Negative Monetary Policy Rates and Systemic Banks' Risk-Taking: Evidence from the Euro Area Administrative Securities Register

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Abstract

We show that negative monetary policy rates affect the securities portfolio of large, systemic banks. For identification, we exploit the introduction of negative deposit rates by the ECB in June 2014 in conjunction with the novel, administrative securities register for the 26 biggest Euro Area banking groups. Banks that are more reliant on customer deposits are more affected by negative rates – exposed banks – as these banks do not pass the negative rates to their customers. Overall, the size of the security portfolios of the large Euro area banks declined in the aftermath of the introduction of negative policy rates. Affected banks retained assets yielding higher returns in their portfolio compared to the other banks. This result holds also when controlling for security risk characteristics, like maturity and ratings, which are the main determinants of capital regulation. The rebalancing of the portfolio was driven by debt securities issued by the private sector, financial and non-financial, and by companies residing in the Euro Area and in other developed countries, as opposed to emerging markets.

Keywords: Negative policy rates, non-standard monetary policy, search for yield, banks.

JEL Codes: E43, E52, G01, G21, G11.

1 Introduction

An important difference in the implementation of monetary policy in the Euro Area and in the US was the use of negative policy rates, which were introduced by the ECB in June 2014, when the deposit rate for commercial banks with an account at the central bank was lowered at -10 basis points. What are the effects of negative policy rates for banks? There is evidence that banks do not pass through the negative rates to their depositors, in particular retail customers. Given the importance of banks in the Euro Area (a bank dominated economy) this may in turn have important aggregate consequences for the economy.

The transmission of monetary policy at the zero lower bound and below has become a topic of particular interest for researchers and policy makers since several central banks have chosen this path in the last few years (Brunnermeier and Koby, 2017; Eisenschmidt and Smets, 2017). There is also a growing literature assessing how negative policy rates (NPR) are transmitted through the banking sector and how they affect credit supply and equity valuation (see for example Ampudia and van den Heuvel, 2017; Basten and Mariathasan, 2017; Heider, Saidi and Schepens, 2017). However, to the best of our knowledge, ours is the first paper to analyze how negative policy rates affect investment choice in the securities portfolios of banks.

Securities holdings are an important fraction of bank balance sheets, around 20% of total bank assets in the US and Europe. There are recent policy initiatives aimed at limiting security trading by banks (Volker Rule in the Dodd-Frank Act in the US, the Liikanen Report in the EU and Vickers' report in the UK) based on financial stability consideration, since risk-taking by banks is easier and faster through adjustment to their liquid securities holdings rather than illiquid credit (Myers and Rajan, 1998). Furthermore, the Euro Area sovereign crisis has shown the vicious negative cycle arising from banks' holdings of sovereign debt during periods of market stress, and the riskiness of the so-called sovereign-bank nexus (Acharya and Steffen, 2015; Brunnermeier, Garicano, Lane, Pagano, Reis, Santos, Thesmar, Van Nieuwerburgh and Vayanos, 2016).

In this context, finding evidence of *search for yield* is especially challenging, as it requires to observe micro-level information on the riskiness of all securities, e.g. the yield or the rating of a security (being sovereign or not). Access to comprehensive, granular banking data is thus crucial to identify phenomena of reach-for-yield. The security register that we use in this analysis contains – at the security (ISIN) level – all securities investments for each of the 26 largest banks in the Euro Area (not just government bonds, or just securities that banks pledge as collateral to borrow liquidity from the ECB). We analyze debt securities, and, for each security, we have information on yield, issuer, rating, price and remaining maturity. In particular we observe, even within the same issuer (like a sovereign), all the different securities with different yields and maturities held by the banks in each quarter.

A reduction in the policy rate transmits to short-term rates first. Since banks tend to have long-term assets and shorter-term liabilities on their balance sheet, a rate cut should result in an increase in bank net worth. This is based on the assumption that banks can immediately pass-through the rate cut on their liability side – and therefore fund themselves at lower rates, while the asset side remains largely unaffected at first – leading to an increase in the value difference between assets and liabilities, and hence in the net worth of banks. This should relax

financial constraints and possibly increase lending and investment in securities. However, banks might be unwilling to pass-through negative rates to their retail customer depositors – fearing the withdrawal of deposits. Hence the intensity of the treatment induced by the introduction of negative policy rates depends on the funding structure of the banks. A cut bringing policy rates into negative territory should have a stronger positive effect on the net worth of banks largely funded by wholesale debt, as opposed to retail customer deposits. On the other hand, operating in a negative interest rate environment is likely to put negative pressure on the net worth of banks with a high customer deposit ratio, and could even induce a *reversal rate* such that lower monetary rates become contractive, rather than expansive, for banks (Brunnermeier and Koby, 2017).

Our estimations are based on a differences-in-differences specification that uses data on securities holdings in Q4 2013–Q1 2014 for the pre-NPR (negative rates) period and Q2 2014–Q4 2014 for the post-NPR. We end the analysis in Q4 2014 because the implementation of the asset purchase program of the ECB (the PSPP program starting in January 2015) is likely to confound our results. The dataset comprises the 26 largest euro area banking groups. We analyse the data at the security-bank-quarter level. This allows us to: (1) test whether the reaction to the introduction of negative policy rates differs with certain (observed) bank characteristics controlling for unobserved bank heterogeneity; (2) control for unobserved security characteristics that affect the supply of a particular security via security (or other related) fixed effects (e.g. issuance of some securities); and (3) to identify search for yield, in particular whether banks with different characteristics (deposit ratio) change their holdings of securities with different ex-ante yields.

Both the supply and the demand for securities should respond to changes in policy rates. By using a differences-in-differences specification we analyze how the holdings of a particular security change in response to the introduction of negative policy rates, differentiating between high-deposit banks and low-deposit banks. We argue that low-deposit banks are differentially affected when policy rates reach negative territory and this provides a way to identify the effects of negative policy rates on the security portfolio from other forces that shape both monetary policy and the investment behaviour of large euro area banks (see Heider, Saidi and Schepens, 2017).

Our robust results show that the introduction of negative policy rates induced an overall deleveraging of the securities portfolio of the large Euro Area banks. Moreover, negative policy rates led to a search for yield in the security portfolio of exposed banks. Banks more reliant on customer deposits retained in their securities portfolio assets yielding higher returns compared to the other banks, also when controlling for security risk characteristics, like maturity and ratings, which are the main determinants of capital regulation. We find no evidence of a similar relationship in the period before the introduction of negative rates. Before the introduction of negative rates, the response of banks' portfolios to changes in yields for different levels of deposit ratio would not differ. Finally, we also show that affected banks became more sensitive to changes in yield of debt securities issued by private firms, financial and non-financial, residing in the Euro Area and in other developed countries, while there are no significant effects on the

holdings of securities issued in emerging markets, suggesting that this channel of international transmission of monetary policy was confined to developed economies.

We contribute to the growing literature on the impact of non-standard monetary policy measures, in particular negative policy rates, on banks' risk-taking. To the best of our knowledge, this is the first paper to show how negative policy rates affect the investment in the securities portfolios of banks. As mentioned above, analyzing risk-taking in securities is particularly important for policy makers as reaching for yield through changes in securities holdings can be easier and faster for banks rather than through changes in their loan portfolio (Myers and Rajan, 1998). To meet related financial stability concerns, proprietary trading in securities by banks has been regulated in the US via Volcker rule in the Dodd-Frank Act, but regulation has only been discussed in Europe via the Liikanen Report and the proposal on limits on sovereign debt holdings by banks.

Our results are complementary to the results found by Heider, Saidi and Schepens (2017). We broadly share their identification strategy, based on the banks' reliance on deposits. They look at the risk profile of the syndicated loan portfolio of banks during the period of the introduction of negative interest rates and disentangle bank specific determinants using different banks within a loan syndicate (see also Aramonte, Lee, and Stebunovs, 2015). They analyze the impact of negative policy rates on the loan supply provided by banks and show that banks with more deposits tend to lend less and to riskier borrowers. We provide complementary evidence based on the analysis of the securities portfolio holdings of banks and in particular of different banks holding the same security. Taken together, these two studies suggest that banks that are more affected by the negative impact on margins increase their risk in both their loans and securities portfolios. Using loans provided to the same firm by different banks and a differences-in-differences strategy via the deposit ratio Schelling and Towbin (2018) find that banks with a lot of deposits offer more generous lending terms in order to capture market shares.

Abbassi, Iyer, Peydró and Rodriguez (2015) find similar evidence for a sample of German banks during the period successive to the bankruptcy of Lehman Brothers. Banks with higher trading expertise increased their investments in securities, especially in low-rated and long-term securities. At the same time, these banks reduced their credit supply, suggesting a substitution from loans to securities yielding higher returns. Our results also complement these findings, since we find evidence related to banks' portfolio holdings for the Euro Area that can be related to changes in monetary policy, as opposed to the financial crisis.

Our study is also related to the analysis of Demiralp, Eisenschmidt and Vlassopoulos (2017), who assess the impact of negative policy rates on lending volumes and holdings of government bonds. Their identification strategy is based on banks' excess liquidity deposited at the ECB. They find that more exposed banks increase their overall holdings of non-domestic government bonds: however their dataset does not have the granularity to control for the risk at the security level nor the exhaustive analysis of heterogeneous effects across different securities with different risk level (i.e., we exploit a securities register). Using a similar identification strategy — central bank reserves at the Swiss National Bank – Basten and Mariathasan (2017) show that, in aggregate, more affected banks are lending more and invest more in financial assets.

