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Portfolio rebalancing and the transmission of large-scale asset programmes: evidence from the euro area

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Abstract

Large-scale asset programmes aim to impact the real economy through the financial system. The ECB has focused much of its policies on safe assets. An intended channel of transmission of this type of programme is the "portfolio rebalancing channel", whereby investors are influenced to shift their investments away from such safe assets towards assets with higher expected returns, including lending to households and firms. We examine the portfolio rebalancing channel around the ECB's asset purchase program (APP). We exploit cross-sectional heterogeneity in the impact of APP on the valuation of the financial portfolio held by different sectors of the European economy. Overall, our results provide evidence of an active portfolio rebalancing channel. In more vulnerable countries, where macroeconomic unbalances and relatively high risk premia remain, APP was mostly reflected into a rebalancing towards riskier securities. In less vulnerable countries, where constraints on loan demand and supply are less significant, the rebalancing was observed mostly in terms of bank loans. Examining large European banks, we confirm similar geographical differences.

JEL classification: E44, E51, G21.

Keywords: quantitative easing, unconventional monetary policy, portfolio rebalancing, search for yield.

Non-technical summary

The crisis triggered by the collapse of Lehman Brothers and the accompanying recession provoked the development of a new set of monetary policy tools. Central banks in all main developed countries reacted to the crisis by cutting official rates and adopting a wide range of unconventional measures. In particular, as policy rates approached their effective lower bound, central banks in the US, UK and the euro area adopted large scale asset purchase programmes, aiming at lowering long-term yields through purchases of bonds. A key question for such programmes is whether they have an impact on macro-economic developments and, if so, through which channel.

In this paper, we examine the European Central Bank's (ECB) Expanded Asset Purchase Programme (APP). This programme was implemented later than the US and UK programmes, against the backdrop of a very prolonged economic downturn in the euro area which coincided with historically low inflation. The ECB announced the APP, on 22 January 2015 and the implementation started in March of 2015.

The analysis is focused on the so-called portfolio rebalancing channel whereby, by reducing yields on safe long-term securities, asset purchase programmes induce investors to shift their investments towards assets with higher expected returns, thus taking on more risk. This search-for yield mechanism is argued to represent an important channel of transmission of purchase programmes, as it implies that the monetary stimulus is passed-through onto sectors which do not hold nor issue eligible securities and therefore do not directly benefit from the programme. Indeed, portfolio rebalancing is deemed to be able to benefit even SMEs, by stimulating banks' supply of loans to this sector.

Exploiting a unique and confidential dataset with granular information on the composition of security portfolios in each euro area country, we find that portfolio rebalancing played a relevant role in the transmission of the ECB's APP, but with important differences across countries. In economies more affected by the crisis, where relatively high risk-premia remained, we find evidence of portfolio rebalancing towards riskier securities. In other countries, where spreads were already compressed and constraints on loan demand and supply were less significant, the rebalancing was observed mostly in terms of bank loans.

1. Introduction

The crisis triggered by the collapse of Lehman Brothers in September 2008 and the accompanying recession provoked the development of a new set of monetary policy tools. Central banks in all main developed countries reacted to the crisis by cutting official rates and adopting a wide range of unconventional measures. A key such measure is asset purchase programmes, whereby the central bank aims at lowering long-term yields through purchases of bonds. These programmes were seen as a necessary monetary policy tool to provide stimulus once policy rates approached their effective lower bound. Early programmes include the US QE1, QE2 and QE3 programmes undertaken by the Federal Reserve starting in 2008 and similar policies initiated by the Bank of England in early 2009.

In this paper, we examine the impact of the European Central Bank's (ECB) Expanded Asset Purchase Programme (APP). This programme was implemented later than the US and UK programmes, against the backdrop of a very prolonged economic downturn in the Euro area which coincided with historically low inflation. The ECB announced the APP, on 22 January 2015 and the implementation started in March of 2015.[1]

A key question about asset purchase programmes is whether they work, in the sense of generating a positive impact on macro-economic developments and, if so, through which channel. It has been argued that the direct stimulative impact from reduced interest rates could be of limited importance for asset purchase programmes (see Stein 2012).[2] Another possible channel is signaling (whereby asset purchases serve as a commitment device for relatively high future inflation targets) but Krishnamurthy and Vissing-Jorgensen (2013) reject this channel for the US.

An additional possible channel, widely emphasized in the policy debate, is the so-called portfolio rebalancing channel: by reducing yields on safe long-term securities, asset purchase programmes induce investors to shift their investments towards assets with higher expected

[1] See https://www.ecb.europa.eu/explainers/tell-me-more/html/asset-purchase.en.html.

[2] This is because it is argued that these programmes reduce (real) long-term interest rates mainly by compressing the term-premium incorporated in yields, rather than the expected levels of future short-term rate. Under these conditions, firms can finance themselves at a cheaper rate by issuing longer-term securities, but the (opportunity) cost of investing in the marginal project does not diminish as its return has to be confronted with the expected return achieved by investing in a sequence of short-term securities, which remains unchanged. In a few words, *LSAPs are likely to elicit a financing response on the part of firms, as opposed to a change in their capital spending plans* (Stein, 2012).

returns, thus taking on more risk. This search-for yield mechanism is argued to represent an important channel of transmission of purchase programmes, if not the main one, as it implies that the monetary stimulus is passed-through onto sectors which, unlike issuers of securities which are eligible for the central bank purchases, cannot directly benefit from the programme. Indeed, portfolio rebalancing is deemed to be able to benefit even SMEs, which typically do not issue securities on financial markets, by stimulating banks' supply of loans to this sector.

According to a different view, portfolio rebalancing is instead an adverse byproduct of asset purchase programmes, as it implies an increased risk taking that may sow the seeds for future crises.[3] Considering these opposite views as well as the heterogeneity in structural and business cycle conditions across euro area countries, it is therefore crucial to document not only if portfolio rebalancing takes place, but also in which jurisdictions and for which types of investors and assets.

This study aims at exploring the relevance of portfolio rebalancing for the transmission of the APP by exploiting a unique and confidential dataset with granular information on the composition of security portfolios for all aggregate holding sectors in each euro area country and for each of the 25 largest banking groups in the euro area, on a consolidated basis.

The announcement and introduction of the APP was associated with a positive impact on financial markets overall. Long-term yields have declined sharply over the period when the debate on a possible purchase programme by the ECB has intensified. At the end of 2013 10–year benchmark government bond yields in the euro area started to decline sharply and kept doing so until the end of March 2015, right after purchases actually began. The prominent role played by the APP in explaining such massive decline in yields has been demonstrated in analyses based on an event study methodology (Altavilla et al., 2015; see also Krishnamurthy and Vissing-Jorgensen, 2013 and Joyce and Tong, 2012 respectively for programmes in the US and the UK).

The core of our analysis consists in an examination of whether sectors that experienced higher gains rebalanced toward riskier assets, compared to holding sectors with smaller gains.

[3] Portfolio rebalancing can be seen as an instance of the risk-taking channel of monetary policy, as recently documented based on granular data in Jiménez et al. (2014), applied to the specific case of asset purchase programmes.

We essentially take the initial impact on financial prices as a given, and ask to what extent it had a secondary effect on asset allocations across different sectors and countries over the period 2014Q1 and 2015Q2, the first data point after the decline in yields induced by expectations of the APP.

Our identification strategy relies on four main elements. First, we assume that across holding sectors, incentives for rebalancing are commensurate to the changes in the value of the portfolio. We deem this assumption reasonable because if, prior to the yield decline phase, a sector was holding securities whose yields diminished little, then there should be no economic reason for such a sector to search-for yield. Based on this we can exploit cross-sectional heterogeneity in the exposure to the APP shock, as measured by the valuation gains experienced against the background of the announcement and introduction of APP. The change in the value of the financial portfolios held in Mach 2014 by each institutional sector in a given country (hereinafter, holding sector) varied substantially. For example, the 25th percentile saw a gain of around 2% whereas for the 75th percentile this figure was close to 4%.

Second, we exploit the granularity of the dataset to address one tricky endogeneity issue. If we observed that holding sectors experiencing higher valuation gains exhibit a sharper rebalancing towards riskier securities, this could in principle be driven by an increase in the financing needs of riskier issuers, whereby such increased credit demand has been met by sectors that typically invest in risky securities and as such were more exposed to the APP shock (that is, experienced larger re-valuations of their portfolio). This would imply an increase in credit demand by some issuers rather than portfolio rebalancing, which is a notion involving an increase in credit supply for risky borrowers or issuers. Crucially, the availability of security-by-security information allows for the comparison of investment patterns in the same security across different sectors, effectively controlling for the credit demand channel.

Third, we exploit the characteristics of the design of the APP. The programme is subject to strict rules concerning the share of purchases allocated to each country which need to be proportional to the capital key (euro-area national central banks' individual shares in the ECB's capital). This rules out the possibility that the ECB targeted securities in specific countries, which could potentially lead to endogeneity issues.

Fourth, while we present results for all securities outstanding, the bulk of the analysis is focused on newly issued debt securities. This means that any mechanical relationship between changes in valuations and changes in portfolio composition, which could generate spurious

correlations, is avoided. Moreover, by construction, as long as the monetary policy stimulus succeeds in inducing rebalancing for the average investor in the economy, this can be accommodated only via an increased issuance of riskier securities. Clearly, for outstanding securities, rebalancing towards riskier securities by some investors needs to be accommodated by portfolio rebalancing in the opposite direction by some other investors.

We will be using yields or spreads as risk indicators (similar to the method used by Becker and Ivashina 2015 to examine cyclical variation in the risk appetite in US insurance portfolios). Moreover, we will also distinguish among specific dimensions of risk, such as the rating, currency of denomination, and the residual maturity.

Throughout our analysis we will also assess portfolio rebalancing across vulnerable and less vulnerable countries.[4] As will be shown, different patterns will be documented between these two groups of countries. Interest in these geographical patterns is warranted by the fact that, in the context of financial fragmentation that emerged with the euro area sovereign debt crisis, different conditions for credit and lending supply have been observed in the two areas.

In addition to the analysis of security portfolios across all types of investors, we also focus on the banking sector and investigate whether rebalancing has induced an increase in the supply of loans. In order to do so, we exploit a detailed dataset with security-by-security information on investment holdings for each of the largest twenty five banking groups in the euro area, matched with information on the stocks and flows of new loans extended to households and firms and the corresponding average interest rates. Moreover, we enhance the dataset with bank-level information on regulatory capital, CDS spreads and credit demand. The latter is derived from a proprietary confidential dataset including individual banking groups' responses to the euro area Bank Lending Survey (BLS).

For each bank we compute the exposure to the APP shock in line with what is done for sectoral holdings, that is, by considering the increase in the value of financial portfolios held before the announcement of the APP. We then assess whether this is related to the amount of loans subsequently extended to the real economy and to the corresponding interest rates, controlling for possible heterogeneity in demand conditions faced by lenders operating in different countries.

[4] Throughout the paper, the term "vulnerable countries" refers to Cyprus, Greece, Ireland, Italy, Portugal, Slovenia and Spain. The remaining euro area countries are referred to as "less vulnerable countries".

The results of our analysis, focusing on newly issued securities, show no statistically significant relationship between portfolio rebalancing patterns across sectors and the exposure to the APP shock for the euro area as a whole. A relationship can however be documented when focusing on more vulnerable economies only, in particular in what concerns corporate bonds held and credit (but not maturity or currency) risk. For what concerns lending activity, banks more exposed to the APP displayed larger reductions in the interest rates applied on new loans to households and, in less vulnerable countries, higher growth of credit extended to non-financial corporations. One possible explanation for our distinct findings across country groups is that in non-vulnerable countries spreads were already so compressed to begin with that, against a background of persisting home-bias, engaging in search for yield would require an unfeasibly large change in portfolio composition. Relative returns on different types of assets would then favour rebalancing towards lending activity.

The rest of the paper is organized as follows. Section 2 contains an overview of the relevant literature. Section 3 provides a brief description of the novel dataset used. Section 4 presents the econometric exercises. Section 5 summarizes the results and concludes.

2. The related literature

Several recent papers attempt to assess the effects of asset purchase programmes. One group of papers aims at empirically documenting the impact on asset prices and bond yields. They rely on granular and high-frequency data to identify the response of market prices for individual securities around announcements of asset purchase programmes by central banks. Overall, this strand of literature argues that asset purchase programmes increase asset prices and diminish bond-yields.[5]

Other papers use bank-level information to investigate the presence of a bank lending channel of asset purchase programmes by testing whether banks that end up receiving most of the liquidity injected with central bank purchases of long-term bonds exhibit relatively larger increases in loan supply. Butt et al (2014), looking at UK's experience, do not find significant

[5] These papers include, among others, Krishnamurthy and Vissing-Jorgensen (2013) on FED's QE, Joyce and Tong (2012) on Bank of England's programme, Krishnamurthy et al (2014) on the ECB's OMT and SMP, Altavilla et al (2015) on APP. A related but different approach is in Wright (2012) who estimates a VAR with daily data where the identification is derived from the assumption that monetary policy shocks have high variance on days of FOMC meetings. In line with the studies mentioned above, this paper also finds an impact of monetary policy shocks on governments and corporate bonds, although only a transitory one.

effects; Kandrac and Schlusche (2016), instead, find evidence of an operational bank-lending channel for the US.

Other authors attempt to assess the effects of asset purchase programmes on real macro-economic variables using VAR or DSGE models. These papers look at different episodes and countries so that results are not always comparable. Nonetheless, the broad message they convey is that there is a significant impact of asset purchase programmes on the real economy.[6] Since the identification in these studies comes from aggregate time series variation, the precision with which specific causal mechanisms can be pinpointed is generally weaker. To the extent that programmes are introduced at non-random times, the results may be confounded.

Koijen et al (2017), based on a dataset similar to ours, describe the evolution of portfolio composition across institutional sectors in the euro area. Peydró et al (2017) exploits granular bank-level data on individual security and borrower exposures of Italian banks and concludes that increases in the size of the central bank balance sheet, which in the period analyzed mainly reflect the take up of banks in long-term refinancing operations, do not induce risk-taking in the composition of security portfolios nor on lending supply. Compared to Peydró et al (2017), whose sample period ends in 2013, we look at a shorter but more recent sample period, covering the APP, which is our focus. We look at all main institutional sectors, not just banks, and cover all euro area countries. Another difference is related to the indicator adopted to capture unconventional monetary policy (size of central bank balance-sheet) which cannot reflect what occurs in anticipation of the actual implementation of such policy measures.[7]

3. The data and descriptive evidence

The security holding statistics (SHS) dataset, compiled by the Eurosystem, contains confidential granular information, at individual ISIN level, on securities held by each institutional sector in each euro area country. The coverage is close to 90 per cent of the

[6] Baumeister and Benati (2012) use a Bayesian time-varying parameter structural VAR for a sample of advanced economies and argue that a compression in the long-term yield spread exerts a powerful effect on both output growth and inflation. Following a broadly similar approach, Kapetanios et al. (2012) studies the first round of QE in UK and suggest that QE may have had a peak effect on the level of real GDP of around 1.5 and 1.25 percentage points on real GDP level and CPI inflation respectively. Chen (2014) finds that the sole LSAPs interventions in the US had an insignificant effect on the macro-economy. She finds instead a strong effectiveness of the policy involving an extended period of near-zero interest rates, either on output or on inflation, depending on whether perfect foresight rational expectations are incorporated into the model or not.

[7] This approach, adopted in several other papers (e.g., Gambacorta et al., 2014), is not suitable for our purposes given our focus on the ECB's asset purchase programme whose impact on yields took place entirely before purchases started.

universe of debt securities reported in the national accounts. SHS also includes information on the portfolio of securities held by each of the 25 largest euro area banks. This dataset is matched with Eurosystem confidential bank-level data on stocks and flows of loans granted to the non-financial private sector (iBSI) and on the corresponding interest rates (iMIR) as well as with bank-level information on regulatory capital, CDS spreads and credit demand. The latter is derived from a proprietary confidential dataset including individual banks' responses to the euro area Bank Lending Survey (BLS).

We focus on the period between 2014Q1 and 2015Q2, over which yields declined in anticipation of the APP. In each euro-area country, we consider the securities held by the following institutional sectors: banks, money-market funds, insurance corporations, pension funds, other financial institutions, non-financial corporations, households (including non-profit institutions serving households), general governments and rest of the world.[8]

When distinguishing across types of securities, no clear patterns of rebalancing are detected in the period under scrutiny (Chart 1). Some rebalancing towards equity instruments is observed for other financial institutions and, to a smaller extent, private sector non-euro area investors. This, however, was to a large extent driven by a higher valuation of the outstanding equity portfolio and not by new (equity) finance provided by less risk-averse investors. Once holding amounts are adjusted for valuation effects (not shown), a visible rebalancing towards equity was observed only for OFIs, whose holdings represent a negligible share of the overall portfolio of securities. The rest of the analysis of rebalancing in security portfolios is focused on debt securities, which account for about 70% of the overall portfolio and for which we have detailed information on the yields provided by each security.[9]

Table 1 shows some descriptive statistics, focusing on the sample of debt securities issued in the two quarters considered. Large differences are observable in the holding amounts, across securities and holding sectors, reflecting heterogeneity in the size of issuances and of holding sector portfolios. Portfolio valuation, m_h, is the investor specific measure of APP shock intensity and is defined as the change in the value of securities held by each sector in 2014Q1, before the anticipation of the APP. This measure displays significant variation both across institutional sectors and countries. Concerning holding sectors, the impact was particularly significant for insurance corporations and pension funds and for other financial intermediaries,

[8] Details on data used are available at https://www.ecb.europa.eu/stats/money/shs/html/index.en.html.

[9] This figure is computed excluding investment fund and money-market fund units, whose underlying assets are not observed.

reflecting the long duration of the securities held by these classes of investors. Looking at countries, a noteworthy pattern is that the stronger valuation effects are discernible in non-vulnerable countries. This finding, which may come as a surprise, is explained by the higher share of equity instruments and of investment fund and money market fund participation units in these countries, against a background in which the value of these assets was more affected by the APP than that of debt securities. Maturities are similar across groups of countries, but show considerable dispersion across individual countries and holders. Yields and spreads are higher in more vulnerable countries, as expected.

Table 2 reports similar statistics, for the two periods separately. Some increase in the average maturity and in the share of non euro-denominated bond holdings is observable between the two periods. Furthermore, not only average yields but also spreads decline, which would not be consistent with increased risk taking. However, one needs to take into account that purchase programmes may possibly exert a downward pressure on expected future short-term rates and on unit risk premium (for both term and credit risk). This pricing impact may hide a rebalancing towards *relatively* higher yield securities.[10]

4. Econometric evidence

4.1 The empirical framework

The objective of this section is to explore the role played by monetary policy in shaping the risk appetite of euro area investors. The empirical strategy exploits heterogeneity in the exposure to the monetary policy shock in the cross section of investors, measured by the impact of the APP on the valuation of the portfolio of securities held at 2014 Q1.

The approach used to implement this strategy essentially consists in the estimation of a regression equation with the following baseline specification:

$$h_{i,h,t} = \left(\beta_0 m_h + \beta'_0 r_{it} + \beta_0'' m_h r_{i,t}\right) + \left(\beta_1 m_h T_t + \beta_1' T_t r_{i,t} + \beta_1'' m_h T_t r_{i,t}\right) + \\ + \gamma T_t + a_{i,t} + b_{h,t} + \varepsilon_{i,h,t} \qquad (1)$$

The variable $h_{i,h,t}$ is the (log) amount of holdings of a security with ISIN *i* by holding sector *h* (e.g. French investment funds), in the two periods considered (*t* is either 2014 Q1 or 2015 Q2). m_h is the intensity of the monetary policy shock specific to holding sector *h* and is

[10] Residual maturity is used as a proxy for financial duration for which no information is available.

defined as $m_h = w'_h e$, where w_h is a vector defining the composition at 2014 Q1 of the financial portfolio for investor h and e is the vector of the actual variations in the price of each security over the period observed. T_t is a dummy variable identifying the post-announcement period, 2015 Q2. r_{it} is the yield-to-maturity of security *i* at time *t*. A positive estimate for the coefficient β_1'' would indicate that between the two periods investors more exposed to the monetary policy shock rebalanced their portfolio towards riskier securities more intensely than other holding sectors.

The estimation of β_1'' provides information on the extent to which investors embark in more or less risky strategies in response to changes in valuations of the securities held (in turn reflecting changes in their yields). Although, changes in investors' portfolios in response to shocks to the valuation of their portfolios should not, in principle, depend on the reason underlying the shock, anecdotal evidence and the relevant literature (e.g. Altavilla et al., 2015) show that the most important driver of financial asset prices in the period under examination was the announcement of the APP and its anticipation by financial market participants.

Exogeneity of m_h, which allows us to interpret β_1'' as the reaction of portfolio rebalancing to changes in valuations and yields, requires that m_h itself is not influenced by changes in the portfolio composition over the period analysed, i.e. by the dependent variable. This is a reasonable assumption precisely because market participants were not anticipating the programme in 2014 Q1 (indeed, yields had not yet started to decline at this point).

From an aggregate perspective, portfolio rebalancing can occur only if there is an additional supply of risky securities. Given that our objective is to assess the transmission of monetary policy on credit we focus on newly issued securities. For each of the two dates considered (2014 Q1 and 2015 Q2), newly securities are defined as those issued in the preceding 4-quarters. This is done to smooth out possible seasonality effects and to avoid capturing developments specific to a given quarter. This also means that any mechanical relationship between changes in valuations and changes in portfolio composition, which would generate spurious correlations, is avoided.[11]

[11] The focus on newly issued securities is useful also to overcome the problems caused by sluggishness in portfolio rebalancing. For example, one may plausibly think that retail investors do not optimally adjust their portfolio holdings in real time, but only in discrete time. Therefore, when the portfolio composition changes because of heterogeneous changes in value across the securities held, it might take time before a household makes

Exploring the granularity of our dataset, we will conduct our estimates by also including different sets of fixed effects. These are crucial to be able to control for possible unobservable characteristics of the securities or of the holding sector which may blur the results. In particular, we can perfectly control for developments in credit risk or financing needs that are associated to a given security or issuer.[12] Indeed, starting from Khwaja and Mian (2008), a recent and growing empirical literature in banking exploits loan-level datasets and the fact that borrowers concomitantly borrow from multiple lenders, to run estimations including (time specific) borrower fixed effects. Introducing fixed effects for each security (in each period) allows us to isolate from credit developments everything which is explained by specific instrument or borrower characteristics, irrespectively of whether these are time varying, time invariant, observable or not. Therefore, the introduction of these fixed effects is the most effective control for credit risk and demand conditions.

Similarly, with holding sector (time-varying) fixed effects, we can effectively control for everything that is specific to a given class of investors and has an impact on the overall size of its portfolio. This is important given that different investor categories may structurally invest in securities involving different levels of risk.

As m_h may vary only across different holding sectors, all regressions are estimated by clustering errors at the level of *h*.

4.2 Results for the baseline model

Table 3 shows the estimation of model 1 for the sample of newly issued securities and for different specifications characterized by the types of controls and the sub-samples used. Looking at the first three columns, referring to the estimation for the whole sample, it turns out that irrespectively of the specification adopted, the triple interaction is never positive and statistically significant.

As mentioned, heterogeneity could be expected to be significant across investors residing in different countries. An obvious breakdown is the one between vulnerable and less vulnerable

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new transactions to re-optimize the portfolio. Acquisitions of newly issued securities require, by definition, that some transaction is conducted, so sluggishness for such sectors is supposedly less relevant.

[12] When fixed effects are included in the estimations some terms of equation (1) will mechanically be dropped. Also, given that by definition a security is newly issued in one of the two periods only, introducing time-invariant security fixed effects (a_i) would be equivalent to having period-specific security fixed effects ($a_{i,t}$). We keep this notation as we will also show, among the extensions, some estimations conducted on both seasoned and newly issued securities.

euro area economies. During the sovereign debt crisis financial conditions in countries more directly involved have significantly diverged from those of other countries, at least partly reflecting financial fragmentation. In early 2014, when long-term yields started their declining trend in anticipation of the adoption of APP, differences were still sizeable, though much less so than at the peak of the sovereign debt crisis.[13]

These differences may have important implications for portfolio rebalancing. On the one hand, one may conjecture that given the already higher level of risk in vulnerable countries, domestic investors would be less inclined to take on additional risks. On the other hand, interest rates in less vulnerable economies were so low and possibly squeezed toward their lower bound that in order to search-for-yield, in a context where most of the securities offer return rates close to nil, one would need to distort the portfolio composition to an extent that would be too costly or even impossible (e.g. constrained by investment policies). This conjecture implicitly requires some fragmentation in financial markets, otherwise investors in non-stressed countries could rebalance by simply investing in riskier securities issued in stressed economies.

Column 4 of Table 3 shows the OLS specification for the subsample of holding sectors residing in vulnerable countries. The coefficient for the triple interaction term is now positive and statistically significant, suggesting that in these countries monetary policy has brought about some rebalancing towards risky assets. Results (not shown) for the subsample of less vulnerable economies confirm that rebalancing is limited to investors in vulnerable countries.[14] As mentioned, this can be interpreted as a sign that in a context of diminishing returns and fragmented financial markets, risk balancing is easier in vulnerable economies, where securities paying non trivial yields are available.

The robustness of the result to the introduction of fixed effects for each pair period-holding sector (column 5) suggests that it is not driven by an increase in the size of the portfolio of some sectors which are specialized in investing in more risky securities but rather a genuine tilt in asset allocation (it should be noted that these sectors would also likely exhibit larger values

[13] For instance, the spread between the yield on domestic 10-year sovereign bonds and the corresponding German figure was about 2 percentage points in Italy and Spain, 3 percentage points in Portugal. Sovereign spreads started diminishing thereafter and reached minimum levels in March 2015 when they stabilized at smaller but still non negligible levels (1 percentage point in Italy and Spain, 2 in Portugal).

[14] Results for less vulnerable countries are similar to those obtained for the whole sample, both in terms of sign and statistical significance.

for m_h). More generally, this implies that the result is robust once we control for any kind of factors affecting the entire portfolio of each holding sector considered.

The coefficient on the triple interaction term remains positive and statistically significant also when introducing (time-varying) security fixed-effects together with time-varying holding-sector fixed effects (column 6). This suggests that the rebalancing observed is not exclusively originated by a stronger than usual issuance of risky securities, something we may label confidence or credit-demand effect, but it is at least partly induced by an intensified desire of (high m_i) investors to increase their holdings of such securities. The particularly low spreads on risky securities prevailing in this period also corroborate this credit supply-side view.[15]

The documented effects are sizable. As shown in Table 4, based on the coefficients of the OLS model, for a sector with a median shock (m_i=2.42%) the semi-elasticity of the amount of holdings to the level of yield (the percentage change of the amount of holdings of a security when its yield increases by one percentage point) increases in the post period by 10 percentage points.[16] In contrast, for a sector almost not exposed to the APP shock (m_h=0.46%, 10th percentile of the distribution of m_h), such semi-elasticity remains almost unchanged at negative values between 2014 Q1 and 2015 Q2. If anything, it actually slightly diminishes, possibly reflecting the generalized reduction of spreads (for a given increase in yields in the post period, the increase in underlying risk – say the probability of default – is larger than it was before the announcement).

As discussed above, one interpretation of finding rebalancing only in more vulnerable economies is that investors residing in the other countries, where long term yield are squeezed to very low levels, may find additional constraints to rebalance to riskier portfolios, as this would require investing in other economies, which may be problematic in a context of financial fragmentation and home bias.

[15] This specification determines a reduction in the number of securities as some of them are held by one sector only (this is typical for Germany).

[16] Note that the OLS is the only specification where an estimate of the level of the coefficient of semi-elasticity, which summarises asset allocation, can be derived for the different sectors and in the different periods. In all the following specifications, where we also introduce fixed effects at the holding sector or at the security level, one loses information on the level and can just focus on cross-sectional differences. Accordingly, for those specifications we will be commenting only on the sign of the triple interaction term.

4.3 Extensions and robustness

Table 5 repeats the same type of regressions considering only government bonds or other securities, respectively. As can be seen, much of the rebalancing documented in Table 3 takes place within the category of securities issued by the private sector.

This is relevant as it suggests that the monetary-policy induced increase in risk appetite, where observed, has benefitted mainly the supply of credit to the real economy, which is in line with the notion of portfolio rebalancing as a transmission channel of asset purchase programmes. At the same time, it should be emphasized that in the euro area only large corporates tend to have access to funding in wholesale debt markets, and these firms tend to be less constrained in their access to credit.[17]

The level of the yield is a summary measure of the risk involved in investing in a given security. It may thus subsume different components, namely credit risk, maturity risk or currency risk.[18] This is explored for more vulnerable economies in Table 6 where the variable r_{jt} is replaced by three alternative measures of risk: the spread between the yield paid by the security and the risk-free rate of a corresponding maturity; the maturity of the security (in months); a dummy for non-euro denominated securities. The specification is modified so as to include, for each of these risk measures, all possible double- and triple-interaction terms.

As shown in Table 6, the results of this exercise suggest that most of the rebalancing is driven by increasing investments in securities involving higher credit risk (the only triple interaction term with a positive sign and statistically significant is that for the spread). This holds across all specifications, irrespectively of the type of fixed effects included.

One interpretation for the lack of amplified risk taking in terms of maturity is that investing in long-term assets is a relatively costly way to search for yield precisely because the term structure has flattened (to increase the yield by one percentage point one needs to lengthen the

[17] Note also that this analysis neglects possible rebalancing taking place between these two categories of securities.

[18] Investing in non-euro currency involves some currency mismatch for resident investors that typically have liabilities denominated in euro. Information on the extent to which investors hedge against this type of risk is not available.

maturity by a much bigger amount compared to normal times). Absence of rebalancing towards non-euro denominated securities is consistent with the home bias patterns documented above.[19]

While our focus is primarily on new issuances, we also conduct estimations on the entire sample also including seasoned securities. The main purpose of this exercise is not to assess the transmission of APP to the real economy, but rather to hint at its implications for financial stability, as the overall risk to which investors are exposed obviously needs to be measured on the entire portfolio. As shown in Table 7, when controlling for both sets of fixed effects, no visible APP-related rebalancing is detected, not even for more vulnerable economies (the coefficient for the triple interaction term in columns 3 and 6 is not significant). These results suggest that the rebalancing observed in newly issued securities was not large enough to modify the overall risk profile of the portfolios of securities held. This assessment may, of course, change over time if rebalancing continues in a context of persisting low rates.

A potential concern for identification arises if the behavior of holders was already different before the APP and, in particular, if holders that came to be more affected by the programme were already rebalancing towards riskier securities before the policy started to be anticipated by the markets. In this case one would expect to find a positive triple interaction before the policy announcement. Tables A1 and A2 in the Appendix show that this is not the case: there is no positive relationship between changes in the portfolio allocation of different sectors in the period from 2013Q4 to 2014Q1 and the extent to which these sectors were then affected by monetary policy, not even in vulnerable countries.[20]

4.4 Portfolio rebalancing in the extensive margin

The regression set up described in equation (1) is not suitable to explore the extent to which APP-related portfolio rebalancing has involved the extensive margin, i.e., investments in securities issued by debtors toward which investors were not already exposed prior to APP announcements.

[19] Note also that these regressions exclude foreign investors who, together with investment funds, are responsible for much of the increase in the share of non-euro denominated securities (by definition, for them it is not clear whether investing in non-euro represents an increase or a decline in the currency mismatch).

[20] The choice of 2013Q4 as the starting period is driven data availability.

In order to do so, it is necessary to take into account that the dataset does not include observations for triples *i,h,t* (security, holder, period) for which the amount of holdings is nil (irrespectively of the fact that we are taking log-amounts).

To account for non-reported nil holdings one observation with a nil holding amount is added to the dataset for each pair security-holding sector that is absent from the dataset (and this for each time period). In order to keep the number of observations manageable, such "rectangularisation" of the dataset is based on security categories, or pseudo-securities, instead of actual individual securities. We defined about 2,300 categories distinguished by different combinations of issuer sector, issuer country, maturity, coupon type, nominal currency and rating.

We focus on the cross section of the security-categories that are held in 2015 Q2 and estimate a linear probability model for the dummy-variable identifying new holdings, i.e. security categories held in positive amount in 2015 Q2 but not in 2014 Q1. We estimate different specifications allowing the model to incorporate pseudo-security fixed effects and holding sector fixed effects. As the time dimension is lost, the emphasis is now on the coefficient for the term of interaction between the security yield r_i and the holding sector portfolio valuation m_h.

The results are displayed in Table 8, looking at investors in more vulnerable countries and showing that, irrespectively of the specification adopted, the coefficient for $r_i^* m_h$ is never significant. Therefore, we do not find evidence of APP-related portfolio rebalancing leading to investments in new security categories but only within such categories, possibly reflecting the presence of some constraints on the investment strategies that investors may follow.[21]

4.5 Portfolio rebalancing and lending supply for individual banks

This section intends to shed some light on the direct link between monetary policy and euro area banks' lending activity. It relies on SHS data collected for the 25 largest euro area banking groups in order to obtain a bank-level measure of the intensity of the monetary policy shock (m_h), defined as described in Section 4.1.[22] We then investigate the impact of this measure on quantities and prices of loans granted to the non-financial private sector. Although

[21] For robustness purposes we conduct the analysis on the intensive margin in the "rectangularised" dataset. Results, displayed in Table 9, confirm the presence of portfolio rebalancing.

[22] While changes in the valuation of securities held by sectors are reflected in accounting profits only for assets recorded at fair value or for securities that are actually sold, our measure of exposure m_h takes into account that the impact of APP on bond economic values takes place irrespectively of their accounting treatment.

the small number of banks represents a constraint for the econometric exercise we conduct, the dataset is relevant in terms of coverage as it includes a large share of the euro area banking system, at 73% of total assets on a consolidated basis (69 and 74%, respectively, for vulnerable and other countries in the sample).

One observation in the dataset used for these regressions is a pair *b-s,* where *b* stands for a given bank and *s* for a given borrowing sector (households and non-financial corporations). The dependent variable is the yearly growth rate of loans extended by bank *b* at the end of 2015 Q2. The regressions are estimated by including a set of country and sector fixed effects, as controls for credit demand and risk, as well as bank specific control variables meant to capture possible balance sheet impairments.[23] Standard errors are clustered at the bank level.

Table 10 shows that there is a statistically significant relationship between the monetary policy shock and the growth rate of loans to non-financial private sector (column 1).[24] The results show that a 1 standard deviation (or 1.2 percentage points) increase in a bank's APP-related portfolio valuation is associated with increased credit growth by about 2 percentage points. The results in the second column of the table show that this effect remains qualitatively unchanged once we enrich the specification with a proxy for credit demand at the bank-level. This is a variable indicating whether each bank reported a relatively high demand of credit from the corresponding sector – household or non-financial corporations – derived from its responses to the euro area quarterly Bank Lending Survey (BLS).[25]

The third column of Table 10 explores whether the effect is heterogeneous across sectors or regions. The interaction term between m_b and a dummy for loans to non-financial corporations shows that the intensity of portfolio rebalancing towards lending does not depend on the institutional sector. In what concerns geographical patterns, instead, the relationship is found to be significant only for banks headquartered in less vulnerable countries. The last

[23] Namely, a dummy variable for banks with regulatory capital below the first quartile and each bank's CDS spread (end of 2013 figure for capital ratios; 2014 Q1 for CDS).

[24] For what concerns the security portfolios of banks, we also estimated equation (1) with bank-group data and could not find any significant evidence of rebalancing, neither in vulnerable nor in non-vulnerable economies (not shown). This reassures about the fact that the results shown above for sector-by-sector holdings are not affected by possible (reverse causality) endogeneity issues that could arise if the ECB targeted the securities held by sectors whose investment portfolio is made preeminently of government bonds, in response to anticipations of a rebalancing of their portfolios.

[25] We start by computing the average of the BLS qualitative indicators of changes in credit demand over the corresponding period. We then compute a dummy variable identifying banks for which this variable is in the top quartile of the distribution.

column enhances the specification in order to check for the presence of heterogeneity in rebalancing patterns across banks based on their capital ratio. The negative coefficient on the interaction term between m_b and a dummy variable identifying banks whose capital ratio is in the bottom quartile of the distribution suggests that less capitalized institutions were less able to expand lending supply. Nonetheless, the results indicate that the geographical location was a more important factor in shaping banks' ability to rebalance towards lending than their balance sheet conditions.

We then run similar estimations where the dependent variable is the change in interest rates applied on new loans extended between 2014 Q1 and 2015 Q2. No relationship is found for the non-financial private sector as a whole, regardless of whether the bank-level credit demand is controlled for or not (Table 11, columns 1 and 2). However, this masks underlying differences across sectors. A higher m_b is found to be associated with lower interest rates applied on loans to households while such relation is not significant for non-financial corporations (column 3). The effect of the monetary policy measure on lending rates is not found to depend on whether the bank is headquartered in a more vulnerable economy or not nor on its capital ratio (columns 3 and 4).[26]

The fact that the monetary policy shock is found to be associated with higher growth of loans to NFC but not with a comparatively stronger decline in interest rates is consistent with the presence of some rebalancing within this borrowing sector towards riskier borrowers.

5. Conclusions and policy implications

In this paper we empirically study whether the APP has induced portfolio-rebalancing, a channel of transmission that has attracted much attention in the public debate, even though the evidence on its actual relevance is scant.

Overall, our results provide evidence of an active portfolio rebalancing channel. We show that the APP-related rebalancing of security portfolios was concentrated in vulnerable economies, it has affected instruments issued by corporates (as opposed to sovereigns) and it has resulted in more credit risk-taking (as opposed to maturity or currency risk-taking). When

[26] In a similar vein to the exercise described in the last paragraph of Section 4.3, Tables A3 and A4 show that the there is no positive relationship between the lending behavior of different banks in the period from 2013Q4 to 2014Q1 and the extent to which these banks were subsequently affected by monetary policy.

looking at lending volumes granted by banks, we obtain evidence of effects limited to non-vulnerable countries and of a muted response by less capitalized credit intermediaries.

One possible explanation of these geographical patterns is that in non-vulnerable countries spreads were already so compressed to begin with that, in order to reach a given increase in the average yield of a given portfolio, a dramatic change in its composition would be needed.[27] This could also explain why in these economies some rebalancing of banks towards real-sector loans (where spreads remained higher) is detectable. In addition, our evidence indicates that the geographical location was a more important factor in shaping banks' ability to rebalance towards lending than their balance sheet conditions.

[27] To exemplify, if the yield curve is perfectly flat, then even an arbitrary large increase in average duration does not help in raising the average yield. In other words, when comes to search-for yield, both income and substitution effects are at play; when spreads are very much compressed, as it is the case in non-stressed countries during LSAPs, substitution effects may actually dominate.

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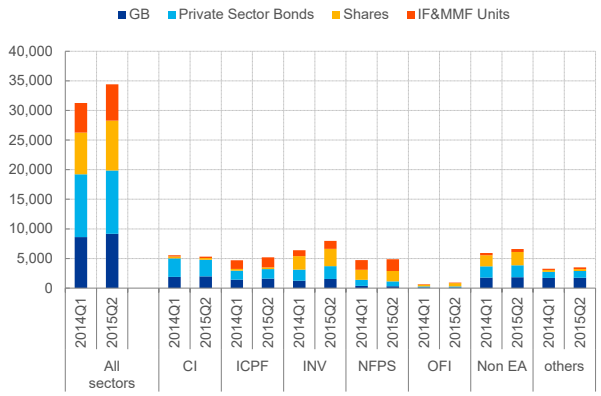
Charts and Tables

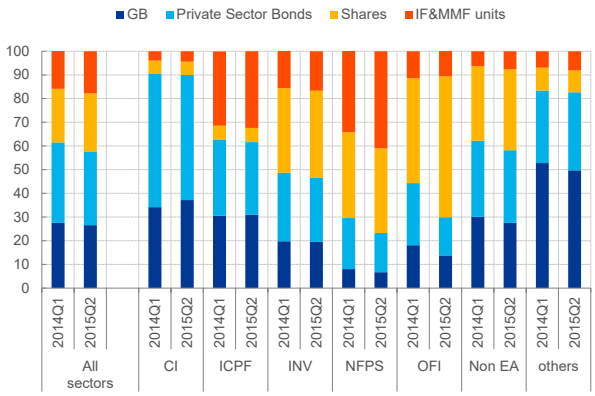
Chart 1

Portfolio rebalancing between 2014Q1 and 2015Q2 across types of instruments

a) Outstanding amounts (*billions of euro*)



b) Shares (*percentage points*)



Notes: The chart shows the investment in each type of instrument by holding sector based on market values. Excluding non-euro-area residents' third-party holdings (non-euro area residents' holdings reported by euro area NCBs) and non-euro area securities held by non-euro area residents. The category OFI does not include FVCs (financial vehicles); non EA does not include holdings of non-resident central banks and general government.

Table 1

Descriptive statistics for newly issued securities

	Mean	Std. Dev.	P25	P50	P75	N. Obs
Full sample						
Holding amount	19.62	157.31	0.20	1.08	6.35	235423
Log (Holding Amount)	0.12	2.55	-1.55	0.11	1.88	232626
Portfolio valuation (mh)	4.12	2.06	3.46	3.89	4.86	235423
Yield-to-maturity	2.96	2.55	1.05	2.60	4.13	235423
$Spread_{it}$	2.53	2.46	0.69	2.07	3.61	228721
$Maturity_{it}$	80.64	72.66	36.00	59.00	96.00	228721
$NonEur_{it}$	0.40	0.49	0.00	0.00	1.00	228721
Vulnerable countries						
Holding amount	22.86	217.56	0.26	1.52	6.99	50140
Log (Holding Amount)	0.31	2.40	-1.31	0.44	1.95	49869
Portfolio valuation (mh)	2.69	1.87	2.26	2.42	3.70	50140
Yield-to-maturity	3.20	2.40	1.67	3.15	3.91	50140
$Spread_{it}$	2.67	2.30	1.07	2.68	3.38	49193
$Maturity_{it}$	86.92	81.13	37.00	59.00	111.00	49193
$NonEur_{it}$	0.34	0.47	0.00	0.00	1.00	49193
Less vulnerable countries						
Holding amount	18.74	136.49	0.20	1.00	6.10	185283
Log (Holding Amount)	0.07	2.59	-1.59	0.03	1.85	182757
Portfolio valuation (mh)	4.51	1.94	3.70	4.53	5.66	185283
Yield-to-maturity	2.89	2.58	0.88	2.42	4.21	185283
$Spread_{it}$	2.49	2.50	0.59	1.91	3.71	179528
$Maturity_{it}$	78.92	70.06	36.00	59.00	95.00	179528
$NonEur_{it}$	0.41	0.49	0.00	0.00	1.00	179528

Notes: Data for 2014Q1 and 2015Q2. Holding amount in EUR millions. Only holdings of newly issued securities, defined as those issued in the preceding 4 quarters. The term "vulnerable countries" refers to Ireland, Greece, Spain, Italy, Cyprus, Portugal and Slovenia. Yield-to-maturity in percent. $Spread_{it}$ is the difference at time t between the yield-to-maturity of security i and the risk-free benchmark rate of a corresponding maturity, in percent. $Maturity_{it}$ is the residual maturity of security i at time t, in months. $NonEur_{it}$ is a dummy for securities denominated in currencies other than the euro. m_h is the change in valuation between 2015Q2 and 2014Q1 of the portfolio held by sector h in 2014Q1, in percent.

Table 2

Descriptive statistics for newly issued securities before and after the shock

	Mean		Weighted mean		N. Obs.	
	Pre	Post	Pre	Post	Pre	Post
Full sample						
Yield-to-maturity	3.23	2.71	2.34	1.80	112159	123264
$Spread_{it}$	2.65	2.42	1.63	1.41	108880	119841
$Maturity_{it}$	79	83	93	98	108880	119841
$NonEur_{it}$	0.38	0.42	0.17	0.23	108880	119841
Vulnerable countries						
Yield-to-maturity	3.42	2.96	2.55	1.94	25514	24626
$Spread_{it}$	2.75	2.58	2.09	1.66	24983	24210
$Maturity_{it}$	81	93	82	102	24983	24210
$NonEur_{it}$	0.32	0.36	0.11	0.14	24983	24210
Less vulnerable countries						
Yield-to-maturity	3.17	2.65	2.27	1.76	86645	98638
$Spread_{it}$	2.62	2.38	1.49	1.33	83897	95631
$Maturity_{it}$	78	80	97	96	83897	95631
$NonEur_{it}$	0.39	0.43	0.11	0.14	83897	95631

Notes: Data for 2014Q1 and 2015Q2. Holding amount in EUR millions. Only holdings of newly issued securities, defined as those issued in the preceding 4 quarters. The term "vulnerable countries" refers to Ireland, Greece, Spain, Italy, Cyprus, Portugal and Slovenia. Yield-to-maturity in percent. $Spread_{it}$ is the difference at time t between the yield-to-maturity of security i and the risk-free benchmark rate of a corresponding maturity, in percent. $Maturity_{it}$ is the residual maturity of security i at time t, in months. $NonEur_{it}$ is a dummy for securities denominated in currencies other than the euro. m_h is the change in valuation between 2015Q2 and 2014Q1 of the portfolio held by sector h in 2014Q1, in percent.

Table 3

Baseline estimation: newly issued securities

	Full sample			Investors in vulnerable countries		
	(1)	(2)	(3)	(4)	(5)	(6)
yield-to-maturity (r_{it})	-0.0596	-0.0551*		-0.0968*	-0.0617**	
	(-1.26)	(-1.72)		(-1.80)	(-2.44)	
portfolio valuation (m_h)	-0.122*			0.0915		
	(-1.85)			(1.12)		
post-APP period dummy (T_t)	0.114			0.594		
	(0.46)			(1.59)		
$r_{it}*m_h$	-0.0200	-0.0195	0.0171	0.0155	0.00118	0.0487***
	(-0.95)	(-1.54)	(1.30)	(0.80)	(0.09)	(2.70)
$r_{it}*T_t$	-0.00852	-0.0778		-0.274**	-0.319**	
	(-0.07)	(-0.82)		(-2.47)	(-2.61)	
m_h*T_t	-0.0368			-0.0445		
	(-0.78)			(-0.63)		
$r_{it}*m_h*T_t$	-0.00620	0.00718	-0.00175	0.0528**	0.0708**	0.0469*
	(-0.20)	(0.32)	(-0.35)	(2.31)	(2.37)	(1.92)
holder*time f.e.	No	Yes	Yes	No	Yes	Yes
security f.e.	No	No	Yes	No	No	Yes
N	232626	232618	182580	49869	49865	39450
R^2	0.051	0.320	0.558	0.030	0.244	0.635

Notes: Dependent variable is log of the amounts of security i held by sector h (a given institutional sector in a given country), in period t. Data for 2014Q1 and 2015Q2. Only holdings of newly issued securities, defined as those issued in the preceding 4 quarters. The term "vulnerable countries" refers to Ireland, Greece, Spain, Italy, Cyprus, Portugal and Slovenia. r_{it} is the yield-to-maturity of the corresponding security, in percent. m_h is the change in valuation between 2015Q2 and 2014Q1 of the portfolio held by sector h in 2014Q1, in percent. T_t is a dummy for the period 2015 Q2. In all specifications errors are clustered at the holding-sector level. t-statistics in parentheses * p<0.10 ** p<0.05 *** p<0.01.

Table 4

Semi-elasticity of the amount of security holdings to the yield-to-maturity in vulnerable countries

m_h		2014 Q1	2015 Q2
p10	(0.46)	-9.0	-9.3
p25	(2.26)	-6.2	3.0
p50	(2.42)	-5.9	4.1
p75	(3.70)	-3.9	12.8
P90	(4.71)	-2.4	19.7

Notes: Percentage variation of holdings for a one percentage point change in the yield-to-maturity, conditional on the time period and on the portfolio valuation m_h. Based on column 4 of Table 3. The term "vulnerable countries" refers to Ireland, Greece, Spain, Italy, Cyprus, Portugal and Slovenia.

Table 5

Investors in vulnerable countries; holdings of newly issued sovereign and corporate bonds

	Sovereign Bonds			Corporate bonds		
	(1)	(2)	(3)	(4)	(5)	(6)
yield-to-maturity (r_{it})	0.0289	-0.148*		-0.0829*	-0.0489	
	(0.25)	(-1.76)		(-1.78)	(-1.63)	
portfolio valuation (m_h)	0.0937			0.0962		
	(1.58)			(1.01)		
post-APP period dummy (T_t)	0.269*			0.620		
	(1.83)			(1.46)		
$r_{it}*m_h$	-0.0418	0.000525	0.0314	0.0175	0.00323	0.0518***
	(-1.20)	(0.03)	(1.45)	(1.01)	(0.24)	(2.98)
$r_{it}*T_t$	-0.113	-0.219*		-0.276**	-0.309**	
	(-1.63)	(-1.72)		(-2.24)	(-2.36)	
m_h*T_t	0.00333			-0.0510		
	(0.08)			(-0.61)		
$r_{it}*m_h*T_t$	0.0259	0.0524	0.00982	0.0535**	0.0689**	0.0525*
	(1.35)	(1.58)	(0.46)	(2.07)	(2.11)	(1.79)
holder*time f.e.	No	Yes	Yes	No	Yes	Yes
security f.e.	No	No	Yes	No	No	Yes
N	4382	4368	3904	45487	45482	35532
R^2	0.015	0.206	0.567	0.031	0.258	0.648

Notes: Dependent variable is log of the amounts of security *i* held by sector *h* (a given institutional sector in a given country), in period *t*. Data for 2014Q1 and 2015Q2. Only holdings of newly issued securities, defined as those issued in the preceding 4 quarters. The term "vulnerable countries" refers to Ireland, Greece, Spain, Italy, Cyprus, Portugal and Slovenia. r_{it} is the yield-to-maturity of the corresponding security, in percent. m_h is the change in valuation between 2015Q2 and 2014Q1 of the portfolio held by sector *h* in 2014Q1, in percent. T_t is a dummy for the period 2015 Q2. In all specifications errors are clustered at the holding-sector level. t-statistics in parentheses * p<0.10 ** p<0.05 *** p<0.01.

Table 6

Investment in newly issued securities of holders resident in vulnerable countries; individual risk factors

	(1)		(2)		(3)	
portfolio valuation (m_h)	0.177	(1.61)				
post-APP period dummy (T_t)	0.452	(1.46)				
$Spread_{it}$	-0.132*	(-1.98)	-0.0330	(-1.17)		
$Maturity_{it}$	0.00391	(0.99)	0.00232	(0.70)		
$NonEur_{it}$	-1.005**	(-2.22)	-1.437***	(-5.35)		
$m_h * T_t$	-0.0326	(-0.61)				
$Spread_{it} * m_h$	0.0359*	(1.68)	0.00739	(0.63)	0.0230	(1.15)
$Maturity_{it} * m_h$	-0.00111	(-1.23)	-0.000928	(-1.24)	-0.0000211	(-0.07)
$NonEur_{it} * m_h$	0.0432	(0.40)	0.0111	(0.20)	0.0525	(0.48)
$Spread_{it} * T_t$	-0.262**	(-2.34)	-0.256*	(-1.91)		
$Maturity_{it} * T_t$	-0.000737	(-0.75)	0.0000207	(0.03)		
$NonEurit * T_t$	0.384*	(1.82)	0.673***	(2.84)		
$Spread_{it} * m_h * T_t$	0.0529**	(2.31)	0.0571*	(1.87)	0.0435*	(1.83)
$Maturity_{it} * m_h * T_t$	0.000179	(0.72)	0.0000614	(0.41)	-0.0000783	(-0.58)
$NonEur_{it} * m_h * T_t$	-0.0551	(-0.84)	-0.110*	(-1.86)	-0.109**	(-2.16)
holder*time f.e.	No		Yes		Yes	
security f.e.	No		No		Yes	
N	50374		50370		40209	
R^2	0.058		0.286		0.626	

Notes: Dependent variable is log of the amounts of security *i* held by sector *h* (a given institutional sector in a given country), in period *t*. Data for 2014Q1 and 2015Q2. Only holdings of newly issued securities, defined as those issued in the preceding 4 quarters. The term "vulnerable countries" refers to Ireland, Greece, Spain, Italy, Cyprus, Portugal and Slovenia. $Spread_{it}$ is the difference at time t between the yield-to-maturity of security *i* and the risk-free benchmark rate of a corresponding maturity, in percent. $Maturity_{it}$ is the residual maturity of security *i* at time *t*, in months. $NonEur_{it}$ is a dummy for securities denominated in currencies other than the euro. m_h is the change in valuation between 2015Q2 and 2014Q1 of the portfolio held by sector *h* in 2014Q1, in percent. T_t is a dummy for the period 2015 Q2. In all specifications errors are clustered at the holding-sector level. t-statistics in parentheses * p<0.10 ** p<0.05 *** p<0.01.

Table 7

Estimations on full portfolios (including newly issued and seasoned securities)

	Full sample			Investors in vulnerable countries		
	(1)	(2)	(3)	(4)	(5)	(6)
yield-to-maturity (r_{it})	-0.0733**	-0.0695***		0.0167	-0.00149	
	(-2.58)	(-2.77)		(0.38)	(-0.11)	
portfolio valuation (m_h)	-0.0802			0.0556		
	(-1.31)			(0.77)		
post-APP period dummy (T_t)	0.184			0.307*		
	(1.55)			(1.80)		
$r_{it}*m_h$	-0.0192**	-0.0219***	0.0139	-0.0409***	-0.0305***	0.0406***
	(-2.01)	(-2.74)	(1.27)	(-2.82)	(-6.87)	(3.94)
$r_{it}*T_t$	-0.0966*	-0.124***		-0.149***	-0.151**	
	(-1.77)	(-2.83)		(-2.72)	(-2.39)	
m_h*T_t	-0.0326			-0.0115		
	(-1.41)			(-0.33)		
$r_{it}*m_h*T_t$	0.0146	0.0213**	0.000476	0.0297**	0.0326*	-0.00772
	(1.24)	(2.16)	(0.12)	(2.29)	(1.96)	(-1.60)
holder*time f.e.	No	Yes	Yes	No	Yes	Yes
security*time f.e.	No	No	Yes	No	No	Yes
N	957680	957677	800033	249374	249372	190264
R^2	0.037	0.226	0.509	0.020	0.182	0.590

Notes: Dependent variable is log of the amounts of security *i* held by sector *h* (a given institutional sector in a given country), in period *t*. Data for 2014Q1 and 2015Q2. The term "vulnerable countries" refers to Ireland, Greece, Spain, Italy, Cyprus, Portugal and Slovenia. r_{it} is the yield-to-maturity of the corresponding security, in percent. m_h is the change in valuation between 2015Q2 and 2014Q1 of the portfolio held by sector *h* in 2014Q1, in percent. T_t is a dummy for the period 2015 Q2. In all specifications errors are clustered at the holding-sector level. t-statistics in parentheses * p<0.10 ** p<0.05 *** p<0.01.

Table 8

Investors in vulnerable countries; extensive margin

	(1)	(2)	(3)	(4)
yield-to-maturity (r_{it})	0.00886*		0.0105***	
	(2.40)		(3.17)	
portfolio valuation (m_h)	-0.00176	-0.00354		
	(-0.44)	(0.74)		
r_{it}*m_h	-0.00101	-0.00141	-0.000412	-0.0000575
	(-0.76)	(-0.95)	(-0.41)	(-0.06)
pseudo-security f.e.	No	Yes	No	Yes
holder f.e.	No	No	Yes	Yes
N	15179	14956	15179	14956
R^2	0.002	0.326	0.074	0.44

Notes: The sample is restricted to securities held in 2015Q2. The dependent variable identifies new holdings, i.e. conditional on being held in 2015Q2, securities which were not also held in 2014Q1, for each sector h (a given institutional sector in a given country). The term "vulnerable countries" refers to Ireland, Greece, Spain, Italy, Cyprus, Portugal and Slovenia. The dataset is "rectangularised" in order to account for the fact that non-reported holdings actually represent zero holdings. In order to keep the number of observations manageable, securities are grouped into around 2300 categories according to issuer sector, issuer country, maturity, coupon type, nominal currency and rating. r_{it} is the yield-to-maturity of the corresponding security, in percent. m_h is the change in valuation between 2015Q2 and 2014Q1 of the portfolio held by sector h in 2014Q1, in percent. In all specifications errors are clustered at the holding-sector level. t-statistics in parentheses * p<0.10 ** p<0.05 *** p<0.01.

Table 9

Investors in vulnerable countries; intensive margin ("rectangularised" dataset)

	Full sample				Investors in vulnerable countries			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
yield-to-maturity (r_{it})	-0.138***	-0.130***			-0.0955***	-0.0701***		
	(-6.13)	(-6.96)			(-4.46)	(-4.30)		
portfolio valuation (m_h)	0.0503*				0.0944***			
	-1.68				-4.21			
post-APP period dummy (T_t)	0.118***				0.11			
	-3.01				-1.6			
$r_{it}*m_h$	-0.00275	-0.0048	-0.00501	-0.00328	0.0006	-0.00640*	-0.00658	-0.00574
	(-0.74)	(-1.57)	(-1.50)	(-1.20)	-0.09	(-1.70)	(-1.53)	(-0.83)
$r_{it}*T_t$	-0.0496***	-0.0263**			-0.0365**	-0.0151		
	(-4.68)	(-2.56)			(-2.35)	(-1.31)		
m_h*T_t	-0.012				-0.0386*			
	(-1.38)				(-1.71)			
$r_{it}*m_h*T_t$	0.00414*	0.00153	0.0013	0.00510**	0.0117**	0.00397	0.003	0.00789**
	(1.91)	(0.75)	(0.57)	(2.40)	(2.47)	(1.37)	(0.94)	(2.58)
holder*time f.e.	No	Yes	Yes	Yes	No	Yes	Yes	Yes
pseudo-security*time f.e.	No	No	Yes	Yes	No	No	Yes	Yes
holder*issuer f.e.	No	No	No	Yes	No	No	No	Yes
N	103402	103400	102957	74294	30817	30816	30340	21094
R^2	0.022	0.334	0.525	0.93	0.041	0.314	0.545	0.928

Notes: Dependent variable is log of the amounts of security *i* held by sector *h* (a given institutional sector in a given country), in period *t*. Data for 2014Q1 and 2015Q2. The term "vulnerable countries" refers to Ireland, Greece, Spain, Italy, Cyprus, Portugal and Slovenia. The dataset is "rectangularised" in order to account for the fact that non-reported holdings actually represent zero holdings. In order to keep the number of observations manageable, securities are grouped into around 2300 categories according to issuer sector, issuer country, maturity, coupon type, nominal currency and rating. r_{it} is the yield-to-maturity of the corresponding security, in percent. m_h is the change in valuation between 2015Q2 and 2014Q1 of the portfolio held by sector *h* in 2014Q1, in percent. T_t is a dummy for the period 2015 Q2. In all specifications errors are clustered at the holding-sector level. t-statistics in parentheses * p<0.10 ** p<0.05 *** p<0.01.

Table 10

Portfolio valuation and credit growth

	(1)	(2)	(3)	(4)
portfolio valuation (m_b)	1.467**	1.346*	3.337***	3.434***
	(2.28)	(1.88)	(3.61)	(3.76)
High demand		3.631	4.368*	4.403*
		(1.31)	(1.72)	(1.73)
*m_b*Loans to Non Financial Corporations*			-1.375	-1.375
			(-0.99)	(-0.97)
*m_b*Vulnerable countries*			-3.563***	-3.225**
			(-2.97)	(-2.54)
*m_b*Low capital*				-1.051*
				(-1.89)
sector f.e.	Yes	Yes	Yes	Yes
country f.e.	Yes	Yes	Yes	Yes
bank controls	Yes	Yes	Yes	Yes
N	50	50	50	50
R^2	0.431	0.477	0.564	0.571

Notes: Dependent variable is the y-o-y growth rate of loans to households and to non-financial corporations granted by bank *b* in 2015Q2. m_b is the change in valuation between 2015Q2 and 2014Q1 of the portfolio held by bank *b* in 2014Q1, in percent. *High demand* is a dummy variable derived from the BLS identifying banks that reported a change in demand by a specific sector which is above the 3rd quartile of the distribution. *Loans to non-financial corporations* is a dummy variable identifying observations for this sector (so that loans to households become the baseline). Bank controls include each bank's *CDS* spread and *Low capital*: a dummy variable for banks with regulatory capital below the first quartile. *High demand* and *Low capital* are measured in 2013Q4, the *CDS* spread is measured in 2014Q1. In all specifications errors are clustered at the bank level. t-statistics in parentheses * p<0.10 ** p<0.05 *** p<0.01.

Table 11

Portfolio valuation and interest rates on loans

	(1)	(2)	(3)	(4)
portfolio valuation (m_b)	0.0406	0.0415	-0.279**	-0.266**
	-0.73	(0.75)	(-2.57)	(-2.33)
High demand		-0.441	-0.498**	-0.515**
		(-1.51)	(-2.13)	(-2.15)
*m_b*Loans to Non Financial Corporations*			0.390**	0.391**
			(2.64)	(2.63)
*m_b*Vulnerable countries*			0.0742	0.122
			(0.71)	(1.35)
*m_b*Low capital*				-0.146
				(-1.62)
sector f.e.	Yes	Yes	Yes	Yes
country f.e.	Yes	Yes	Yes	Yes
bank controls	Yes	Yes	Yes	Yes
N	100	100	100	100
R^2	0.342	0.374	0.526	0.542

Notes: Dependent variable is the change in the interest rates on new loans to households and to non-financial corporations applied by bank *b* between 2015Q2 and 2014Q1. m_b is the change in valuation between 2015Q2 and 2014Q1 of the portfolio held by bank *b* in 2014Q1, in percent. *High demand* is a dummy variable derived from the BLS identifying banks that reported a change in demand by a specific sector which is above the 3rd quartile of the distribution. *Loans to non-financial corporations* is a dummy variable identifying observations for this sector (so that loans to households become the baseline). Bank controls include each bank's *CDS* spread and *Low capital*: a dummy variable for banks with regulatory capital below the first quartile. *High demand* and *Low capital* are measured in 2013Q4, the *CDS* spread is measured in 2014Q1. In all specifications errors are clustered at the bank level. t-statistics in parentheses * p<0.10 ** p<0.05 *** p<0.01.

Appendix

Table A1

Baseline estimation on newly issued securities before the APP

	Full sample			Investors in vulnerable countries		
	(1)	(2)	(3)	(4)	(5)	(6)
yield-to-maturity (r_{it})	-0.0504	-0.0647**		-0.0998*	-0.0928***	
	(-1.21)	(-2.29)		(-1.99)	(-4.15)	
portfolio valuation (m_h)	-0.120*			0.0506		
	(-1.87)			(0.69)		
post-APP period dummy (T_t)	0.0452			0.000143		
	(0.69)			(0.00)		
$r_{it}*m_h$	-0.0134	-0.0108	0.0122	0.021	0.0175*	0.0281**
	(-0.83)	(-1.03)	(-1.12)	(1.09)	(1.84)	(2.29)
$r_{it}*T_t$	0.00554	0.0221**		0.0164	0.0389***	
	(0.38)	(2.27)		(0.94)	(3.49)	
m_h*T_t	0.00452			0.0466*		
	(0.31)			-1.71		
$r_{it}*m_h*T_t$	-0.00692	-0.00847***	0.00208	-0.00744	-0.0159***	0.0118
	(-1.52)	(-3.14)	(0.56)	(-1.28)	(-4.83)	(1.09)
holder*time f.e.	No	Yes	Yes	No	Yes	Yes
security f.e.	No	No	Yes	No	No	Yes
N	216898	216887	172160	49980	49975	39843
R^2	0.034	0.288	0.546	0.011	0.235	0.642

Notes: Dependent variable is log of the amounts of security i held by sector h (a given institutional sector in a given country), in period t. Data for 2013Q4 and 2014Q1. Only holdings of newly issued securities, defined as those issued in the preceding 4 quarters. The term "vulnerable countries" refers to Ireland, Greece, Spain, Italy, Cyprus, Portugal and Slovenia. r_{it} is the yield-to-maturity of the corresponding security, in percent. m_h is the change in valuation between 2015Q2 and 2014Q1 of the portfolio held by sector h in 2014Q1, in percent. T_t is a dummy for the period 2014Q1. In all specifications errors are clustered at the holding-sector level. t-statistics in parentheses * p<0.10 ** p<0.05 *** p<0.01.

Table A2

Estimations on full portfolios (including newly issued and seasoned securities) before the APP

	Full sample			Investors in vulnerable countries		
	(1)	(2)	(3)	(4)	(5)	(6)
yield-to-maturity (r_{it})	-0.0559**	-0.0700***		0.0175	-0.0239	
	(-2.32)	(-3.16)		-0.46	(-1.37)	
portfolio valuation (m_h)	-0.0713			0.0184		
	(-1.24)			-0.3		
post-APP period dummy (T_t)	0.0104			-0.0343		
	-0.36			(-0.74)		
$r_{it}*m_h$	-0.0197**	-0.0174**	0.0103	-0.0384***	-0.0195***	0.0210*
	(-2.50)	(-2.58)	-1.08	(-2.93)	(-3.53)	-1.8
$r_{it}*T_t$	0.00241	0.0163***		0.00261	0.0220**	
	-0.31	-2.93		-0.18	-2.31	
m_h*T_t	0.000872			0.0343*		
	-0.14			-1.99		
$r_{it}*m_h*T_t$	-0.00135	-0.00481***	0.001	0.00116	-0.00607**	0.0021
	(-0.53)	(-3.16)	-0.46	-0.25	(-2.13)	-0.53
holder*time f.e.	No	Yes	Yes	No	Yes	Yes
security f.e.	No	No	Yes	No	No	Yes
N	894714	894709	745334	243120	243117	183738
R^2	0.029	0.214	0.507	0.015	0.181	0.592

Notes: Dependent variable is log of the amounts of security *i* held by sector *h* (a given institutional sector in a given country), in period *t*. Data for 2013Q4 and 2014Q1. The term "vulnerable countries" refers to Ireland, Greece, Spain, Italy, Cyprus, Portugal and Slovenia. r_{it} is the yield-to-maturity of the corresponding security, in percent. m_h is the change in valuation between 2015Q2 and 2014Q1 of the portfolio held by sector *h* in 2014Q1, in percent. T_t is a dummy for the period 2014Q1. In all specifications errors are clustered at the holding-sector level. t-statistics in parentheses * p<0.10 ** p<0.05 *** p<0.01.

Table A3

Portfolio valuation and credit growth before the APP

	(1)	(2)	(3)	(4)
portfolio valuation (m_b)	1.479	0.364	2.120	2.679
	(0.41)	(0.42)	(1.17)	(1.22)
High demand		2.943	1.159	0.853
		(1.05)	(0.54)	(0.40)
*m_b*Loans to Non Financial Corporations*			-1.146	-1.225
			(-0.75)	(-0.77)
*m_b*Vulnerable countries*			-7.189	-5.962
			(-1.20)	(-1.34)
*m_b*Low capital*				-3.422
				(-0.86)
sector f.e.	Yes	Yes	Yes	Yes
country f.e.	Yes	Yes	Yes	Yes
bank controls	Yes	Yes	Yes	Yes
N	50	48	48	48
R^2	0.315	0.331	0.405	0.427

Notes: Dependent variable is the y-o-y growth rate of loans to households and to non-financial corporations granted by bank h in 2014Q1. m_b is the change in valuation between 2015Q2 and 2014Q1 of the portfolio held by bank *b* in 2014Q1, in percent. *High demand* is a dummy variable derived from the BLS identifying banks that reported a change in demand by a specific sector which is above the 3rd quartile of the distribution. *Loans to non-financial corporations* is a dummy variable identifying observations for this sector (so that loans to households become the baseline). Bank controls include each bank's *CDS* spread and *Low capital*: a dummy variable for banks with regulatory capital below the first quartile. *High demand*, *Low capital* and *CDS* are measured in 2012Q4. In all specifications errors are clustered at the bank level. t-statistics in parentheses * p<0.10 ** p<0.05 *** p<0.01.

Table A4

Portfolio valuation and interest rates on loans before the APP

	(1)	(2)	(3)	(4)
portfolio valuation (m_b)	-0.00863	-0.00863	-0.133	-0.161
	(-0.22)	(-0.22)	(-0.88)	(-1.01)
High demand		0.0903	0.264	0.264
		(0.29)	(0.96)	(0.96)
*m_b*Loans to Non Financial Corporations*			0.112	0.112
			(0.79)	(0.78)
*m_b*Vulnerable countries*			0.243	0.172
			(0.99)	(0.99)
*m_b*Low capital*				0.191
				(1.23)
sector f.e.	Yes	Yes	Yes	Yes
country f.e.	Yes	Yes	Yes	Yes
bank controls	Yes	Yes	Yes	Yes
N	96	96	96	96
R^2	0.132	0.133	0.160	0.175

Notes: Dependent variable is the change in the interest rates on new loans to households and to non-financial corporations applied by bank *b* between 2014Q1 and 2013Q4. m_b is the change in valuation between 2015Q2 and 2014Q1 of the portfolio held by bank *b* in 2014Q1, in percent. *High demand* is a dummy variable derived from the BLS identifying banks that reported a change in demand by a specific sector which is above the 3rd quartile of the distribution. *Loans to non-financial corporations* is a dummy variable identifying observations for this sector (so that loans to households become the baseline). Bank controls include each bank's *CDS* spread and *Low capital*: a dummy variable for banks with regulatory capital below the first quartile. *High demand, Low capital* and *CDS* are measured in 2012Q4. In all specifications errors are clustered at the bank level. t-statistics in parentheses * p<0.10 ** p<0.05 *** p<0.01.

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