also between holder and issuer sectors. In order to assess the heterogeneity between different groups, we allow the coefficients in (β_s^1,...,β_s^k) to differ by different dimensions: countries, sectors, and country groups. The advantage of this method is that we are able to infer statistical differences between coefficients estimating the coefficients for all of these groups as we are estimating everything in a single regression.

Regarding the asset-specific characteristics, we include the currency denomination (binary variable for euro-denomination), the remaining maturity, and the amount outstanding. With the latter, we test whether investors hold the market-portfolio which should be the case when investors have identical preferences under the assumptions that there are no financial frictions and all assets are priced efficiently. This benchmark gives us an important indication of the extent to which investors follow the predictions from the CAPM in which case the estimated coefficient should equal to unity. Furthermore, we also control for the pre-PSPP holdings of an individual security, following Galstyan and Lane (2013) who find a "reversion to the mean" effect in bilateral portfolio investment patterns during the Global Financial Crisis as cross-border positions were reduced most where pre-crisis bilateral holdings were the largest.

For our gravity model, we use control variables commonly used in the international portfolio allocation literature. Data on the distance between the country of the investor and issuer is derived from the CEPII database. In order to include the effect of trade flows on international portfolio allocations, we obtain bilateral trade data from the IMF's Direction of Trade Statistics. Finally, we include an index capturing the similarity of two countries' languages from Melitz and Toubal (2014). These bilateral variables measure the extent of information asymmetries between two countries (Aviat and Coeurdacier (2007),Okawa and van Wincoop (2012)).

Our base unit of observation is therefore the country-sector combination for each of the 19 member states of the euro area. For the regressions, we exclude Ireland and Luxembourg from the analysis due to the large intermediation role of the financial sector, in particular mutual funds. Results including these financial centres can be found in our robustness tests.

In all regressions besides the country level regression, we cluster the standard errors by holding country*sector pairs and we indicate only 5%, 1% and 0.1% significance level with asterisks in the regression tables.

3 Descriptive evidence on portfolio rebalancing of euro area investors since the launch of the PSPP

In this section, we shed light on investment patterns of euro area investors in terms of debt securities before the launch of the PSPP as well as the dynamics observed during the first two years of the programme. Figure 1 shows that before the start of the PSPP, debt holdings of euro area countries were concentrated mainly in euro area non-sovereign and PSPP-eligible debt securities (i.e. those issued by the sovereign sector in the euro area) and – albeit to a lesser extent – in foreign non-sovereign debt securities. Figure 2 extends this analysis with a breakdown for these categories by country. What stands out is the variation in holdings of PSPP-eligible assets which varies from around 10 to over 60 % of a country's debt portfolio. Financial centers (Luxembourg and Ireland) hold the least eligible assets which is offset by the largest

foreign non sovereign holdings. In Figure 5, we can see this breakdown by sector. Before the APP, insurance companies and pension funds held the largest share of PSPP-eligible debt relative to their total debt portfolio, followed by mutual funds and banks. In contrast, most of the households' debt securities was concentrated in non-sovereign holdings within the euro area.

In contrast to the stock positions in the last graphs, Figure 4 shows the overall net debt transactions by issuer-type which took place throughout the PSPP period (2014Q4 - 2016Q4). We can see that euro area investors have adjusted their debt portfolios by selling both euro area non-sovereign and PSPP-eligible debt instrument, which have been mainly replaced – in terms of volume – by foreign non-sovereign and foreign sovereign debt. Thus, euro area investors did not only rebalance away from those securities eligible to be bought by the ECB, but also from those issued by non-sovereign euro area entities. This finding aligns with a portfolio rebalancing hypothesis as not just securities directly targeted but yields of euro area securities decreased in general after the start of APP. A further breakdown of holders by euro area countries (Figure 2 and sectors (Figure 5) shows that overall net sales of euro area non-sovereign debt is driven by Italian investors, while the net sales of PSPP-eligible are largest for Spain. We also observe this pattern for Germany, France, and the Netherlands. The sectoral breakdown shows in Figure 6 that banks, but also households were the primary net sellers of PSPP eligible and euro area non-sovereign debt. ICPFs show net purchases for all of these asset groups while mutual funds (OFIs) strongly rebalanced their investment from PSPP eligible assets to foreign assets. Analyzing this stylized fact in combination with the findings from the previous graph (Figure 2), we can suggest that this pattern was driven by the financial centers in Luxembourg and Ireland.

Starting in Figure 7, we analyse what is commonly referred to as the "home bias". In the following graphs, we simply depict the amount of domestically held debt as Home.[5] We start by showing the portfolio before the PSPP and notice that the vast majority of euro area debt securities are held domestically. The remaining securities are almost equally spread across foreign and other euro area country holders. The next Figure 8 shows this same breakdown by country. Besides the financial centers Ireland and Luxembourg, the highest relative exposures to foreign debt holdings are recorded in Greece, Finland, Malta and Estonia. In line with previous literature, southern euro area countries (Spain, Italy and Portugal) hold a higher share of domestic and euro area debt and very limited exposures to foreign debt markets. Looking at the heterogeneity by sectors, we note that the largest relative share of euro area debt is held by households, which –at the same time– hold the smallest share of foreign debt. The reverse picture is observed for OFIs, which hold the highest relative share of foreign debt and the lowest share of domestic debt.

We also analyse whether we can see a continuation of this pattern during the PSPP. Figure 10 shows the transaction dynamics generated by portfolio rebalancing of each euro area economy after 2014Q4. We can roughly divide countries into net debt acquirers (e.g. Ireland, Luxembourg) and net debt sellers (mainly the Netherlands, Italy, Spain, Germany, Belgium). When looking at transaction volumes of domestic debt, Italy, Germany, Spain, France and the Netherlands are the largest sellers. These debt securities seem to be only partially absorbed by other euro area member states, such as Spain, Ireland,

[5] We are aware that other empirical analyses often use more complex calculations, such as the deviation from the market portfolio, as the home bias. However, the idea of these graphs is just to give a simple idea of what share of debt is domestically held.

Italy and Luxembourg. We also notice a substantial net increase in foreign debt holdings, especially in the financial centers Ireland, Luxembourg, but also in Germany, France, and Italy. Among the countries with significant net transactions, we notice a common trend: the reduction of home debt holdings balanced by purchases of foreign debt holdings. In addition, Spain, Italy, and Ireland also show net acquisition of debt from other euro area countries, even when to a smaller extent. The breakdown by sectors emphasises the heterogeneity between the sectors in our sample. Banks sell the largest volume of domestic debt, but purchase foreign debt, while households sell all types debt securities. ICPFs show net purchases for all categories, while mutual funds concentrated net purchases in foreign securities.

As a last step, we look at the currency denomination of debt securities held in 2014q4 and 2016q4 in Table 1. We can see that holdings in EUR decreased, which was balanced by an increase in holdings in USD and also to a smaller extend in GBP. As all of our holdings are recorded in EUR, this can be due to two developments: net purchases of these assets or an appreciation in the respective foreign currency. Therefore, we look at Figure 12 where we see that it is the former: euro area investors actively sold significant amount of EUR denominated assets, while we find net purchases of securities denominated in USD and the GBP.

4 Rebalancing under the microscope: empirical results

4.1 The overall picture

We start our empirical analysis by pooling all euro area country-sectors in an estimation of the determinants of portfolio debt holdings in the fourth quarter of 2014, thus just before the announcement of the ECB's Public Sector Purchase Programme (PSPP) in January 2015 (Table 2). The estimated coefficients for the 'macro' bilateral characteristics are consistent with the gravity model literature on international investment positions, i.e. physical distance exhibits a negative coefficient, while bilateral trade is positively linked to holdings of debt securities.[6] As our dataset includes euro area investors' security holdings of both domestic (i.e. the country of residence of the investor) and foreign securities, we can estimate the 'home bias' in a very clean way and find significant evidence of this phenomenon for euro area investors (in line with Fidora et al., 2007). Exploiting the 'micro'-dimensions of our dataset, we observe that the level of holdings of an individual debt security is significantly positively correlated with the total amount outstanding (in market value terms) of this security. However, the estimated coefficient of around 0.4 is substantially below the predictions of CAPM-type models, which may be partly due to high substitutability of individual bonds (Boermans and Vermeulen, 2016). Moreover, there is significant evidence for the preference of euro area investors for holding euro-denominated bonds and bonds with a longer residual maturity.

Second, we explore to what extent these empirical regularities apply for transactions, i.e. net purchases or net sales of individual debt securities over the PSPP period 2014Q4 to 2016Q4. Our findings indicate a 'reversion-to-the-mean-effect', as euro area investors rebalanced disproportionately away from (into) those securities of which the pre-PSSP holdings were the largest (smallest), in line with the findings of Galstyan and Lane (2013) for the global financial crisis retrenchment in bilateral portfolio holdings. Moreover, euro

[6] Language similarity between country pairs is not significant in our model.

area investors net transactions are positively linked to changes in the amounts outstanding of a security, with a coefficient of around 0.5. The home bias in net transactions during the PSPP period is even larger than observed for pre-PSPP holdings, while among the gravity-type variables we find a positive link with bilateral trade levels during the PSPP period, while the other variables fail to be significant.

4.2 Is there evidence of heterogeneity across sectors?

We re-estimate our analysis presented in the previous sub-section, but now allow for heterogeneity across sectors, in line with the approach of Boermans and Vermeulen (2016). All coefficients are estimated in a single regression and the columns in Table 3 represent the estimates for each holding sector. Starting with the estimates for the pre-PSPP period (2014Q4), all sectors exhibit a significant link to amounts outstanding of a security (which is most pronounced for the household sector) and bilateral trade as well as a home bias (the latter two are strongest for MFIs). Bilateral distance is not significant for MFIs and ICPFs, but has the strongest negative impact for NFCs' and households' holdings of securities, potentially due to the larger cost associated with acquiring information about foreign investment opportunities for this sector, which is also confirmed by the significant positive role of linguistic similarity for these sectors. The preference for holding euro-denominated securities is most pronounced for ICPFs and MFIs, while ICPFs also have the strongest preference for bonds with a longer residual maturity. The latter result is likely driven by the the desire of insurance companies and pension funds to match the maturity profile of theirassets holdings with their long-term liabilities.

Turning to the rebalancing observed during the PSPP period, marked difference across sectors appear, suggesting that the PSPP and has induced heterogeneous portfolio shifts across sectors. In particular, the preference for net purchases of euro denominated securities differs markedly across sectors, with ICPFs and OFIs showing a continued preference for euro, while NFCs and in particular households rebalanced significantly away from euro-denominated securities, ceteris paribus. The 'reversion-to-the-mean' effect is found for all sectors and particularly pronounced for OFIs and households.The home bias is estimated to be the largest for banks and households, while it is not relevant for net purchases of NFCs. The positive link between net purchases of securities and trade is most pronounced for banks, suggesting that trade-financial linkages of the banking sector were an important factor in driving banks investment decisions over the PSPP period.

4.3 Do stressed and non-stressed euro area countries differ?

Next, we consider potential differences in the investment patterns of investors from the (formerly) stressed euro area countries (Cyprus, Greece, Italy, Portugal and Spain) compared with those of the other euro area countries (Table 4).[7] In terms of the pre-PSPP holdings, a significant home bias is only found for the non-stressed euro area countries, defying conventional wisdom that domestic investors in stressed countries seem to be overly exposed to domestically issued debt securities. Geographic distance has a somewhat more detrimental effect for stressed countries – for which also language similarity matters – suggesting that investors in these countries rather exhibit a 'familiarity' and 'proximity' bias, than a

[7] Please note that we continue to exclude Ireland and Luxembourg from the analysis due to the large intermediation role of the financial sector, in particular mutual funds.

home bias. The preference for euro-denominated securities and those with a longer residual maturity is somewhat stronger for non-stressed countries, which is likely due to the structure of the investor base in these countries.

Examining potential differences among stressed and non-stressed countries during the PSPP period, a somewhat stronger 'reversion to the mean' effect is found for stressed countries, while the home bias continues to be significant only for non-stressed countries. Among the gravity-type variables, only bilateral trade matters significantly, which is more pronounced for non-stressed countries. Interestingly, stressed country investors show a significant preference for securities with a longer residual maturity, which may indicate some catching-up towards the maturity profile of non-stressed countries.

4.4 Are there differences across euro area countries?

Motivated by the difference between stressed and non-stressed countries, we re-estimate our model by including the euro area countries individually in the joint estimation (Table 5). For the pre-PSPP period, it stands out that the home bias is largest for investors from France, while it is the lowest for Italian investors, who are however most strongly affected by distance and linguistic similarity. Trade ties matters most for investors from France and least for Italian investors, ceteris paribus. The preference for euro-denominated securities is largest for German and Italian investors, who also have – along with the Netherlands – the most pronounced preference for securities with a longer residual maturity.

During the PSPP period (Table 6), a significant home bias in net purchases is visible for Slovakia, Spain, Greece and Germany, while for the Netherlands there is evidence of a significant foreign bias. The largest negative distance effects are found for net purchases of Finnish, and Portuguese investors, while French investors' net purchases even increase with distance. Country heterogeneity is quite pronounced in terms of preference for euro-denomination, with German and French investors having a preference for foreign currency, while Spanish, Finnish and Dutch investors continue to prefer euros. For all countries, we find evidence for holding preferably bonds with a longer maturity, possibly reflecting the low yield environment. This is particularly pronounced for Finnish and Slovenian investors.

5 Robustness

We conduct a host of robustness and sensitivity checks, in terms of the coverage of our sample. For the sake of brevity, we report variants of our overall benchmark regression (Table 2), focusing on pre-PSPP (i.e. for 2014Q4) holdings of debt securities (reported again in column I of Table 7).

In column II, we only include holdings of foreign securities (i.e. those issued outside the investors' country of residence), thereby cutting the sample size by around 40% and dropping the home bias variable. The results indicate a continued, but less pronounced role for physical distance, while language similarity becomes significant and trade turns insignificant. The residual maturity becomes insignificant once domestic securities are exclude.

Next, we also drop those securities that were issued by other euro area countries (column III), which renders bilateral trade linkages significant and leads to a stronger preference for euro-denominated securities.

Next, we re-run our benchmark regressions, but exclude those debt securities issued by offshore financial centres, which leaves our main results unchanged (column IV). Then we include holdings by residents from Ireland and Luxembourg (column V), confirming our main results with the exception of the home bias – which turns insignificant – due to the prevalence of investment funds in Luxembourg and Ireland that act as gateways for investments abroad.

In column VI we exclude those euro area countries that joined the euro area after 2002, leaving our main results intact, with the exception of the home bias coefficient which turns insignificant.

6 Conclusion

We analyse euro area investors' portfolio rebalancing during the ECB's Public Sector Asset Purchase Programme (PSPP) at the security level. Using data on net purchases and net sales of domestic and foreign debt securities, we can observe actual capital flows data into individual securities, cleaned from valuation effects. Our descriptive evidence shows that euro area investors have adjusted their portfolios of debt securities in response to the ECB's PSPP by selling both euro area sovereign and non-sovereign debt instrument, while rebalancing into extra-euro area non-sovereign and sovereign debt securities. Euro area investors mostly sold those debt securities issued in their country of residence, thereby reducing the 'home bias'. This patterns was most pronounced for the euro area banking sector, while mutual funds were the largest net buyers of debt securities issued outside the euro area. The overall rebalancing patterns evolved in line with bilateral international trade, thereby confirming the validity of gravity-type models in explaining international capital flows. The gravity-type regression analysis shows evidence for a 'reversion-to-the-mean-effect' in net transactions of individual debt securities over the PSPP period, indicating that euro area investors rebalanced disproportionately away from those securities of which the pre-PSSP holdings were the largest. Our analysis reveals significant differences across sectors, suggesting that the PSPP has induced heterogeneous portfolio shifts across sectors. In particular, the preference for net purchases of euro denominated securities differed across sectors, with insurance companies and mutual funds showing a continued preference for euro denominated assets, while non-financial corporations and households rebalanced significantly away from euro-denominated securities.

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7 Figures

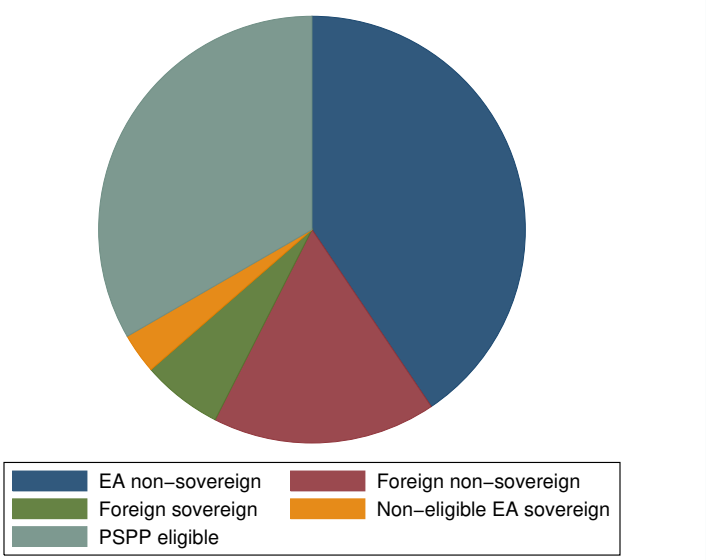

Figure 1: Debt Security Holdings of euro area countries in 2014Q4

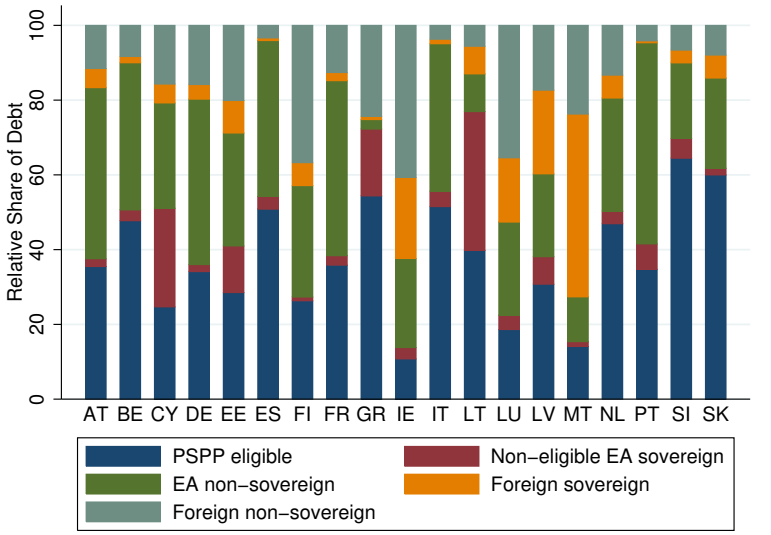

Figure 2: Debt Security Holdings by Country in 2014Q4

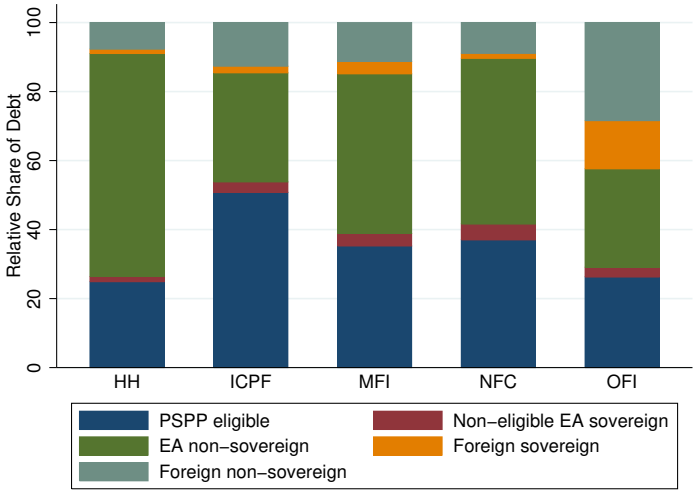

Figure 3: Debt Security Holdings by Sector in 2014Q4

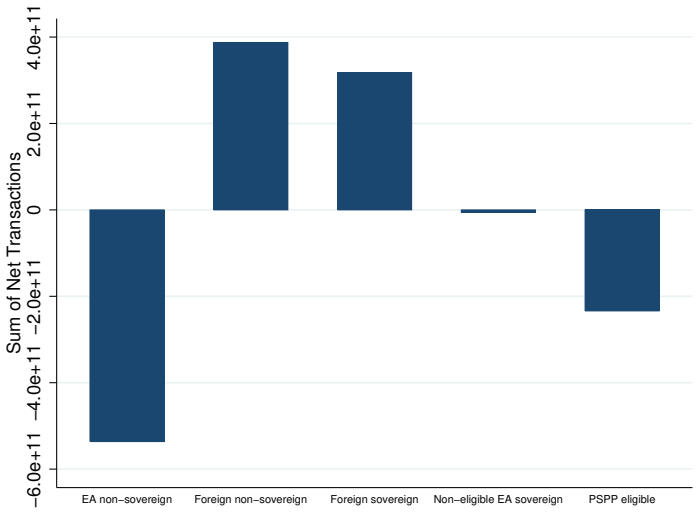

Figure 4: Contribution to Portfolio Rebalancing from 2014Q4 to 2016Q4

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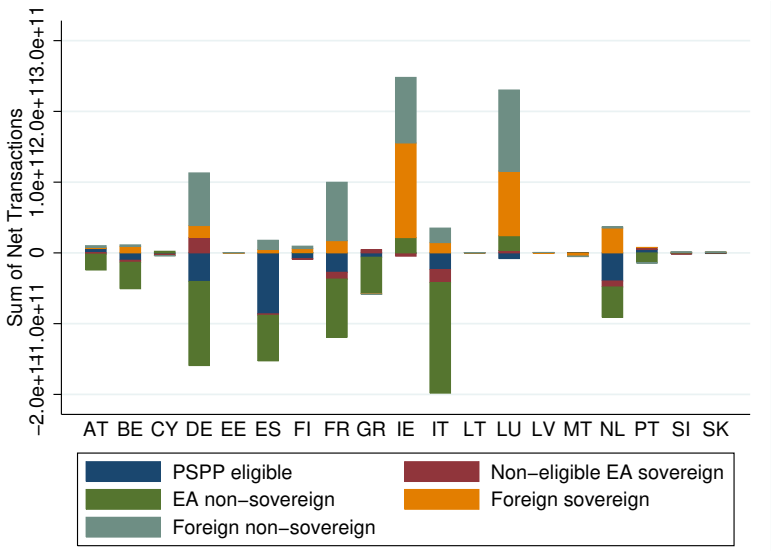

Figure 5: Contribution to Portfolio Rebalancing by Country from 2014Q4 to 2016Q4

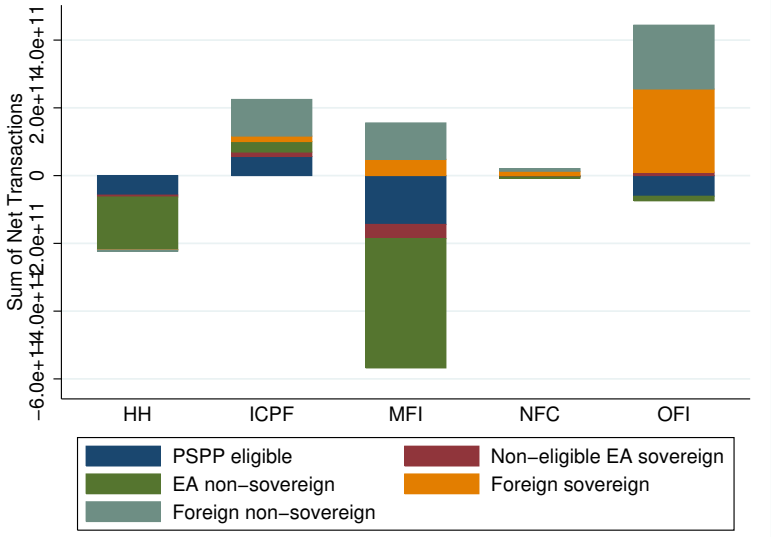

Figure 6: Contribution to Portfolio Rebalancing by Sector from 2014Q4 to 2016Q4

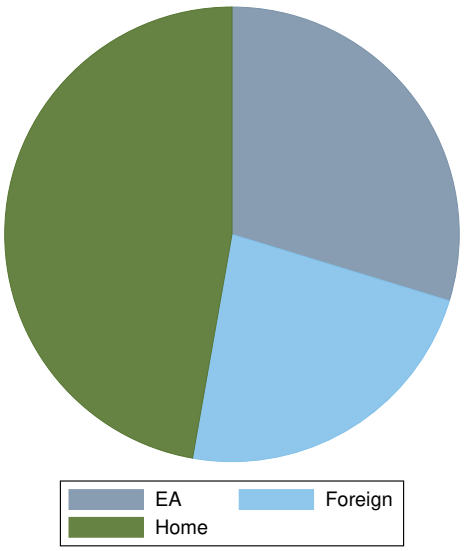

Figure 7: Debt Security Holdings in 2014Q4

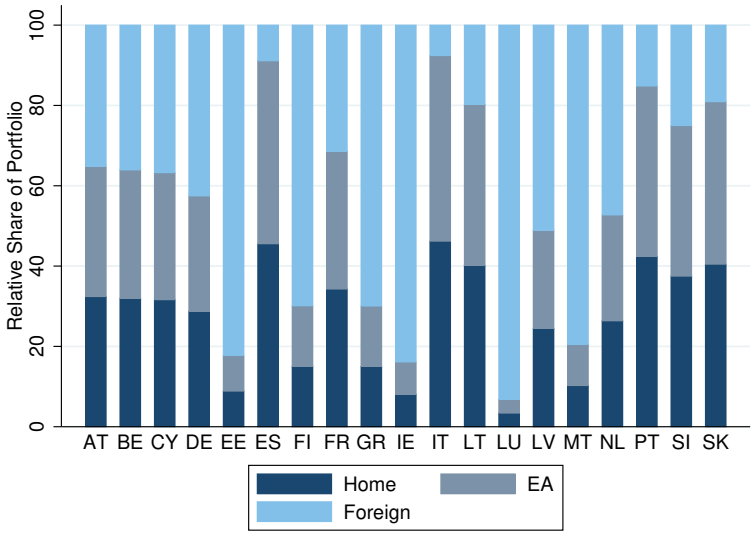

Figure 8: Debt Security Holdings by Country in 2014Q4

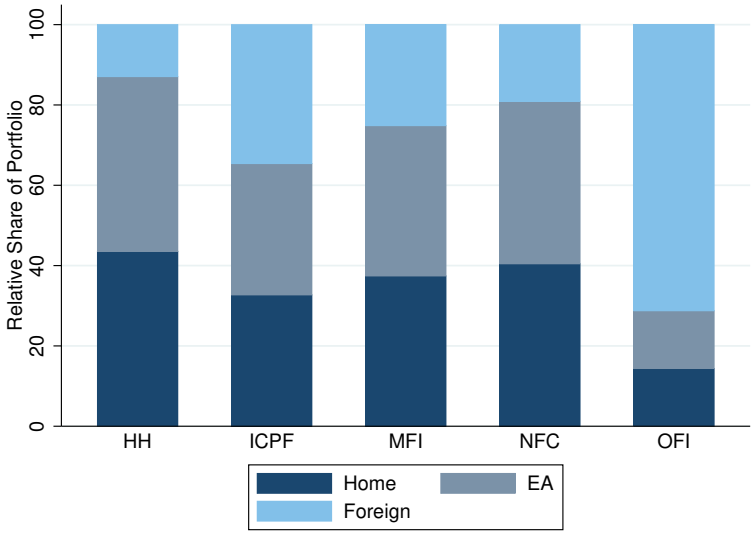

Figure 9: Debt Security Holdings by Country in 2014Q4

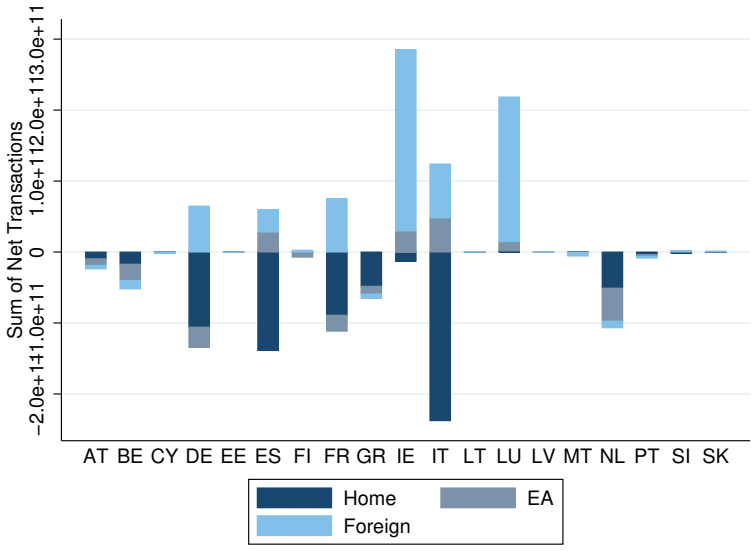

Figure 10: Contribution to Portfolio Rebalancing by Country from 2014Q4 to 2016Q4

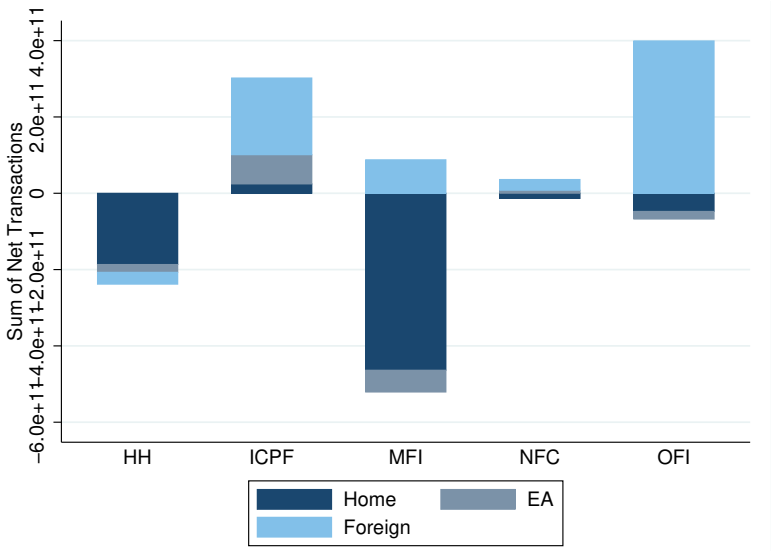

Figure 11: Contribution to Portfolio Rebalancing by Country from 2014Q4 to 2016Q4

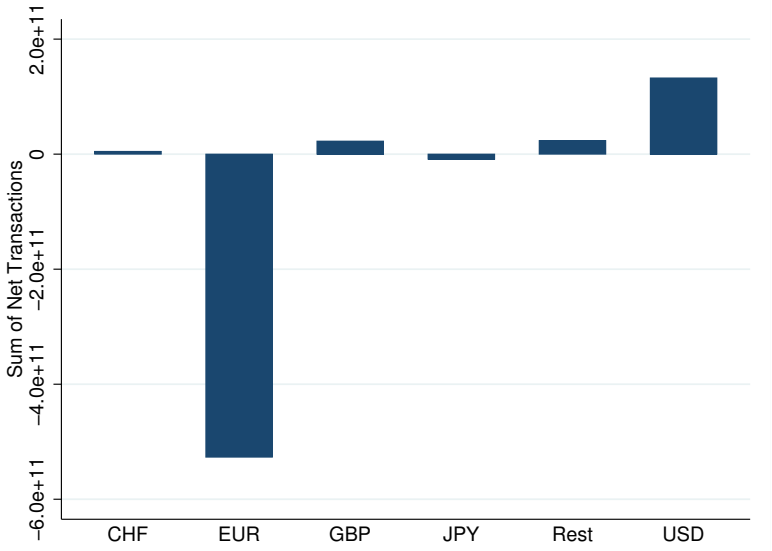

Figure 12: Contribution to Portfolio Rebalancing: Currency Denomination

8 Tables

Table 1: Currency Decomposition of Debt Securities

	Sum of Holdings in bn		Share	
Currency	2014Q4	2016Q4	2014Q4	2016Q4
EUR	12,200	11,700	84.14%	79.05%
USD	1,360	1,910	9.38%	12.91%
GBP	452	628	3.12%	4.24%
JPY	47	70	0.32%	0.47%
CHF	32	33	0.22%	0.23%
SEK	35	34	0.24%	0.23%
AUD	32	81	0.22%	0.24%
DKK	29	35	0.20%	0.24%
BRL	28	29	0.19%	0.20%
Rest	783	744	3.02%	2.63%

Table 2: Determinants of investment in debt securities

	Holding 2014Q4	Transactions 2014q4-2016q4
ln(Amount outstand)$_{2014q4}$	0.383***	
	(5.09)	
Δ ln(Amount outstand)$_{2014q4-2016q4}$		0.474***
		(15.72)
ln(Holdings)$_{2014q4}$		-0.772***
		(-16.04)
Home	9.758*	25.65***
	(1.83)	(2.93)
ln(Distance)	-0.317***	0.216
	(-2.95)	(1.23)
ln(Trade)	3.262**	7.465***
	(2.14)	(2.97)
Common Language	0.0515	-0.0869
	(0.16)	(-0.16)
EUR	1.166***	-0.180
	(10.48)	(-0.50)
ln(Residual Maturity)	0.0647***	-0.0367
	(2.94)	(-0.14)
N	530598	403083
Holder Country-Sector FE	YES	
Issuer Country-Sector FE	YES	
t statistics in parentheses		
=”* p<0.10	** p<0.05	*** p<0.01”

Table 3: Determinants of investment in debt securities across sectors

	Holding					Transactions				
	MFI	ICPF	OFI	NFC	HH	MFI	ICPF	OFI	NFC	HH
ln(Amount outstand)$_{2014q4}$	0.359***	0.177***	0.337***	0.357***	0.543***					
	(5.81)	(7.86)	(10.56)	(4.83)	(4.42)					
Δ ln(Amount outstand)$_{2014q4-2016q4}$						0.614***	0.390***	0.397***	0.465***	0.454***
						(9.07)	(9.72)	(13.22)	(21.62)	(10.44)
ln(Holdings)$_{2014q4}$						-0.644***	-0.432***	-0.868***	-0.651***	-0.861***
						(-4.84)	(-4.50)	(-8.31)	(-9.43)	(-11.67)
Home	15.48**	13.52***	9.023**	9.042**	9.477*	37.93***	19.18**	19.27**	12.75	28.71***
	(2.06)	(3.06)	(2.39)	(2.38)	(1.87)	(4.39)	(2.26)	(2.29)	(1.37)	(4.25)
ln(Distance)	-0.142	-0.112	-0.206***	-0.249***	-0.410***	0.0239	0.157	0.392**	-0.109	0.223
	(-1.47)	(-1.53)	(-3.16)	(-3.52)	(-5.02)	(0.11)	(0.85)	(2.28)	(-0.75)	(1.22)
ln(Trade)	4.620**	4.335***	3.108***	3.134***	3.164**	11.17***	5.491**	5.388**	3.880	8.537***
	(2.12)	(3.28)	(2.80)	(2.86)	(2.20)	(4.26)	(2.33)	(2.15)	(1.48)	(4.62)
Common Language	-0.532	-0.00431	-0.227	0.651**	1.535***	-1.571***	0.370	1.835*	-0.451	-0.877
	(-1.10)	(-0.03)	(-0.55)	(2.54)	(2.86)	(-2.73)	(0.63)	(1.81)	(-0.44)	(-1.50)
EUR	1.555***	1.852***	1.104***	0.845***	0.803**	0.743**	1.754**	0.279	-0.508*	-1.790***
	(6.72)	(5.87)	(6.94)	(3.86)	(2.30)	(2.38)	(2.53)	(0.50)	(-1.81)	(-5.42)
ln(Residual Maturity)	0.00315	0.144**	0.0915**	0.000561	0.0326**	0.0467	1.196***	0.621***	-0.241	-0.428
	(0.11)	(2.24)	(2.21)	(0.02)	(2.33)	(0.16)	(5.87)	(4.44)	(-0.68)	(-1.66)
N	530598					403083				
Holder Country-Sector FE	YES									
Issuer Country-Sector FE	YES									
t statistics in parentheses	** "* p<0.10,p<0.05,*** p<0.01"									

Table 4: Determinants of investment in debt securities across country groups

	Holdings 2014Q4		Transactions 2014q4-2016q4	
	Stress	Non-stress	Stress	Non-stressed
ln(Amount outstand)$_{2014q4}$	0.321***	0.399***		
	(5.11)	(4.69)		
Δ ln(Amount outstand)$_{2014q4-2016q4}$			0.476***	0.467***
			(7.69)	(15.08)
ln(Holdings)$_{2014q4}$			-0.913***	-0.734***
			(-9.72)	(-14.70)
Home	1.577	12.59**	16.09	24.62***
	(0.29)	(2.41)	(1.56)	(2.87)
ln(Distance)	-0.271***	-0.152**	-0.168	0.120
	(-3.23)	(-2.17)	(-0.56)	(0.73)
ln(Trade)	0.591	3.851**	5.512*	7.301***
	(0.36)	(2.52)	(1.86)	(2.95)
Common Language	1.033*	-0.107	0.441	-0.105
	(1.80)	(-0.31)	(0.37)	(-0.18)
EUR	1.050***	1.190***	0.227	-0.278
	(4.28)	(9.27)	(0.48)	(-0.65)
ln(Residual Maturity)	0.0388*	0.0699***	0.511***	-0.155
	(1.86)	(2.90)	(3.67)	(-0.57)
N	530598		403083	
Holder Country-Sector FE	YES			
Issuer Country-Sector FE	YES			
t statistics in parentheses	** "* p<0.10,p<0.05,*** p<0.01"			

Table 5: Determinants of debt securities holdings in 2014Q4 across countries groups

	ln(Amount outstand)$_{2014q4}$	Home	ln(Distance)	ln(Trade)	Common Language	EUR	ln(Residual Maturity)
AT	0.291***	11.63***	-0.128***	3.452***	-0.139**	0.959***	-0.00105
	(91.17)	(11.27)	(-6.35)	(11.32)	(-2.30)	(35.50)	(-0.16)
BE	0.184***	11.60***	-0.0782***	3.211***	0.0146	1.133***	0.0352***
	(45.71)	(8.79)	(-4.29)	(8.24)	(0.10)	(41.08)	(4.14)
DE	0.580***	17.09***	-0.0450***	4.866***	0.674***	1.940***	0.103***
	(378.93)	(14.65)	(-3.34)	(14.30)	(11.91)	(105.72)	(30.66)
EE	0.132***	10.44***	-0.136	3.033***	-0.887	0.219*	-0.0718**
	(6.87)	(4.64)	(-1.56)	(4.53)	(-1.28)	(1.69)	(-1.97)
ES	0.133***	15.22***	-0.0164	4.516***	0.629***	0.577***	-0.0226**
	(28.89)	(8.90)	(-0.43)	(9.29)	(4.90)	(11.03)	(-2.00)
FI	0.379***	14.78***	-0.271***	4.705***	-1.171***	0.689***	-0.0619***
	(50.31)	(11.10)	(-7.09)	(12.32)	(-2.87)	(16.51)	(-4.48)
FR	0.249***	24.43***	0.0808***	7.148***	0.0861	1.208***	0.0113**
	(123.89)	(21.28)	(5.33)	(21.22)	(0.94)	(68.06)	(2.39)
GR	0.0839***	20.45***	0.238***	4.427***	-0.138	0.227***	0.0509***
	(8.67)	(12.95)	(5.15)	(10.02)	(-0.27)	(3.78)	(2.64)
IT	0.443***	4.931***	-0.247***	1.436***	1.058***	1.463***	0.0412***
	(154.67)	(4.16)	(-11.18)	(4.17)	(9.40)	(59.32)	(7.75)
NL	0.204***	16.64***	0.00906	5.090***	0.383***	1.171***	0.113***
	(48.01)	(13.79)	(0.56)	(14.18)	(4.31)	(41.94)	(13.40)
PT	0.214***	15.73***	-0.00737	4.195***	-0.471***	0.706***	0.0249*
	(34.01)	(10.41)	(-0.18)	(9.99)	(-3.74)	(13.24)	(1.87)
SI	0.0305**	15.59***	0.0745	4.250***	0.282	0.309***	-0.0394
	(2.18)	(7.74)	(1.44)	(7.21)	(0.93)	(2.70)	(-1.48)

Table 6: Determinants of net purchases in debt securities between 2014Q4 and 2016Q4 across countries groups

	$\ln(\text{Holdings})_{2014q4}$	$\Delta \ln(\text{Amount outstand})_{2014q4-2016q4}$	Home	ln(Distance)	ln(Trade)	Common Language	EUR	ln(Residual Maturity)
AT	-0.618***	0.477***	1.690	-0.294**	0.711	-0.952**	-0.232	0.599***
	(-23.85)	(55.17)	(0.27)	(-2.41)	(0.38)	(-2.56)	(-1.34)	(11.25)
BE	-0.518***	0.426***	5.297	-0.170*	1.511	-0.843	0.0598	0.529***
	(-18.55)	(49.53)	(0.72)	(-1.70)	(0.69)	(-1.11)	(0.40)	(9.22)
DE	-0.486***	0.552***	13.86**	0.111	4.122**	-0.110	-1.195***	0.647***
	(-54.17)	(144.99)	(2.08)	(1.48)	(2.12)	(-0.36)	(-13.10)	(27.74)
EE	-0.820***	0.260***	5.793	0.493	2.594	7.441*	0.0900	0.832***
	(-4.83)	(5.75)	(0.40)	(0.92)	(0.61)	(1.73)	(0.11)	(2.71)
ES	-0.408***	0.543***	18.76*	0.355	5.943**	3.279***	1.655***	0.307***
	(-5.94)	(39.75)	(1.84)	(1.57)	(2.05)	(4.12)	(5.05)	(3.37)
FI	-0.727***	0.323***	-9.496	-1.132***	-4.639*	-13.88***	0.916***	0.965***
	(-16.19)	(21.16)	(-1.14)	(-4.85)	(-1.94)	(-5.51)	(3.42)	(8.83)
FR	-0.363***	0.505***	2.721	0.184**	0.707	1.471***	-0.265**	0.577***
	(-17.88)	(85.20)	(0.40)	(2.05)	(0.35)	(2.63)	(-2.30)	(16.85)
GR	-0.516***	0.377***	22.87**	0.417	3.172	1.047	-0.221	0.343**
	(-6.61)	(17.99)	(2.46)	(1.51)	(1.22)	(0.35)	(-0.61)	(1.97)
IT	-0.752***	0.545***	3.340	-0.146	1.507	-0.521	0.149	0.447***
	(-47.66)	(92.79)	(0.48)	(-1.12)	(0.74)	(-0.78)	(0.98)	(11.72)
NL	-0.525***	0.236***	-21.11***	-0.228**	-6.191***	-1.330**	1.188***	0.255***
	(-15.90)	(28.10)	(-2.96)	(-2.39)	(-2.92)	(-2.51)	(6.91)	(4.33)
PT	-0.668***	0.341***	-2.412	-0.748***	0.461	0.813	0.426	0.580***
	(-13.68)	(24.21)	(-0.28)	(-3.14)	(0.19)	(1.15)	(1.44)	(6.17)
SI	-0.175	0.370***	28.10***	0.0421	7.400**	-2.571	0.269	1.136***
	(-1.57)	(13.35)	(2.64)	(0.15)	(2.38)	(-1.63)	(0.43)	(5.38)

Determinants of debt securities holdings in 2014Q4 (robustness)

	I ALL	II ONLY FOREIGN	III ONLY NON EA	IV EXCL OFF-SHORE	V WITH LUX&IE HOLD	VI EA10 HOLD
$\ln(\text{Holdings})_{2014q4}$	0.383*** (5.09)	0.224*** (14.66)	0.237*** (7.56)	0.383*** (4.91)	0.392*** (6.28)	0.388*** (5.09)
Home	9.758* (1.83)	0 (.)	0 (.)	11.79* (1.95)	-2.155 (-0.57)	11.75 (1.56)
ln(Distance)	-0.317*** (-2.95)	-0.100* (-1.91)	-0.0885 (-1.21)	-0.347*** (-3.11)	-0.431*** (-4.31)	-0.342*** (-2.85)
ln(Trade)	3.262** (2.14)	1.557 (1.45)	3.157*** (3.22)	3.965** (2.27)	-0.183 (-0.17)	3.918* (1.81)
Common Language	0.0515 (0.16)	0.340* (1.73)	0.00983 (0.03)	0.125 (0.37)	0.0310 (0.13)	0.0102 (0.03)
EUR	1.166*** (10.48)	1.153*** (8.50)	1.501*** (10.35)	1.199*** (9.91)	1.085*** (11.43)	1.244*** (10.83)
ln(Residual Maturity)	0.0647*** (2.94)	0.0133 (0.75)	-0.0135 (-0.51)	0.0690*** (3.00)	0.0417* (1.77)	0.0660*** (2.93)
N	530598	307930	133554	497840	643432	511532
=”* p<0.10	** p<0.05	* p<0.01				