However, also in this study, it is not clear if they can control for the borrower and/or the security-level risk. Arce, García-Posada, Mayordomo and Ongena (2018) rely on bank's self-reports of the degree to which negative interest rates affect their net income for identification of the effects of negative interest rates on credit growth, credit standards and loan supply. They use banks that report their profits to be unaffected by negative policy rates as the control group in a differences-in-differences analysis on the bank- and (non-syndicated) loan-level.

Our work is closer in spirit to the analysis of Koijen, Koulischer, Nguyen and Yogo (2016) which use a security-level dataset on holdings for euro area sectors. We use the holdings of a limited (albeit the largest majority in terms of asset size) euro area banks and can disentangle the holdings at the level of a single banking group.

Ampudia and van den Heuvel (2017) look at the effects of ECB monetary policy announcements on bank equity, measured by a bank's stock market capitalization, including during periods of low interest rates. They find that when interest rates are positive, an unexpected decrease in policy rates raises bank equity – as in English, Van den Heuvel and Zakrajsek (2014). However, when rates are negative, the impact can be reversed and further rate cuts lower bank equity, a result consistent in spirit with the notion of a reversal rate as in Brunnermeier and Koby (2017).

Finally, we corroborate some of the findings by Peydró, Polo and Sette (2017). Using the Italian security register during the recent crisis period, they show that in response to a monetary policy loosening bank risk-taking is proportional to a particular bank's risk-bearing capacity (i.e. bank leverage) – a result inconsistent with the risk-shifting hypothesis which would apply to banks with low levels of capital (gambling for resurrection). We confirm their findings for the period in which negative policy rates were introduced by the ECB, showing that this relationship holds for a sample of banks incorporated in both core and periphery euro area countries.

2 Data and Empirical Strategy

The main database used in this analysis is the new Eurosystem Securities Holdings Statistics by Group (SHSG) database. The database contains security-level information on the securities portfolios of 26 reporting banking groups in the euro area (see Annex 1 for a detailed list of the banking groups in the sample), which overall covers the large majority of the euro area banking sector in terms of financial assets. Data are collected on a quarterly basis since 2013Q4.

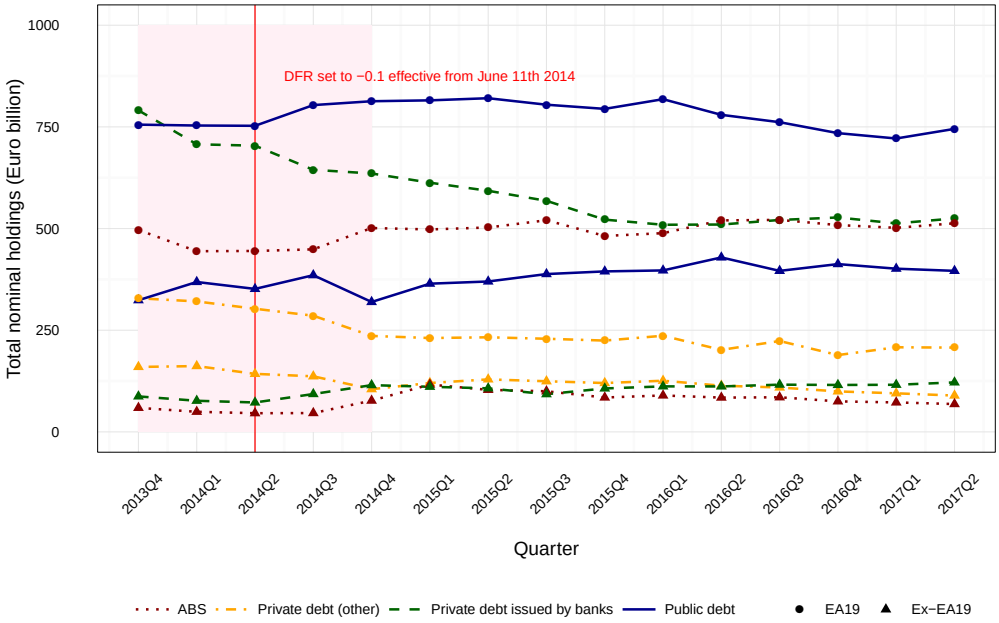
The SHSG database provides information on holdings at the security level as identified by the International Securities Identification Number (ISIN). For the purpose of the analysis in this paper, we focus on the portfolio of debt securities (both short-term and long-term) and enrich the database with security level information from the Eurosystem Centralised Securities Database (CSDB) – like rating and maturity. Data on banks' balance sheets are from SNL Financials.

Using information on the issuer of the debt securities, we classify the assets in four broad categories. Securities are classified as Public Debt if they are issued by the sectors "General Government" and "Central Bank" as well as by certain supranational institutions such as the

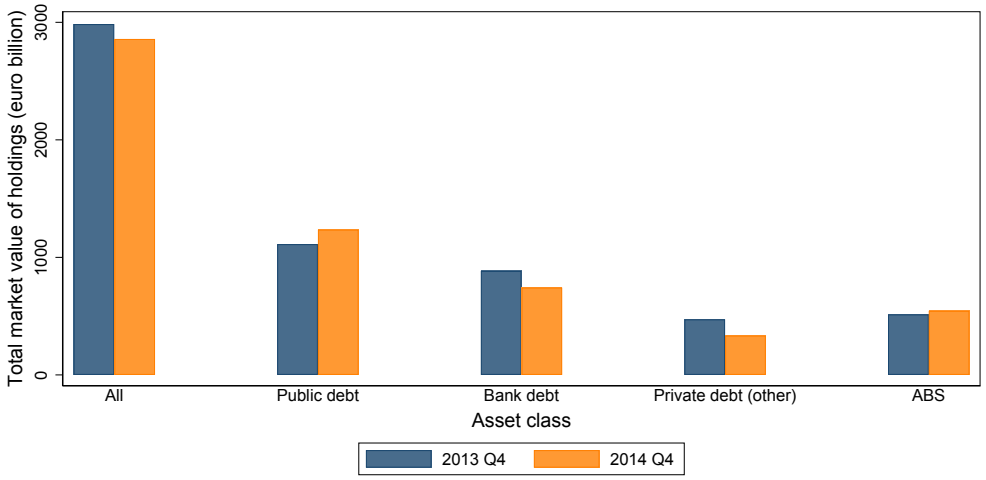
European Investment Bank (EIB) or the European Stability Mechanism (ESM). Private Debt includes three distinct categories. Securities issued by "Deposit-taking corporations except the central bank" are classified as "Private debt issued by banks". "Asset backed securities (ABS)" includes different types of securitized debt securities: covered bonds, MBS, Pfandbrief, CDOs and other ABS. The asset class "Private debt (other)" is a residual category and includes debt issued by Financial Corporations other than banks and by the corporate sector. Figure 1a shows the evolution of total nominal holdings for the four asset classes considered over the entire available sample. We also report the overall change in the market values of portfolio holdings throughout the period of interest (Figure 1b).

Figure 1: Evolution of the holdings of debt securities by the 26 reporting banking groups

(a) Nominal values



(b) Market values

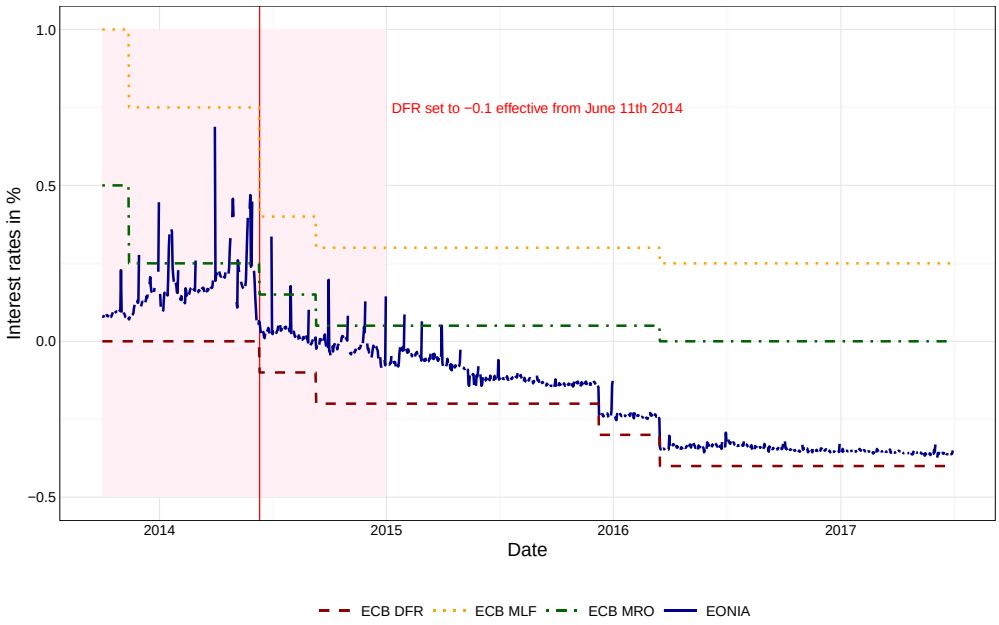


Source: SHSG

Figure 1a is based on nominal holdings in euro but it also includes securities in other currencies. Overall, we see that during the period considered there was a broad disinvestment from debt securities issued by euro area banks and other private issuers, while there were rather stable patterns with respect to public debt securities and asset backed securities (ABS). Figure 1b shows the market value of the total portfolio of banks and the different categories by asset classes at the beginning of our sample period and at the end of 2014. Overall the market value of the portfolio of debt securities of the large euro area banks declined, with an increase in the value of public debt and ABS and a decrease in the value of other debt securities.

Policy rates in the euro area moved into negative territory in June 2014, when the ECB brought the deposit facility rate to -0.10%. A series of steps in the same direction brought the ECB deposit rate to -0.40% by March 2016 (see Figure 2 for a description of the policy rates in the euro area). These policy actions aimed at incentivising bank lending in the interbank market while preserving the difference between the cost of borrowing from the ECB (at the Main Refinancing Operation rate) and the benefit of depositing liquidity to the ECB. In the current economic and institutional environment in the euro area, where central bank liquidity is allocated on a full allotment basis and a series of non-standard monetary policy actions are in place, commercial banks hold in aggregate excess liquidity at the central bank, i.e. more liquidity than what they need in order to fulfil reserve requirements. The deposit facility rate has therefore become the relevant policy rate in the euro area (see Heider, Saidi and Schepens (2017) for a detailed discussion of the policy actions of the ECB during the period that we consider).

Figure 2: ECB key policy rates and interbank lending rate



Source: ECB SDW

The ECB deposit facility rate was set to -0.10% effective from June 11th 2014. We classify the period Q4 2013 – Q1 2014 as the pre-NPR period and Q2 2014 – Q4 2014 as the post-

NPR period. We stop the analysis at the end of 2014 so that we can interpret our findings as resulting mainly from the introduction of negative policy rates, and we exclude the following period when the asset purchase program (the PSPP) started.[1] Heider, Saidi and Schepens (2017) perform their analysis until the end of 2015 and run robustness check for the sub period of 2014. We chose to exclude altogether the time in which the asset purchases were performed because this policy action has a direct impact on the securities portfolio and may have impacted differently banks depending on their ex-ante securities allocation. Both the pre-NPR and the post-NPR periods are highlighted in light red in Figure 1a, while the red vertical line indicates the start of the post-NPR period.

2.1 Empirical Strategy

There is a wide literature on the impact of policy rates on banks' investment. Lower policy rates decrease the cost of funding of the banks and this generally translates in higher bank net worth, because of the maturity transformation operated by banks (see for example Dell'Ariccia, Laeven and Marquez, 2014). However, negative policy rates add an additional dimension to the analysis, because deposit rates are sticky when reaching the zero lower bound and therefore negative deposit rates are not immediately passed-through.

Our main identification argument is based on the limited pass-through of negative policy rates to the rates paid on bank deposits of households and firms. For systematic evidence on this, we refer to Heider, Saidi and Schepens (2017) as well as Eisenschmidt and Smets (2017). Figure 3 shows that the average deposit rates paid on deposits of households and firms remained positive even after the introduction of negative policy rates.[2]

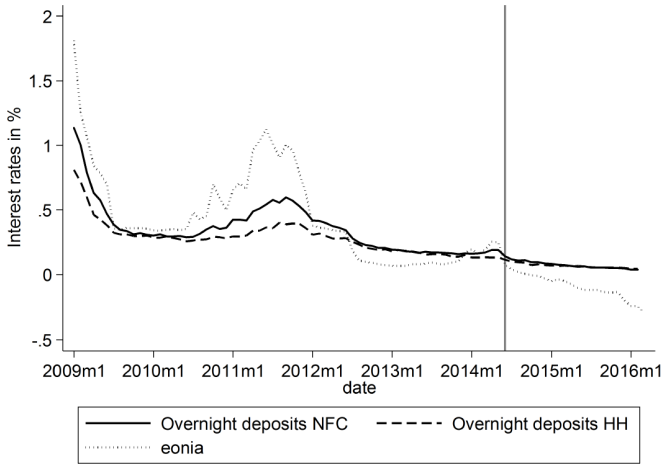
Banks may be reluctant to charge negative rates to depositors for several reasons, at least over shorter horizons. Indeed, banks may not want to jeopardize long-term customer relationships, and depositors can just decide to hold currency and/or move deposit to another bank that doesn't charge negative rates. This seems to be especially true for retail deposits that are typically smaller in size. There may also be legal constraints in charging negative deposit rates, due to the institutional setting of some deposit-taking corporations (like cooperative banks for example).

At the same time, the benchmark rate on interbank deposits in the euro area — EONIA – turned negative during the 3rd quarter of 2014. Therefore, the ability of banks to pass-through negative interest rates depended on the relative importance of deposit funding, i.e. the composition of their liabilities. Figure 4 shows that the large euro area banks in our sample fund between 20% and 60% of their balance sheet via customer deposits. It is noticeable that

[1] During the period that we consider there were other measures of non-conventional monetary policy that were undertaken. The first targeted longer-term refinancing operations (TLTRO) with allotments taking place in September 2014 and December 2014 were announced by the ECB in June 2014. As Heider et al. (2017) argue, there were significant substitution effects with respect to other types of central bank funding and the 2011 and 2012 LTROs. Therefore, it is not clear ex-ante, why the TLTRO take-up would differ across large banks with different deposit ratios.

[2] Eisenschmidt and Smets (2017) show that in the most recent period German banks are charging negative deposit rates to corporations (-0.02% on average as of July 2017), while rates for households deposits remain positive. This suggests that eventually the pass-through of negative rates takes place, but it takes longer time than with positive rates and it may be directed only to certain customer.

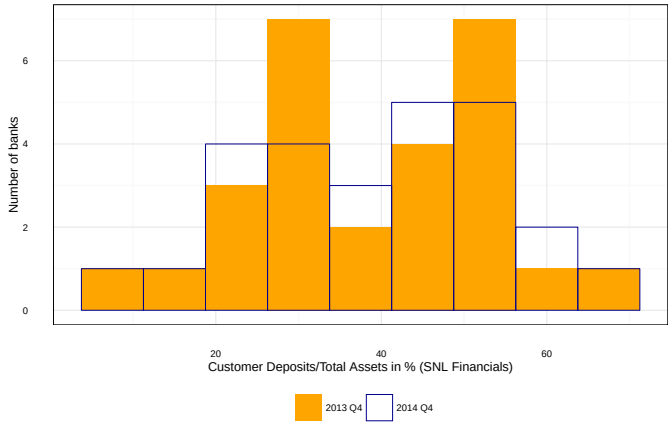
Figure 3: Rates on Overnight Deposits by House-holds (HH) and Non-financial Corporations(NFC)



Source: Heider, Saidi and Schepens (2017), ECB IMIR interest rate statistics database

there is an ample variation in terms of deposit ratios even across this limited set of large banking groups.

Figure 4: Distribution of the deposit ratio pre-NPR vs. post-NPR



Source: SNL Financials

Therefore, negative rates may have a more detrimental impact on the profitability of banks that are more reliant on deposit funding, since their profitability margins are compressed. This may induce these same banks to invest in higher yields assets in order to make up for the losses in profitability – *search for yield*. We investigate if banks with a larger deposit base are systematically investing in higher yielding securities.

We quantify the effect of negative policy rates on banks differentially treated via the deposit ratio. The benchmark specification that we consider has the following form:

$$ln(holdings)_{ijt} = \beta_0 \times Post_t \times Deposit\_ratio_{jt} \times ACY_{ijt} + \beta_1 X_{ijt} + \mu_j + \eta_{\diamond} + \varepsilon_{ijt}$$

The dependent variable is the holdings of the security i, held by banking group j at time t. $Deposit\_ratio_{jt}$ is the ratio of customer deposits over total assets. $Post_t$ is a dummy variable equal to one for the period June 2014 onwards. The vector X_{ijt} contains control variables and their interactions with our variables of interest. We include the log of total assets and the ratio of equity over total assets (i.e. the leverage ratio of the bank) as controls. The fixed effects term $\eta_{\diamond}$ includes bank fixed effects in all specifications. We add time, security and maturity-rating-time fixed effects in some of the specifications. In all our specifications we cluster standard errors at the bank- and the security-level.

We employ fixed effects in order to control for the factors that can explain banks' portfolio investment in certain securities, such as regulatory pressures, strategic buying opportunities or the need to raise funding. A major development in the regulatory landscape during the period that we analyze was the implementation of the Single Supervisory Mechanism (SSM) in the euro area and the transfer of the direct supervision of large euro area banks from the national supervisory authorities to the ECB. All the banks in our sample were affected by this change and their direct supervision was transferred from the competent national supervisory authorities to the SSM.[3]

The analysis is based on a differences-in-differences estimation where we capture the effect of monetary policy through a dummy variable that equals 1 when policy rates are below 0. Figure 2 shows the evolution of the ECB Marginal Lending Facility (MLF) rate, the ECB Main Refinancing Operations Rate (MRO) rate, the ECB Deposit Facility (DF) rate, and the Euro Overnight Index Average (EONIA) rate between January 2012 and July 2016. The vertical line indicates the date of June 11th 2014, the day the DF rate was set below zero.

To compare investment in financial assets with different yield patterns, we use the adjusted current yield (ACY) measure as in Abbassi et al. (2015). Differences in risk can explain difference in ACY of otherwise similar securities. In the SHSG database the banking groups report the value of their holdings both in nominal terms and valued at market prices[4] along with the number of securities held at the end of the quarter. In order to obtain prices for all securities in our database we rely on this information as opposed to using external sources. We compute the prices by dividing the reported market value of the holdings of a certain ISIN by the number of securities that the bank holds. We then compute the ACY of security i as using the pricing information of bank j as:

$$\text{ACY}_{it} = 100 \cdot \frac{\text{coupon}_i[\%\text{ ann.}]}{\text{price}_{it}} + \frac{100 - \text{price}_{it}}{\text{residual\_maturity}_{it}/365}$$

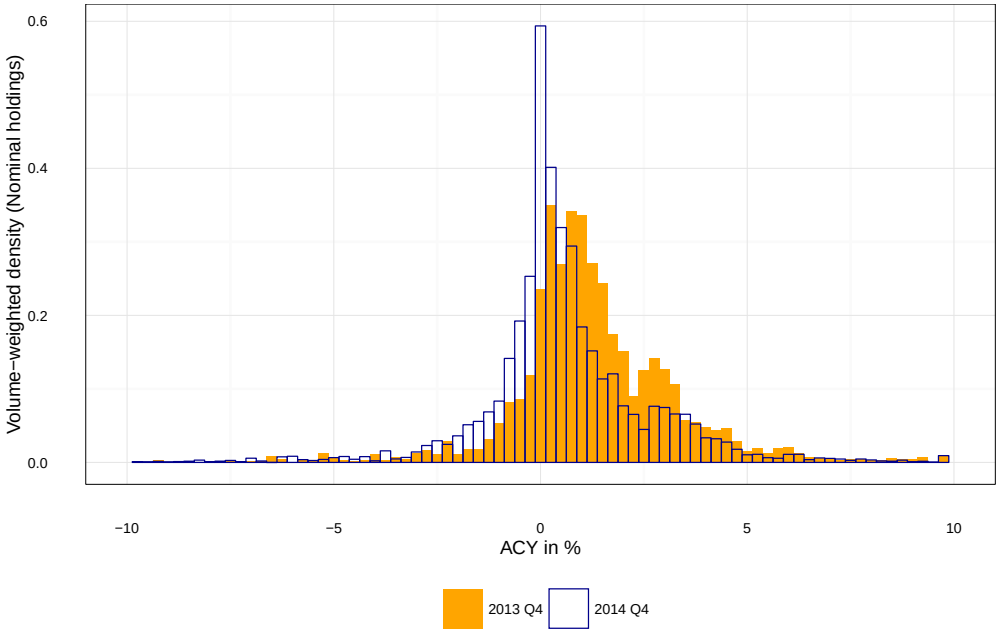
The information on coupon rates and residual maturities is obtained from the Eurosystem CSDB. Figure 5 shows how the overall distribution of the ACY (weighted by the nominal holding amount) for the securities portfolios in our sample changed between Q4 2013 (the

[3]The SSM became operational in November 2014, but preparatory work was well undergoing during the period of time that we analyse. The same applies to certain other regulatory measures such as the introduction of the mandatory Liquitidy Coverage Ratio (LCR), that came into effect in October 2015. Our estimations would be affected if these would apply differentially across banks with high- and low deposit ratios during our estimation window in the years 2013-2014.

[4]See also Table 2 in "Who holds what – new information on securities holdings" (ECB Economic Bulletin, Issue 2/2015, p. 75).

beginning of our sample) and Q4 2014 (the end of our sample period). In between the two periods the cross-sectional distribution shifts to the left, also as a result of lower interest rates. Therefore at the end of 2014 a large fraction of the securities portfolios of the largest euro area banks was yielding a negative return.[5] We are interested in exploring changes in the composition of the portfolio that may have been spurred by negative policy rates. If the return of the overall security portfolio declined due to the implementation of negative rates, did banks increase their relative exposure to certain (high-yielding) securities?

Figure 5: Distribution of ACY pre-NPR vs. post-NPR



Source: ECB calculations, SHSG

We include in the sample all securities with a nominal holding amount that at some point exceeded 0.5 million euro, summing up the holdings of the 26 reporting banking groups. Furthermore, we trim our data according to the variable ACY and include all securities with an ACY between the 5th and the 95th percentile of the overall distribution. Table 1 shows summary statistics[6] of the variables included in our empirical specification for all ISIN-bank-quarter observations.

3 Results

We show three different sets of results. First, we estimate a baseline model and analyse how securities holdings in the banks' portfolios interact with changes in ACY. We consider the period before and after the introduction of negative policy rates and control for different sets of fixed

[5]Please note that the ACY values securities at current market prices. Banks do not necessarily incur losses on their holdings at negative values of the ACY, e.g. since securities may have been bought earlier at different prices.

[6]The summary statistics are simple (unweighted) averages computed from observations on the bank-quarter-ISIN-level.

Table 1: Summary Statistics of the main variables of interest Q4 2013 – Q4 2014

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
ACY	454,534	0.979	4.008	-29.75	14.47
Equity/TA in % (from SNL)	453,144	4.812	1.156	3.109	8.167
Customer deposits / Assets in % (from SNL)	453,144	35.25	13.39	9.943	85.68
Total assets (ln)	453,144	27.48	0.745	25.02	28.36
Nominal holdings (ln)	404,039	14.22	3.619	-4.605	24.57

Source: SHSG database, SNL Financials

effects. Second, we estimate the benchmark model, include interactions with the bank deposit ratios and see whether banks with a larger deposit base reacted differently to the introduction of negative interest rates. This enables us to quantify the relative impact of negative rates via a differences-in-differences approach. Third, we extend the analysis into the direction of diversification through asset classes and geographical regions of issuance. These channels might be of particular relevance in a sample consisting of large internationally diversified banks. We show the results of estimations that use subsamples by asset class and country of issuance.

3.1 Negative policy rates and search for yield: Simple benchmark

The results of the baseline estimation as shown in Table 2 show that overall, the implementation of negative policy rates had a negative impact on securities holdings, and that the deleveraging was stronger for riskier securities with a high ACY. This holds both in a specification with bank + time fixed effects (column 2) as well in specifications with security fixed effects (column 1 and 3).

In the fourth column we include fixed effects for securities in the same rating category, and with similar residual maturity. The rationale for these fixed effects is to group securities that need a similar amount of regulatory capital. We construct these fixed effects as follow: First, we group securities by maturity. We use multiples of 100 days (i.e. the first group contains all securities maturing between 0-99 days, the second group those with 100-199 remaining days of maturity etc.). Then we compute a common fixed effect for securities within the same maturity group, that hold the same rating during a certain reporting period. When estimating this specification, we find that within the same category of risky assets (maturity and rating) banks aim for riskier securities overall (positive coefficient of ACY in column 4), a result similar in spirit to Efing (2015). The limited availability of ratings information, however, restricts our analysis to a smaller subsample in this case.

Table 2: Baseline Model

	(1) Ln(holdings)	(2) Ln(holdings)	(3) Ln(holdings)	(4) Ln(holdings)
Post	-0.291**		-0.283**	
	(0.136)		(0.136)	
ACY		-0.00934	-0.00150	0.0278***
		(0.00671)	(0.00890)	(0.00870)
Post*ACY		-0.0393***	-0.0173**	-0.0148
		(0.0141)	(0.00719)	(0.0151)
Observations	386,551	402,649	386,551	276,939
R-squared	0.580	0.220	0.580	0.327
Bank Controls	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Time FE	No	Yes	No	–
Security FE	Yes	No	Yes	No
Maturity*Rating*Time FE	No	No	No	Yes

Robust standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Note: Ln(holdings) is calculated on nominal amounts

3.2 Identification of the effects of negative interest rates via the deposit ratio

In order to identify the link between negative policy rates and a search for yield behaviour, we estimate a differences-in-differences specification where identification is provided by the reliance of banks on customer deposits. We can then compare banks that were more affected by the introduction of negative interest rates to a control group that was less affected. Thereby we can disentangle the effects due to changes in the supply of securities, or driven by other economic developments, from those effects that we can attribute to the introduction of negative interest rates by the ECB.

Results are reported in Table 6 with different specifications of fixed effects. The estimated coefficient for the interaction **Deposit Ratio*post*ACY** shows that the impact of an increase in the ACY in the post-NPR (negative period rate) was significantly different for banks with a higher deposit ratio. This can be interpreted as evidence of (relative) search for yield induced by the introduction of negative interest rates. We find that after the introduction of negative policy rates, an increase of the deposit ratio by 10% (approximately one standard deviation) translates in a 0.02 percentage points increase in the sensitivity of the holdings of a particular security in response to a 1%-change in the adjusted current yield.

Overall, in terms of the direction and the significance patterns of the coefficients Table 3 is similar to Table 2. The coefficient of the triple interaction **Deposit Ratio*Post*ACY** is positive and significant both exploiting within-security variation and within-maturity-rating-quarter variation.

Table 3: Estimation of benchmark model with deposit ratio interaction

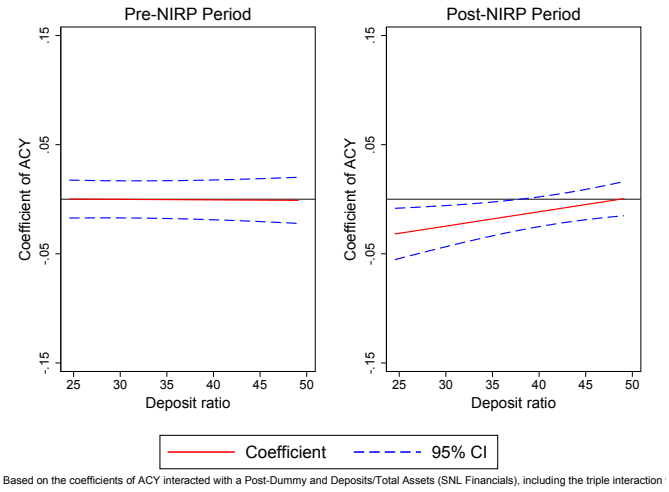
	(1) Ln(holdings)	(2) Ln(holdings)	(3) Ln(holdings)	(4) Ln(holdings)
Post	-0.291**		-1.204**	
	(0.136)		(0.494)	
ACY		0.0186	0.00133	0.0640***
		(0.0197)	(0.0133)	(0.0180)
Post*ACY		-0.115***	-0.0655***	-0.112***
		(0.0434)	(0.0206)	(0.0364)
Deposit ratio*Post		0.0317**	0.0251**	0.0379**
		(0.0130)	(0.0104)	(0.0149)
Deposit ratio*ACY		-0.000790*	-4.75e-05	-0.000976**
		(0.000411)	(0.000335)	(0.000402)
Deposit ratio*Post*ACY		0.00223**	0.00136**	0.00265***
		(0.000997)	(0.000533)	(0.000955)
Observations	386,551	402,649	386,551	276,939
R-squared	0.580	0.223	0.582	0.331
Bank Controls	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Time FE	No	Yes	No	–
Security FE	Yes	No	Yes	No
Maturity*Rating*Time FE	No	No	No	Yes

Robust standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Note: Ln(holdings) is calculated on nominal amounts

The plots in Figure 6 can help to visualize the intuition behind our results.[7] The coefficient of **Deposit Ratio*Post* ACY** determines the pre-NPR and the post-NPR difference in the slope of the relationship between the deposit ratio and the sensitivity of Ln(holdings) to a change in the ACY. In Figure 6, we show the coefficients of model (3), estimated using the specification including bank and security fixed effects. For the left panel we set Post=0 and for the right panel we set Post=1, in order to highlight the differences before and after the introduction of negative policy rates. Figure 6 shows, that before the introduction of negative policy rates, the sensitivity of banks' portfolios to changes in ACY did not depend on their deposit ratio. Conversely, post-NPR low-deposit ratio banks disinvest in response to a positive change in the ACY, while high deposit ratio banks disinvest less or not at all. The overall result is that the post-NPR-portfolio of high-deposit ratio banks became riskier compared to low-deposit ratio banks. This can be interpreted as search for yield in the securities portfolio of the affected banks caused by the introduction of negative interest rates.

Figure 6: Marginal effect of ACY Pre-NPR vs. Post-NPR (Bank + Security Fixed Effects)



3.3 Robustness

Our identification strategy relies on the assumption that, in the period before the introduction of negative policy rates, risk taking behaviour did not differ systematically across banks with low and high deposit ratios once we control for the patterns captured by fixed-effects and other covariates (parallel-trends assumption). To investigate further on this, we estimate a specification that includes dummies for the lags and leads of the policy change, as in Autor (2003).[8] If there is no systematic difference before the policy change, we would expect the pre-treatment interactions of a quarter dummy with ACY and the deposit ratio to be close to zero

[7] They also provide support to the parallel trend assumption before the introduction of negative rates. Please refer to the next paragraph for further discussion.

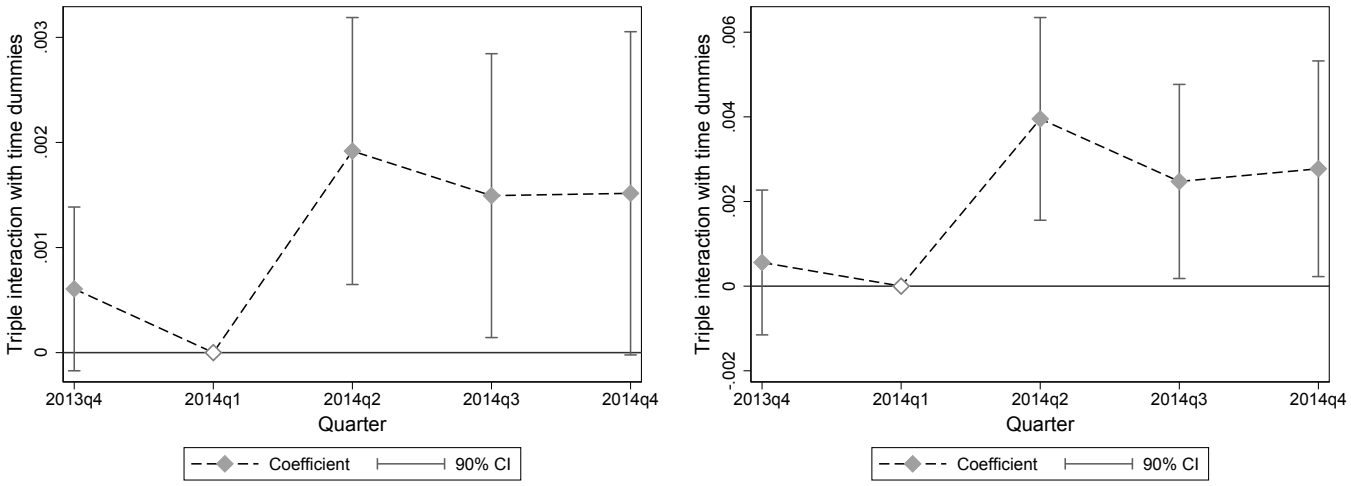
[8] We estimate

$$ln(holdings)_{ijt} = \beta_{01} \times d2013q4_t \times Deposit\_ratio_{jt} \times ACY_{ijt} + \beta_{02} \times d2014q2_t \times Deposit\_ratio_{jt} \times ACY_{ijt} + \ldots,$$

where $d2013q4_t$ is a dummy variable that takes the value 1 during the last quarter of 2013 and is 0 for all other quarters. Figure 7 reports the coefficients β_{01}, β_{02} etc.

(not statistically significant). Our data is available from the 4th quarter of 2013 onwards and we use the quarter before the introduction of negative policy rates (2014q1) as our reference period. Indeed, the coefficient of the triple interaction of our variables Deposit ratio, ACY and a dummy variable for 2013q4 is insignificant. Figure 7 shows all estimated coefficients of the interaction variable of Deposit ratio, ACY and a dummy for each quarter with 90% confidence bands.[9] Given the evidence displayed in Figure 7 we do not reject "H_0 : *parallel trends during the pre-period*".

Figure 7: Evidence on the parallel trends assumption



(a) Security Fixed Effects

(b) Maturity*Rating*Quarter Fixed Effects

Figure 7 also allows us to shed some light on the effects of negative interest rates over time: the strongest effect is already visible at the end of the 2nd quarter (the negative rates were first announced on June 11 2014). While the subsequent reduction in remuneration of the ECB's deposit facility on September 10 to -0.2 % was generally perceived as a "surprise decrease" we do not find a further change in the behaviour of high deposit ratio banks compared to low deposit ratio banks. Including the 2nd quarter of 2104 in the period before the introduction of negative rates would violate the parallel trends assumption. This would prevent us from identifying a causal effect. We end our sample before the implementation of the asset purchases by the ECB in January 2015. This implies a symmetric window around the introduction of negative interest rate. We have checked whether our findings are robust to the extension of the post-NPR period by up to three quarters. However, the availability of our data is constrained to two periods before the introduction of negative interest rates.

[9]Please note that the coefficient for 2014q1 is 0 by construction (reference period, omitted from the regressions). Using 90% percent confidence intervals makes the confidence bands "narrower" and hence a rejection of the "H_0 : *parallel trends during the pre-period*" more likely. Nevertheless, we do not reject H_0 for both graphs displayed in Figure 7.

3.4 Diversification across assets and the international dimension of risk taking

We have shown how banks with different deposit ratio base make different choices in terms of their aggregate security portfolio. Using the granular database at our disposal, we now explore the drivers of these differences. This enables us to answer the question: how did the response to negative rates affect the portfolio choices of high deposit ratio and low deposit ratio banks in terms of choice among different asset classes, currencies and countries of issuance of the securities? This question is of particular relevance within our sample of large internationally diversified banks. We perform the same estimation as in equation (1) but restrict our sample along asset classes, currencies and geographic areas of issuance.

Table 4: Regressions across asset classes

	(1) Public debt Ln(holdings)	(2) Private debt issued by banks Ln(holdings)	(3) Private debt (other) Ln(holdings)	(4) ABS Ln(holdings)
Post	-0.991***	-0.962**	-1.666**	-0.427
	(0.368)	(0.411)	(0.676)	(0.321)
ACY	-0.0629**	0.00345	-0.0147	0.170***
	(0.0312)	(0.0191)	(0.0155)	(0.0440)
Post*ACY	0.0222	-0.0476**	-0.0727***	-0.0255
	(0.0340)	(0.0221)	(0.0207)	(0.0623)
Deposit Ratio*Post	0.0195**	0.0207**	0.0362**	0.00515
	(0.00793)	(0.00864)	(0.0141)	(0.00676)
Deposit Ratio*ACY	0.000430	-7.04e-05	0.000610	-0.00387***
	(0.000652)	(0.000540)	(0.000498)	(0.00107)
Deposit Ratio*Post*ACY	0.000120	0.000879*	0.00152**	0.00111
	(0.000839)	(0.000501)	(0.000641)	(0.00124)
Observations	96,637	116,750	138,505	32,504
R-squared	0.436	0.601	0.652	0.708
Bank Controls	Yes	Yes	Yes	Yes
Security FE	Yes	Yes	Yes	Yes
Time FE	No	No	No	No
Bank FE	Yes	Yes	Yes	Yes
Maturity*Rating*Time FE	No	No	No	No

Robust standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Note: Ln(holdings) is calculated on nominal amounts

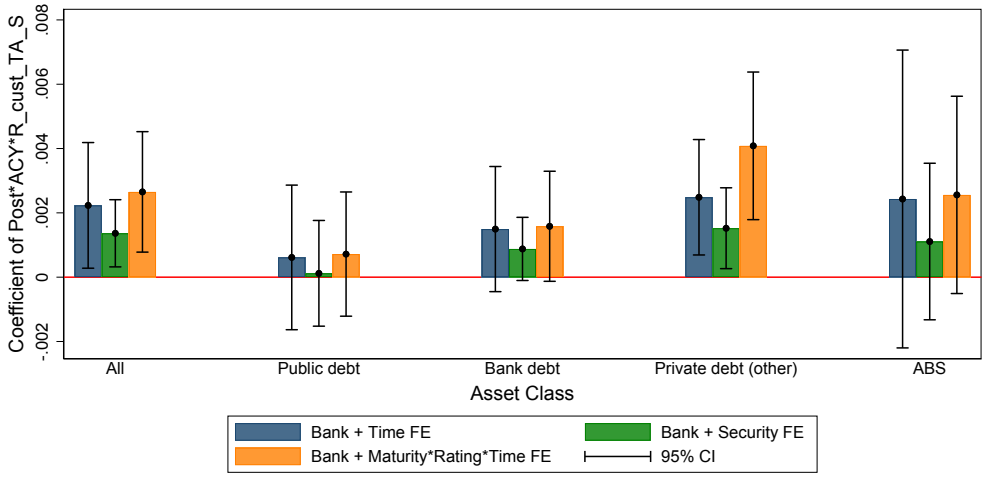
We find that after the introduction of negative interest rates, high deposit ratio banks invest comparatively more in public and private debt securities, but there is no differential response in the investment behaviour towards asset-backed securities (see Table 4).[10] Looking at the

[10]The table reports the results of the estimation of (1) only with the specification with bank and security fixed effects. The complete set of results is available from the authors.

sensitivity of portfolio holdings to changes in ACY, the results suggest that banks with higher deposit ratio became more sensitive to changes in ACY of private debt securities (issued by banks and by non financial corporations) when reshuffling their portfolios.

Figure 8 reports the triple interaction coefficient **Deposit ratio*Post*ACY** of each separately estimated regression alongside a 95% confidence interval and for different specifications of fixed effects. The coefficients from Table 4 are reported on the first bar on the left, with the label "All" in order to provide a meaningful reference point. The values and the confidence intervals of the coefficients vary across the different specifications. The positive relationship captured by the coefficient of **Deposit ratio*Post*ACY** is confirmed for all asset classes, albeit for different levels of statistical and economic significance. Evidence for a risk-shifting behaviour of high-deposit ratio banks is strongest and statistically significant for private debt securities issued by financial and non-financial corporations. When rebalancing their securities portfolios after the introduction of negative policy rates, affected banks seem to have directed their investment more to the class of private debt securities.

Figure 8: Coefficient of triple interaction term across different asset classes



We also find some evidence concerning the geographical allocation of the securities portfolios subsequent to the introduction of negative interest rates. We carry out the estimation of the benchmark model over the sample of securities portfolios grouped along four geographical regions by country of issuer: euro area, EU countries not in the euro area, other developed countries[11] and other countries (see Table 9).

First, we find that negative interest rates induced affected banks to increase their exposure towards securities issued in the euro area and in other developed economies — while no significant reshuffling results for emerging economies (positive coefficient of **Deposit Ratio*Post** in Table 5). Second, the response to changes in ACY differs across geographic areas.

Figure 9 shows the implications of our results for bank risk taking by plotting again the coefficients of the triple interaction **Deposit Ratio*Post*ACY**. The more affected banks respond to an increase in ACY by increasing holdings in securities issued in the euro area

[11]This group includes issuers of securities from Australia, Canada, Cayman Islands, Guernsey, Japan, United States, Virgin Islands and Switzerland.

Table 5: Regressions across geographic areas of issuance

VARIABLES	(1) Euro Area 19 Ln(holdings)	(2) EU non-EA 19 Ln(holdings)	(3) Developed Ln(holdings)	(4) Other Ln(holdings)
Post	-0.934**	-1.266***	-1.744***	-0.977*
	(0.440)	(0.462)	(0.547)	(0.531)
ACY	-0.00429	-0.00936	-0.108**	0.0719**
	(0.0126)	(0.0318)	(0.0480)	(0.0319)
Post*ACY	-0.0568***	0.00815	-0.0602	-0.0382
	(0.0216)	(0.0363)	(0.0472)	(0.0321)
Deposit Ratio*Post	0.0201**	0.0252***	0.0341***	0.0187
	(0.00940)	(0.00962)	(0.0110)	(0.0113)
Deposit Ratio*ACY	0.000172	-0.000193	0.00240**	-0.00239***
	(0.000330)	(0.000721)	(0.00114)	(0.000899)
Deposit Ratio*Post*ACY	0.00127**	-0.000349	0.00134	0.00122
	(0.000502)	(0.000879)	(0.00111)	(0.000814)
Observations	234,485	40,407	70,787	40,802
R-squared	0.553	0.578	0.627	0.624
Bank Controls	Yes	Yes	Yes	Yes
Security FE	Yes	Yes	Yes	Yes
Time FE	No	No	No	No
Bank FE	Yes	Yes	Yes	Yes
Maturity*Rating*Time FE	No	No	No	No

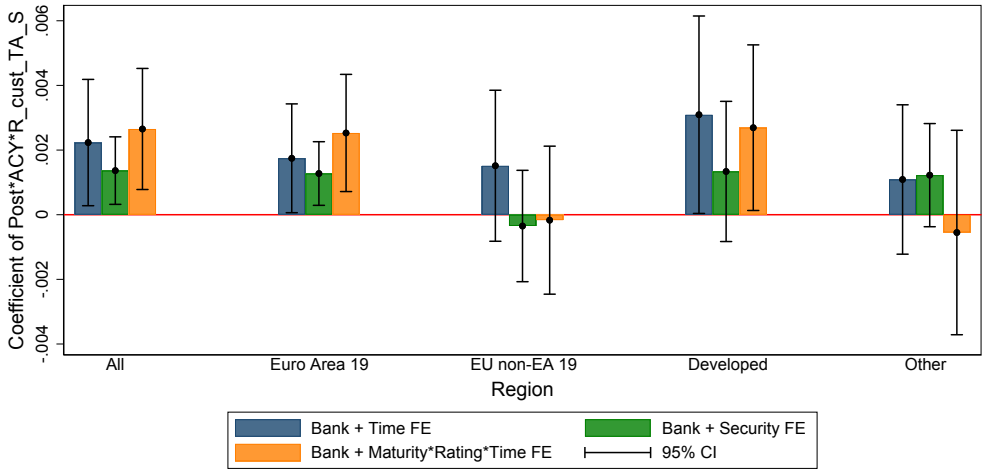
Robust standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Note: Ln(holdings) is calculated on nominal amounts

and in developed economies outside the EU, including the United States and Japan. There is no evidence of a differential response of high-deposit ratio banks to changes in ACY when considering holdings in securities issued in countries that are member states of the European Union but are not part of the euro area. The magnitude of the coefficients is especially high for developed economies outside the EU, where we find statistically significant effects for the specifications with Bank + Time fixed effects and Maturity*Rating*Time fixed effects. In this case, the fact that our estimates are not significant in specifications that include securities fixed effects could be due to shifts in the banks' investment behavior towards securities that were not held in the banks' portfolios in the period before the introduction of the negative interest rates. Hence these securities were not observed in our dataset during the pre-NPR period. Such shifts would decrease our statistical power for the estimations with security fixed effects.

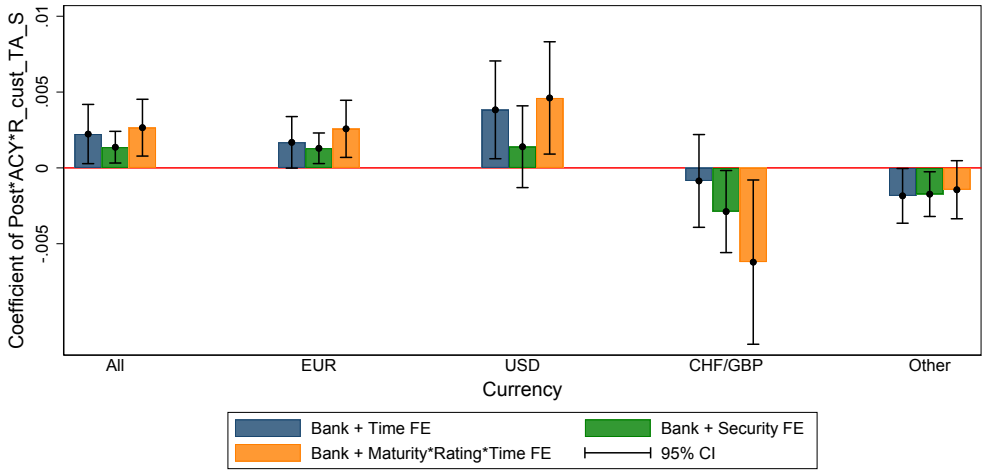
We reach a similar conclusion if we split our sample by currency instead of country of issuance. The differential response by high deposit ratio banks is particularly pronounced for securities denominated in US dollar (USD). Sensitivities in this category are estimated to be twice the size of those for euro securities (Figure 10). Some specifications suggest that we may

Figure 9: Coefficient of triple interaction term across different geographic regions



observe a counteracting effect in securities issued in Swiss Franc (CHF), British Pound (GBP) and other currencies – albeit these categories are rather small compared to the sample banks' holdings in euro and US dollar.

Figure 10: Coefficient of triple interaction term across different currencies

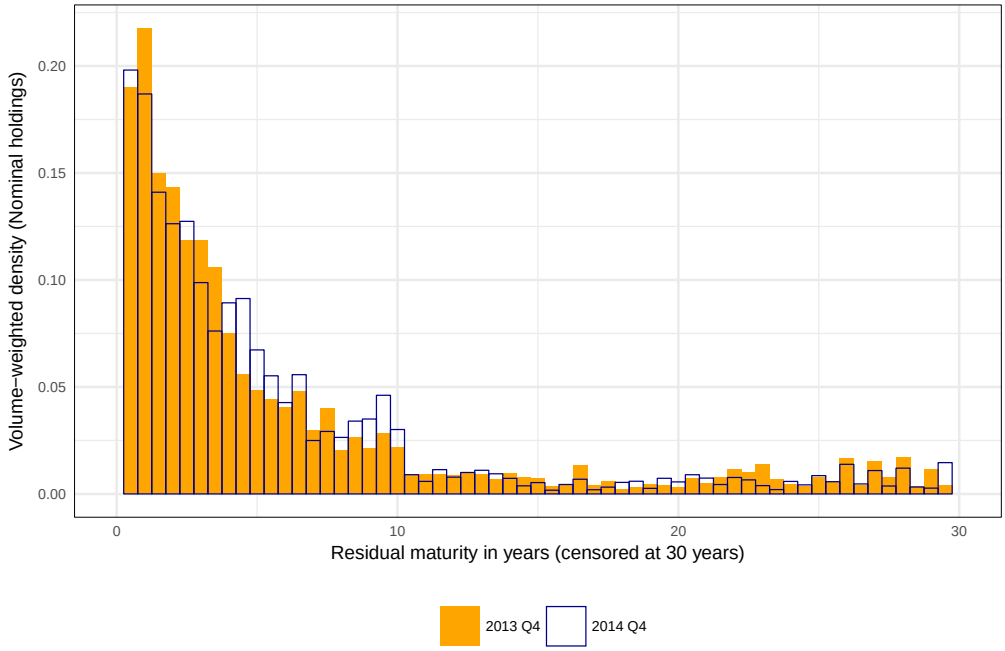


3.5 Alternative sources of risk: duration risk and asset concentration

In reaction to the pressures that negative interest rates induce on their balance sheets, banks could further increase risk taking using alternative channels. We analyze two alternative sources of risk in this section. Banks could seek to increase their exposure to duration risk by increasing the average maturity of their holdings. Similarly, they could increasingly invest into the same kind of assets and therefore increase portfolio concentration and systemic risk in the banking sector. This latter argument is developed in the model proposed among others by Farhi and Tirole (2012) and Allen, Babus and Carletti (2012).

As in the previous section our identification strategy relies on banks' deposit ratio. First, we document aggregate shifts in duration risk during our sample period. We measure duration risk via the maturity structure of the asset portfolio. There is no evident shift in the maturity structure pre-NPR vs. post-NPR that could be an indicator of some degree of search-for-maturity behaviour. This is shown in Figure 11.

Figure 11: Distribution of residual maturity in years pre-NPR vs. post-NPR



Source: ECB calculations, SHSG

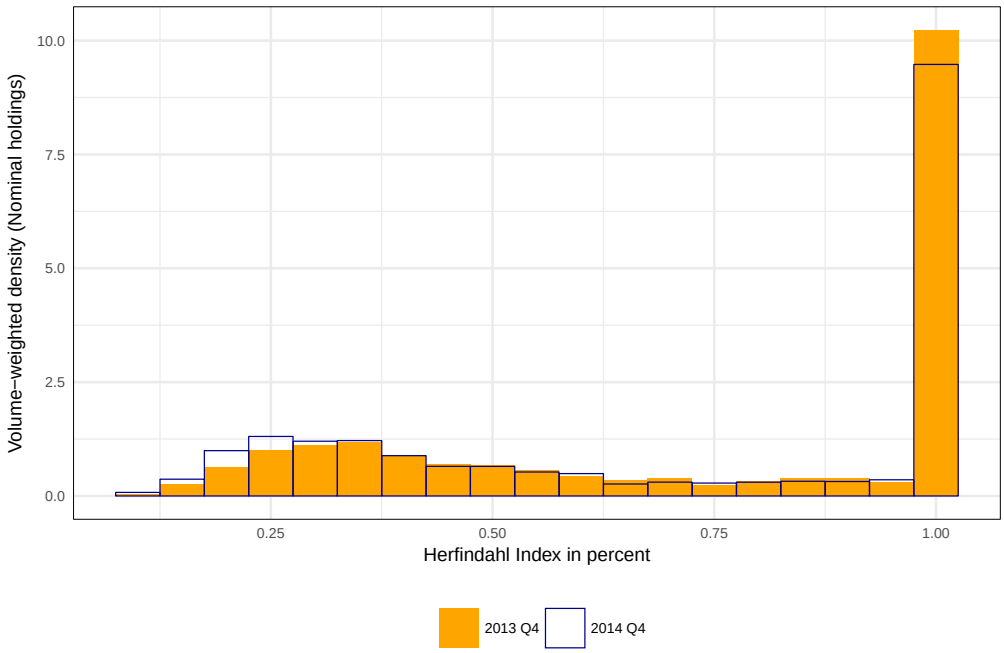
To measure asset concentration in the banks' portfolios, we use a specification of the Herfindahl index, calculated for the holdings of asset i at time t as follows:

$$\text{Herfindahl}_{ijt} = \sum_{j=1}^{26} \left(\frac{h_{ijt}}{\sum_{k=1}^{26} h_{ikt}} \right)$$

The index takes a value of 1 if only one bank in our sample holds the asset. If all banks hold the same quantity of the asset it takes a value of 0.038 (=1/26). Figure 12 shows the distribution of the concentration index pre- and post-NPR. We note a small decrease in assets that are held by a single bank and a slight increase in assets that are held in a distributed fashion across the banking sector (when the Herfindahl index takes a value around 0.25). We have also used alternative concentration measures, for example the inverse of the number of holders of a security, and obtained similar evidence.

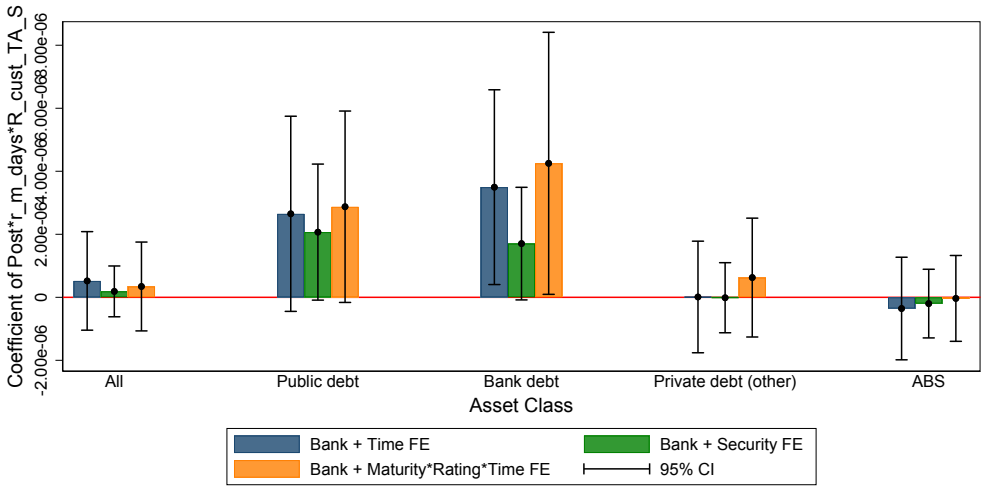
To further investigate these issues, we have estimated our model using maturity and concentration index as measures of risk. Indeed, an empirical specification with fixed effects confirms the patterns we find in the two histograms (see Table 10 in the Appendix). We find no statistical significant effect of maturity on individual asset holdings. At the same time, concentration of assets (measured by Herfindahl index) is negatively associated to holdings in the securities portfolios.

Figure 12: Distribution of concentration pre-NPR vs. post-NPR



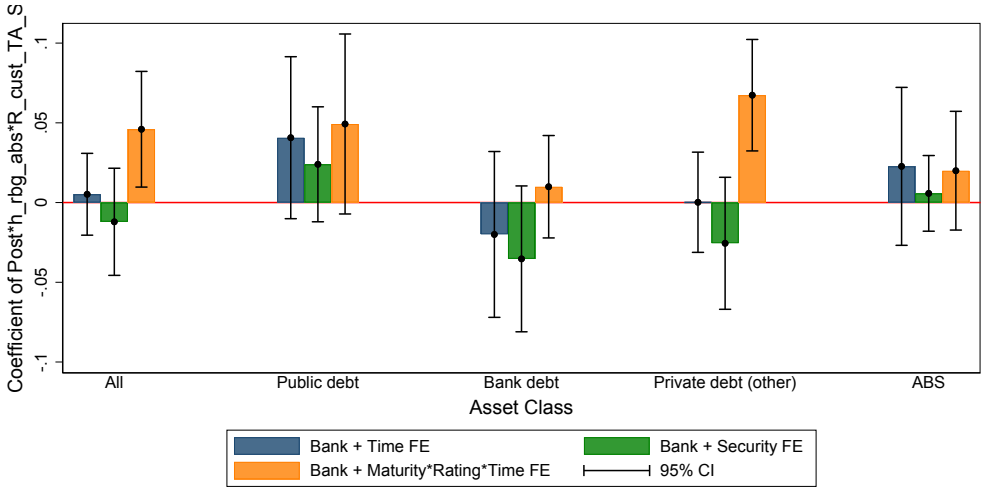
Source: ECB calculations, SHSG

Figure 13: Triple interaction with deposit ratio and maturity



Source: ECB calculations, SHSG

Figure 14: Triple interaction with deposit ratio and Herfindahl indicator for concentration risk



Source: ECB calculations, SHSG

While we were able to connect these shifts to the introduction of negative interest rates in the case of the ACY, this is not possible for the shifts in maturity and concentration. There is no robust evidence that banks that are more affected by the negative interest rates via a high ratio of customer deposits have a different sensitivity to duration and concentration risk across the whole portfolio. Figures 13 and 14 plot the coefficient of the triple interaction term for holdings disentangled by asset classes for maturity and concentration index respectively. There are no effects that are robust across the different specifications of fixed-effects. The only statistically significant result concerns holdings of bank debt, for which banks with a high deposit ratio seems to have increased average maturity.[12]

4 Heterogeneity induced by bank leverage

Peydró, Polo and Sette (2017) provide evidence that during the crisis period bank risk-taking in response to a monetary policy loosening can be explained by a particular bank's risk-bearing capacity (i.e. bank leverage). They run their analysis using granular data on loans and securities holdings for Italian banks. Inspired by their results, we investigate how differences in bank leverage may affect allocation of securities portfolios in the context of negative rates.

Hence we interact our coefficient of interest with the leverage ratio (equity divided by total assets) of each bank. We also add all relevant lower-level interaction terms to our regression. The results are displayed in Table 6.

We find the coefficient of "Leverage ratio*Deposit ratio*Post*ACY" to be negative and significant while the coefficient of "Deposit ratio*Post*ACY" remains positive and significant. This means that our effect of interest (how a bank with a higher depost ratio reacts to changes in the ACY after the introduction of negative policy rates) is weaker for highly capitalized banks. At this point, one might conclude that our results are evidence of risk-shifting: banks

[12]the entire set of estimated results is available from the authors

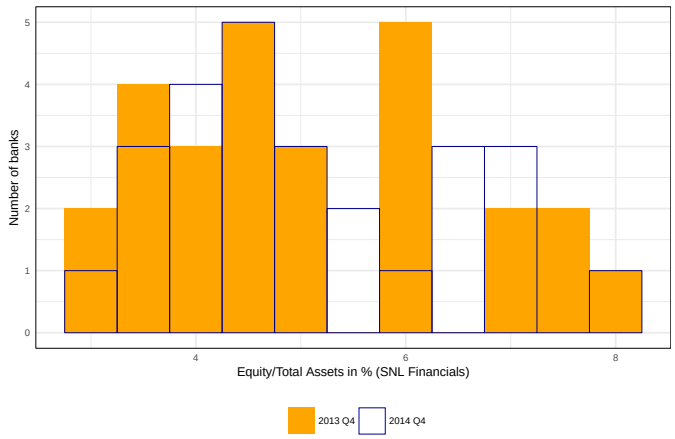
Table 6: Regressions with bank leverage ratio interaction

VARIABLES	(1) Ln(Holdings)	(2) Ln(Holdings)	(3) Ln(Holdings)
Post		-1.852***	
		(0.694)	
ACY	0.393***	0.301***	0.606***
	(0.122)	(0.106)	(0.168)
Post*ACY	-0.769***	-0.531***	-0.883***
	(0.216)	(0.146)	(0.221)
Deposit ratio	-0.0166	-0.0110	-0.0230
	(0.0181)	(0.0127)	(0.0191)
Deposit ratio*Post	0.0177*	0.0140*	0.0235**
	(0.00985)	(0.00802)	(0.0118)
Deposit ratio*ACY	-0.00962***	-0.00810***	-0.0131***
	(0.00280)	(0.00272)	(0.00369)
Deposit ratio*Post*ACY	0.0147***	0.0110***	0.0169***
	(0.00473)	(0.00348)	(0.00488)
Leverage ratio	-1.559***	-1.155***	-1.780***
	(0.571)	(0.418)	(0.648)
Leverage ratio*Post	0.255**	0.209**	0.263**
	(0.113)	(0.0868)	(0.120)
Leverage ratio*ACY	-0.0851***	-0.0666***	-0.127***
	(0.0268)	(0.0244)	(0.0399)
Leverage ratio*Post*ACY	0.155***	0.108***	0.185***
	(0.0450)	(0.0319)	(0.0510)
Leverage ratio*Deposit ratio*ACY	0.00196***	0.00172***	0.00277***
	(0.000605)	(0.000591)	(0.000835)
Leverage ratio*Deposit ratio*Post*ACY	-0.00300***	-0.00225***	-0.00349***
	(0.000959)	(0.000726)	(0.00106)
Observations	402,649	386,551	276,939
R-squared	0.225	0.583	0.333
Bank Controls	Yes	Yes	Yes
Security FE	No	Yes	No
Time FE	Yes	No	–
Bank FE	Yes	Yes	Yes
Maturity*Rating*Time FE	No	No	Yes

Robust standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Note: Ln(holdings) is calculated on nominal amounts

Figure 15: Distribution of the leverage ratio pre-NPR vs. post-NPR



Source: SNL Financials

with low levels of capital seem to be more prone to risk-taking in response to monetary policy changes.

However, to compute the overall effect on the sensitivity to changes in the ACY after the introduction of negative interest rates, one would need to take into account the change in average effect of leverage on the sensitivity to changes in the ACY, "Leverage ratio*Post*ACY". On average, negative rates do not induce highly levered banks to increase their risk exposure more than better capitalized banks (risk-shifting). Instead, better capitalized banks increase their holdings of securities with a higher ACY in order to exploit their higher risk-bearing capacity. This result in particular is consistent with the results obtained by Peydró, Polo and Sette (2017) during the euro area sovereign crisis.

The magnitude and the sign of the aggregate change in the sensitivity post-NPR depend both on the level of retail deposits and on the leverage ratio. The channel that goes via a bank's deposit ratio, remains intact and is stronger for less capitalized banks. However we find evidence of a counteracting effect that works through the bank's overall risk bearing capacity.

5 Conclusions

The implementation of negative policy rates in several countries in the last few years constituted an important novelty for policy makers and researchers interested in the effect of monetary instruments. We contribute to the ongoing literature addressing the impact that negative rates have on financial intermediaries, in particular banks. We exploit a new dataset on securities holdings statistics of the 26 largest euro area banking groups and evaluate the impact of the introduction of the negative rates. The identification relies on a differential effect due to the inability or unwillingness of banks to pass-through negative policy rates to depositors. Indeed, we show that the portfolio holdings of banks that are more reliant on deposit funding are more sensitive to changes in the yields of the securities held after the introduction of negative policy rates. These banks are more likely to retain their investment on riskier securities than other banks. When considering allocation across asset classes and geographical issuers, we

find evidence that the same banks reallocate more towards private debt securities (issued by the financial and non-financial sector) and securities issued by entities residing in developed countries, both in the euro area and outside EU.

Our analysis complements the results obtained by other researchers mainly focusing on the lending portfolio of banks. It remains to be investigated how the results of all these studies can be combined with the view of assessing the macroeconomic impact of negative policy rates and how to evaluate the possible trade-offs between temporary distortions in some part of the financial sector and the effects on the economy at large. Our results also have important implications for the assessment of the effects of non-standard monetary policy tools and how these can induce heterogeneous impacts across financial intermediaries, which are unrelated to the objectives of the policy makers.

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A Appendix Tables

Table 7: List of reporting banking groups

	Country	Code	Short name	Full name
1	AT	AT20100	Erste	Erste Group Bank AG
2	BE	BE0403227515	KBC	KBC Group-KBC Groep NV/ KBC Groupe SA
3	BE	BE0403201185	Belfius	Belfius
4	DE	DE00001	DB	Deutsche Bank AG
5	DE	DE00003	COBA	Commerzbank AG
6	DE	DE00316	LBBW	Landesbank Baden-Wuerttemberg
7	DE	DE00317	BLB	Bayerische Landesbank
8	DE	DE00319	HELABA	Landesbank Hessen-Thüringen Girozentrale
9	DE	DE00320	NORDLB	Norddeutsche Landesbank Girozentrale NORD/LB
10	DE	DE01121	DZ	Deutsche Zentral-Genossenschaftsbank-DZ Bank AG
11	DE	DE03249	PBB	Deutsche Pfandbriefbank AG
12	ES	ES0049	BSCH	Banco Santander SA
13	ES	ES0182	BBVA	Banco Bilbao Vizcaya Argentaria SA
14	ES	ES7865	BFA	BFA Tenedora de Acciones SA
15	ES	ESHO486478	La Caixa	Criteria Caixa Holding SA
16	FR	FR10278	BFCM	Credit Mutuel CM5-CIC
17	FR	FR16188	BPCE	Group BPCE
18	FR	FR30003	SG	Société Générale
19	FR	FR30004	BNP	BNP Paribas
20	FR	FR30006	CA	Crédit Agricole Group-Crédit Agricole
21	IT	IT0000203426147	MPdS	Banca Monte dei Paschi di Siena
22	IT	IT0000102484824	UC	Unicredit SpA
23	IT	IT0000101262255	ISP	Intesa Sanpaolo
24	NL	NL149	ABN	ABN Amro Group NV
25	NL	NL163	ING	ING Groep NV
26	NL	NL600	Rabobank	Rabobank Group-Rabobank Nederland

Table 8: Country classification

Euro area 19	Euro non-EA 19	Developed	Other
Belgium	Bulgaria	Australia	All other countries
Germany	Croatia	Canada	
Estonia	Czech Republic	Japan	
Ireland	Denmark	Guernsey	
Greece	Hungary	Switzerland	
Spain	Poland	Virgin Islands	
France	Romania	Cayman Islands	
Italy	Sweden		
Cyprus	EU Institutions		
Latvia	United Kingdom		
Lithuania			
Luxembourg			
Malta			
Netherlands			
Austria			
Portugal			
Slovenia			
Slovakia			
Finland			

Table 9: Average nominal holdings by asset class and region

	2013q4-2014q1		2014q2-2014q4	
	Euro billion	%	Euro billion	%
Asset Class				
ABS	524.8	17.8%	521.4	18.5%
Private debt (other)	485.5	16.5%	403.0	14.3%
Private debt issued by banks	830.8	28.2%	754.7	26.8%
Public debt	1100.7	37.4%	1141.9	40.5%
Region				
Developed	219.9	7.5%	221.5	7.9%
Other	211.6	7.2%	209.5	7.4%
EU non-EA 19	211.6	7.2%	199.1	7.1%
Euro Area 19	2298.5	78.1%	2190.9	77.7%
Total	2941.7		2821.0	

Table 10: Baseline regression for alternative risk indicators

VARIABLES	(1) Ln(Holdings)	(2) Ln(Holdings)	(3) Ln(Holdings)	(4) Ln(Holdings)	(5) