Portfolio Rebalancing and the Transmission of Large-Scale Asset Programs: Evidence from the Euro Area

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Abstract

One of the main channels of transmission of large-scale asset programs is the so-called portfolio rebalancing channel, whereby, in a context of low yields, investors have incentives to shift their investments towards assets with higher expected returns. Using granular, security-by-security information on the composition of financial portfolios of all aggregate institutional sectors in the euro area countries, we document how asset allocation evolved around the announcement of ECB asset purchase programme (APP). In order to explore the role played by APP in tilting asset allocation, we exploit cross-sectional heterogeneity in the impact of the programme on the valuation of the financial portfolio held by each sector in Mach 2014, well before the introduction of asset purchases. Our findings suggest that portfolio rebalancing has been an active channel of transmission for APP, though significantly so only in the economies which were more affected by the crisis. Bank-level data suggest instead that the APP induced portfolio valuations have translated into increased lending activity only in less vulnerable countries.

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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 programs, whereby the central bank aims at lowering long-term yields through purchases of bonds. These programs were seen as a necessary monetary policy tool to provide stimulus once policy rates approached their effective lower bound. Early programs include the US QE1, QE2 and QE3 programs 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 Program (APP). This program was implemented later than the US and UK programs, 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 programs is whether they work, in the sense of generating a positive impact on macro-economic developments and, if so, through which channel. A direct impact from reduced interest rates is unlikely to be important for asset purchase programs (see Stein 2012).[2] Another possible channel is signaling (whereby asset purchases serve as a commitment device for relatively high future inflation targets). Krishnamurthy and Vissing-Jorgensen (2013) reject this channel for the US. Instead, these authors suggest that the US QE programs have worked largely through a narrower channel, increasing the price of the specific assets purchased under the program, with possible spillovers depending on institutional features and economic conditions.

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[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 programs 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).

A related channel, widely emphasized in the policy debate, is the portfolio rebalancing channel: asset purchase programs exert pressure on the supply of credit to the riskier segments of the economy, typically those suffering the most from credit supply restrictions during downturns as, by reducing yields on safe long-term securities, investors have incentives to shift their investments towards assets with higher expected returns, thus taking on more risk. This search-for yield is argued to represent an important channel of transmission of purchase programs, 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 of the program. 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 a perverse byproduct of asset purchase programs as it implies an increased risk taking that may sow the seeds for future crises.[3] It is therefore crucial to document not only if portfolio rebalancing takes place, but also 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 granular information on the composition of security portfolios for all aggregate holding sectors in euro area countries. 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 program 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 APP in explaining such massive decline in yields has been demonstrated in analyses based on an event study methodology (Altavilla et al., 2015).

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

[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 programs.

gains. 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. 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 corporations, non-financial corporations, households (including non-profit institutions serving households), general governments and rest of the world.[4]

Our identification strategy relies on two assumptions. One is that, across holding sectors, incentives for rebalancing are commensurate to the changes in the value of the portfolio. If, prior to the yield decline phase, a sector was holding securities whose yields has diminished little, then such sector is supposed to be have lower incentives to search-for yield and rebalance towards riskier (higher-yield) securities. This means that 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 was a gain of around 2% and the 75th percentile around 4%.

The second assumption is that we can 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 would be consistent with 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. We present results for all securities in the dataset but we give a special focus on newly issued debt securities. This is because, by

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

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.

It is also crucial to emphasize that purchases under the APP are subject to strict rules concerning their cross-country allocation based on euro-area national central banks' individual shares in ECB's capital. This rules out that the ECB was targeting securities in specific countries and the related possible endogeneity issues.

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), but we will also look at specific dimensions of risk, such as the rating and the residual maturity.

Throughout our analysis we will also assess portfolio rebalancing across vulnerable and less vulnerable countries.[5] 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.

The analysis of rebalancing in debt security portfolios allows for an assessment of effects on the supply of credit in the form of securities. However, in the euro area, bank lending constitutes the key source of financing for most firms – especially SMEs. We estimate the effect of the APP on bank lending by exploiting a detailed dataset for each of the largest twenty five banking groups in the euro area.

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 at before the announcement of the APP. We then measure whether this is related to the amount of loans subsequently extended to the real economy, controlling for possible heterogeneity in demand conditions faced by lenders operating in different countries.

[5] 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 programs. 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 programs by central banks. Overall, this strand of literature argues that asset purchase programs increase asset prices and diminish bond-yields.[6]

Other papers use bank-level information to investigate the presence of a bank lending channel of asset purchase programs by testing whether banks that end up receiving most of the liquidity injected with central bank purchases of long-term bonds have disproportionately

[6] These papers include, among others, Krishnamurthy and Vissing-Jorgensen (2013) on FED's QE, Joyce and Tong (2012) on Bank of England's program, 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. He also finds an impact of monetary policy shocks on governments and corporate bonds, although only a transitory one.

increased their loan supply. Butt et al (2014), looking at UK's experience, do not find significant 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 programs 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 programs on the real economy.[7] 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 programs are introduced at non-random times, the results may be confounded.

Peydrò et al (2016) exploit granular bank-level data on individual security and borrower exposures of Italian banks. Their objective is to study how banks' investment decisions are influenced by the monetary policy rate or by the adoption of unconventional monetary policy measures, captured by the size of the central bank balance-sheet. They conclude that unconventional monetary policy measures do not induce risk-taking in the composition of security portfolios nor on lending supply. Compared to Peydrò et al (2016), whose sample period ends in 2013, we use a dataset covering a more limited time span but which covers the APP. We also analyze security-by-security holdings of 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. 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 program. As mentioned, APP started to reflect on the size of the central bank-balance sheet only gradually, starting in March 2015, while the price impact on long-term yields took place

[7] 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 p.p. 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.

entirely before that date.[8] We also exploit bank-level information on security holdings for a sample of large banking groups in the euro area but, unlike Peydrò et al (2016), we cannot match this information with loan-level data. Nonetheless, we will be able to provide an assessment of whether portfolio rebalancing has benefitted loan-supply by integrating our dataset with bank-level information on the amount and the cost of the credit extended to different sectors, including firms and households.[9]

Another paper close to ours is Koijen et al (2016). Based on a dataset similar to ours, the authors describe the evolution of portfolio composition across institutional sectors in the euro area and build a methodology to assess its impact on yields, different from more standard event study approaches based on high frequency data. Our focus, instead, is on how monetary policy has been affecting the composition of security portfolios.

3. The data and descriptive evidence

The security holding statistics (SHS) dataset contains granular information at individual ISIN level on securities held in the euro area. In more detail, it includes holdings by residents of each euro area and some other EU countries, as collected by the corresponding country, and holdings by non-euro area residents in custody in the euro area.[10] The dataset has a widespread coverage, at close to 90 per cent of the universe of debt securities reported in the national accounts. The SHS dataset includes also granular information on the portfolio of securities held by each of the 25 largest euro area banks. This dataset is matched with bank-level information on stocks and flows of loans granted to the non-financial private sector and on the corresponding interest rates, so as to investigate the impact of the monetary policy shock on bank lending to the real economy.

The first form of rebalancing that can be observed from raw data is across types of securities held (Chart 1). A clear rebalancing of portfolios towards equity instruments was

[8] Implicit in our choice is the idea that portfolio rebalancing is a special case of search for yield. From this perspective, what really matters is the impact of the announced measures on yields and this, in principle, could originate even without actual purchases, as shown by the notorious episode where ECB President Draghi committed to do "whatever it takes" to fulfill his keep the central bank's mandate.

[9] A similar dataset is exploited in Abbassi et al (2015) who uses granular bank-level data from Germany on individual security and borrower exposures and establishes that trading experienced banks are more likely to cut loan supply to exploit investment opportunities in financial markets.

[10] In principle the dataset also includes holdings by non-financial residents of each euro area country in custody in other euro area countries and therefore collected by these other euro area countries; however, due to data quality concerns and in order to avoid possible double-counting, this component is excluded.

observed for OFI and, to a smaller extent, private sector non-euro area investors in 2015 Q2, compared to 2014Q1. This 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, the ultimate goal of monetary policy. Once holding amounts are adjusted for valuation effects (not shown), a visible rebalancing towards equity was observed only for OFIs, though these holdings represent a negligible share of the overall portfolio of securities. It remains therefore to be assessed whether portfolio rebalancing benefitted the supply of new credit in the form of bonds.

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, 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 programs 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.[11]

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:

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

The variable $h_{i,h,t}$ is the (log) amount of holdings of 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 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.

Although expectations and implementation of APP are plausibly the most important drivers of financial asset prices in the period under examination, prices of securities may have also changed for other reasons unrelated to APP. This is not problematic for our approach. First, the notion of search-for-yield refers to a reduction of yields and does not

[11] It should be pointed out that we are considering the security residual maturity as a (rather crude) proxy for financial duration for which no information is available.

require the yield to diminish for a specific reason or factor, such as monetary policy. Second, the distinction between actual changes in prices and changes related to monetary policy matters for the quantification of the its effects but not for the estimation of the coefficient the coefficient β_1'', at least as long as m_h can be considered an exogenous regressor. As the portfolio composition over which m_h is computed is the one prevailing before market yields declined, it can by definition not be influenced by expectations of quantitative easing (which would lead to reverse causality).

As discussed, *on aggregate*, 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 (end 2014 Q1, end 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.[12]

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.[13] Indeed, starting from Kwhaia 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

[12] 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 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.

[13] Clearly 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 will also show, among the extensions, some estimations conducted on both seasoned and newly issued securities.

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*.

Search for yield is investigated using the yield to maturity as an encompassing measure of risk (r_{jt}), as well as more specific components such as credit risk (spread), maturity risk and exchange rate risk.

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 different types of controls and different sub-samples. 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 euro area economies. During the sovereign debt crisis financial conditions in countries more directly involved have significantly diverged from those of other countries. 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.[14]

[14] For instance, the spread between the yield on domestic 10-year sovereign bonds and the corresponding German figure was about 2 p.p. in Italy and Spain, 3 p.p. in Portugal. Spreads on sovereign may be though as a lower bound for spreads on corporates, so financial market fragmentation was still sizeable. Sovereign spreads started diminishing thereafter and reached minimum levels in March 2015 when they stabilized at smaller but still non negligible levels (1 p.p. Italy and Spain, 2 in Portugal).

These differences may have important implications for portfolio rebalancing, although a priori it is not clear in which direction they should affect the intensity of rebalancing. Opposite hypotheses can be made. 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. At the same time, interest rates in less vulnerable economies were so low and possibly squeezed toward their lower bound (10-year Bund in March 2015 was 0.2 percent; yields on many shorter term bonds were negative) 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). Of course, this reasoning implies some fragmentation in financial markets, such that investors in other countries are reluctant to invest in the countries which were more affected by the sovereign crisis. These two hypotheses have opposite implications on whether one should expect more rebalancing in one area or in the other. To gain some insight on this we explore the international coverage of our dataset to investigate the behavior of investors by focusing on the two groups separately.

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 vulnerable countries.[15] 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 for m_h). More generally, this implies that the result is robust once we

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

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.[16]

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 p.p.) increases in the post period by 10 p.p.. [17] 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 is negative in 2014 Q1 and even slightly diminishes in 2015 Q2, possibly reflecting the generalized reduction of spreads (for a given increase in yield in post the increase in underlying risk, say the probability of default, is larger than in the pre-announcement).

As discussed above, one interpretation of finding evidence of rebalancing only in more vulnerable economies is that investors residing in 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 where home bias is still persistent. In other words, being at the zero-lower bound may be a constraint for the rebalancing rather than a factor exacerbating risk taking.

[16] 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).

[17] Note that the OLS is the only specification where an estimate of the level of the coefficient of semi-elasticity, which summarise 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 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 programs. At the same time, it should be emphasized that only large corporates can issue securities on the market and these firms tend to be constrained in their access to credit.[18]

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.[19] 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 p.p. one needs to lengthen the maturity by a much bigger amount compared to normal times). Absence of rebalancing towards non-euro denominated securities may signal a residual persistent fragmentation of

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

[19] 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.

financial markets that is restraining the allocation of euro area investors. Note that these regressions exclude foreign investors who are responsible, together with investment funds, 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).

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, that is, investments in assets issued by issuers toward which the investors were not already exposed prior to APP announcements.

[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 then define a dummy-variable identifying new holdings, i.e. security categories held in positive amount in 2015 Q2 but not in 2014 Q1. We then drop observations for 2014 Q1 and estimate a linear probability model for the new holding dummy. 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.

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.

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. We then investigate the impact of this measure on quantities and prices of loans granted to the non-financial private sector. Although 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 around 70% of total assets.

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 Q1. The regressions are estimated by also including a set of country fixed effects, as controls for (country-wide) credit demand and risk. Standard errors are clustered at the bank level. Table 10 shows that there is a statistically significant relation between the monetary policy shock and the growth rate of loans to non-financial private sector (column 1).[21] The results in the second column of the table show that this effect is not statistically different for loans to households and to non-financial corporations (NFC), even though the negative coefficient suggests that the effect is somewhat weaker for loans to the latter sector.[22] In what concerns geographical patterns, the relationship is found to be significant only for banks headquartered in less vulnerable countries. These results are robust to the inclusion of bank-specific control variables such as regulatory capital ratios, asset quality, CDS and rating (not shown). As such, it should not be driven by differences in the balance sheet strength or market perceptions of the risk of banks across jurisdictions.

We also run similar estimations where the dependent variable is the interest rates applied on new loans extended in the four quarters to 2015 Q1. No relationship is found for the non-financial private sector as a whole (Table 11, column 1). However, this masks underlying differences across sectors. High m_h banks are found to decrease the interest rates

[21] 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 banks whose investment portfolio is made preeminently of government bonds, in response to anticipations of a rebalancing of their portfolios. Focusing on the case of Italy, Affinito et al. (2016) analyze banks' purchases of domestic government bonds in the years 2007-2013. They conclude that investing in sovereign bonds represented, for Italian lenders, a way to support their own balance sheet conditions at a time of increasing credit and liquidity risk.

[22] A test for the join-significance of both coefficients in column 2 allows for the rejection of the hypothesis that the effect for NFC is equal to zero.

applied on loans to households by comparatively more. This is not the case for loans to NFC whose interest rate displays, counter-intuitively, a positive relation with m_h,, the more so the larger the size of the loans 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.[23]

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. As mentioned above, the portfolio rebalancing channel has attracted a lot of attention in the public debate, despite the fact that its actual relevance is largely unknown.

This channel exerts its effects by inducing an increase in risk appetite. While this may conceivably pose financial stability risks, whether an increase in risk appetite is desirable or not depends on whether the current level of risk taking is below optimum or not. One of the main conclusions of our analysis is that the APP-related portfolio rebalancing is statistically significant only for asset holders residing in more vulnerable countries, where credit conditions are still comparatively tight or, in other words, risk taking is still sub-optimal.

Regarding the transmission of the APP to the real economy via the portfolio rebalancing channel, we obtain a mixed picture. First, we show that the APP-related increase in risk-taking in vulnerable economies has affected securities issued by corporates (as opposed to sovereigns) and has resulted in more credit risk-taking (as opposed to maturity or currency risk-taking). However, when looking at lending volumes granted by banks, we obtain evidence of effects limited to non-vulnerable countries.

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

[23] 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 then affected by monetary policy.

be needed.[24] This could also explain why in these economies some rebalancing of banks towards real-sector loans (where presumably spreads are still positive) is detectable. One possible explanation for the fact that in vulnerable economies rebalancing has concerned financial securities but not loans to the real economy is that some constraints have limited the expansion in the supply of bank loans. These could be related to regulatory or supervisory activity. Overall, our results do not support the claim that APP poses risks to financial stability while, at the same time, they are consistent with the presence of exogenous constraints limiting its pass-through to the real economy.

[24] 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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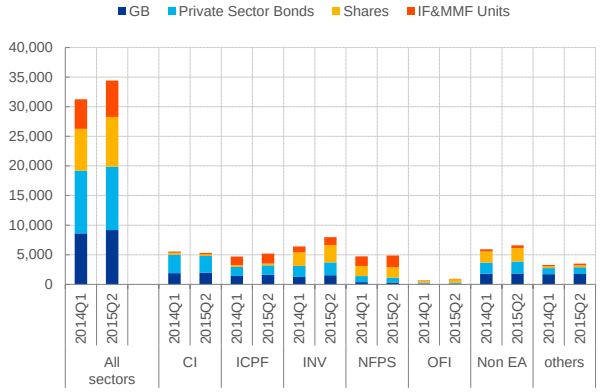
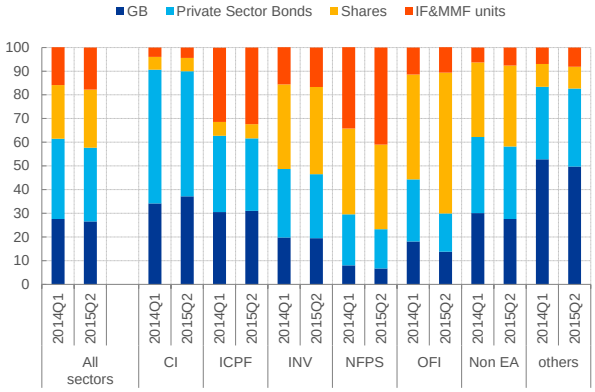
Charts & Tables

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 preceeding 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. mh is the change in valuation of the portfolio of sector h in 2014 Q1, 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. Only holdings of newly issued securities, defined as those issued in the preceeding 4 quarters. The t erm "vulnerable countries" refers to Ireland, Greece, Spain, Italy, Cyprus, Portugal and Slovenia. Yield-to-maturity in percent. Spreadit 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. mh is the change in valuation of the portfolio of sector h in 2014 Q1, 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 preceeding 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 securitiy, in percent. m_h is the change in valuation of the portfolio of sector h in 2014 Q1, 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 p.p. 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 preceeding 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 securitiy, in percent. m_h is the change in valuation of the portfolio of sector h in 2014 Q1, 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)
$Spread_{it} * Tt$	-0.262**	(-2.34)	-0.256*	(-1.91)		
$Maturity_{it} * Tt$	-0.000737	(-0.75)	0.0000207	(0.03)		
*NonEurit*Tt*	0.384*	(1.82)	0.673***	(2.84)		
$Spread_{it} * m_h * Tt$	0.0529**	(2.31)	0.0571*	(1.87)	0.0435*	(1.83)
$Maturity_{it} * m_h * Tt$	0.000179	(0.72)	0.0000614	(0.41)	-0.0000783	(-0.58)
$NonEur_{it} * m_h * Tt$	-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: Dep. 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 preceeding 4 quarters. The term "vulnerable countries" refers to Ireland, Greece, Spain, Italy, Cyprus, Portugal and Slovenia. Spreadit 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 currenciues other than the euro. mh is the change in valuation of the portfolio of sector h in 2014 Q1, in percent. Tt 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**	-456.7
	(-1.77)	(-2.83)		(-2.72)	(-2.39)	(-0.00)
$m_h * T_t$	-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 securitiy, in percent. m_h is the change in valuation of the portfolio of sector h in 2014 Q1, 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 manegable, 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 securitiy, in percent. m_h is the change in valuation of the portfolio of sector *h* in 2014 Q1, 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)	(5)	(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. Only holdings of newly issued securities, defined as those issued in the preceeding 4 quarters. 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 manegable, securities are grouped into around 2300 categories according to issuer sector, issuer country, maturity, coupon type, nominal currency and rating. rit is the yield-to-maturity of the corresponding securitiy, in percent. mh is the change in valuation of the portfolio of sector h in 2014 Q1, in percent. Tt 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_h)	1.633**	2.335**	2.797***	3.527***
	(2.75)	(2.68)	(4.03)	(3.57)
*m_h*Loans to Non Financial Corporations*		-1.405		-1.460
		(-1.04)		(-0.92)
*m_h*Vulnerable countries*			-3.262***	-3.429***
			(-3.64)	(-3.72)
*m_h*L_{NFC}*Vulnerable countries*				0.335
				(0.17)
sector f.e.	Yes	Yes	Yes	Yes
country f.e.	Yes	Yes	Yes	Yes
N	50	50	50	50
R^2	0.402	0.422	0.463	0.483

Notes : Dependent variable is y-o-y growth of loans to households and to non-financial corporations granted by bank h in 2015Q2. The interaction term *Loans to non-financial corporations* is a dummy-variable identifying observations for this sector (so that households becomes the baseline). m_h is the change in valuation between 2015Q2 and 2014Q1 of the portfolio held by bank *h* in 2014 Q1, in percent. 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)	(5)	(6)
portfolio valuation (m_h)	0.034	-0.250*	-0.250*	0.016	-0.271***	-0.271**
	(0.72)	(-1.77)	(-1.75)	(0.40)	(-2.81)	(-2.75)
*m_h*Loans to Non Financial Corporations*		0.378**			0.383***	
		(2.46)			(3.13)	
*m_h*Loans to NFC up to € 0.25 million*			0.324*			0.320**
			(1.92)			(2.35)
*m_h*Loans to NFC above € 0.25 and up to € 1 million*			0.378**			0.413***
			(2.28)			(2.95)
*m_h*Loans to NFC above € 1 million*			0.433***			0.414***
			(3.02)			(3.70)
*m_h*Vulnerable countries*				0.05	0.071	0.071
				(0.44)	(0.24)	(0.23)
*m_h*Vulnerable countries*L_{NFC}*					-0.027	
					(-0.09)	
*m_h*Vulnerable countries*L_{NFC} up to € 0.25 million*						0.021
						(0.05)
*m_h*Vulnerable countries*L_{NFC} above € 0.25 and up to € 1 million*						-0.217
						(-0.63)
*m_h*Vulnerable countries*L_{NFC} above to € 1 million*						0.115
						(0.44)
sector f.e.	Yes	Yes	Yes	Yes	Yes	Yes
country f.e.	Yes	Yes	Yes	Yes	Yes	Yes
N	100	100	100	100	100	100
R^2	0.315	0.455	0.463	0.317	0.457	0.483

Notes : Dependent variable is the change in the interest rates on new loans applied by bank h between 2015Q2 and 2014Q1. m_h is the change in valuation between 2015Q2 and 2014Q1 of the portfolio held by bank *h* in 2014 Q1, in percent. 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		
$r_{it}*m_h$	-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 preceeding 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 securitiy, in percent. m_h is the change between 2014 Q1 and 2015 Q2 in valuation of the portfolio held by sector h in 2014 Q1, in percent. T_t is a dummy for the period 2014 Q1. 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 securitiy, in percent. m_h is the change between 2014 Q1 and 2015 Q2 in valuation of the portfolio held by sector h in 2014 Q1, in percent. T_t is a dummy for the period 2014 Q1. 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_h)	1.479	1.766	1.537	1.866
	(1.32)	(1.15)	(0.88)	(0.87)
*m_h*Loans to Non Financial Corporations*		-0.573		-0.659
		(-0.42)		(-0.53)
*m_h*Vulnerable countries*			-0.163	-0.422
			(-0.09)	(-0.18)
*m_h*L_{NFC}*Vulnerable countries*				0.519
				(0.19)
sector f.e.	Yes	Yes	Yes	Yes
country f.e.	Yes	Yes	Yes	Yes
N	50	50	50	50
R^2	0.270	0.272	0.270	0.272

Notes : Dependent variable is y-o-y growth of loans to households and to non-financial corporations granted by bank h in 2014Q1. The interaction term *Loans to non-financial corporations* is a dummy-variable identifying observations for this sector (so that households becomes the baseline). m_h is the change in valuation between 2015Q2 and 2014Q1 of the portfolio held by bank *h* in 2014 Q1, in percent. 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)	(5)	(6)
portfolio valuation (m_h)	-0.0217	-0.0631	-0.0631	-0.0366	-0.0647	-0.0647
	(-0.48)	(-0.53)	(-0.52)	(-0.53)	(-0.45)	(-0.44)
*m_h*Loans to Non Financial Corporations*		0.0552			0.0374	
		(0.50)			(0.33)	
*m_h*Loans to NFC up to € 0.25 million*			0.0903			0.0850
			(0.86)			(0.77)
*m_h*Loans to NFC above € 0.25 and up to € 1 million*			0.0807			0.0698
			(0.66)			(0.55)
*m_h*Loans to NFC above € 1 million*			-0.00535			-0.0425
			(-0.05)			(-0.35)
*m_h*Vulnerable countries*				0.0418	-0.0393	-0.0393
				(0.54)	(-0.34)	(-0.34)
*m_h*Vulnerable countries*L_{NFC}*					0.108	
					(0.79)	
*m_h*Vulnerable countries*L_{NFC} up to € 0.25 million*						0.0321
						(0.31)
*m_h*Vulnerable countries*L_{NFC} above € 0.25 and up to € 1 million*						0.0663
						(0.54)
*m_h*Vulnerable countries*L_{NFC} above to € 1 million*						0.226
						(0.69)
sector f.e.	Yes	Yes	Yes	Yes	Yes	Yes
country f.e.	Yes	Yes	Yes	Yes	Yes	Yes
N	100	100	100	100	100	100
R^2	0.118	0.121	0.127	0.119	0.124	0.138

Notes : Dependent variable is the change in the interest rates on new loans applied by bank h between 2014Q1 and 2013Q4. m_h is the change in valuation between 2015Q2 and 2014Q1 of the portfolio held by bank h in 2014 Q1, in percent. In all specifications errors are clustered at the bank level. t-statistics in parentheses.

* p<0.10 ** p<0.05 *** p<0.01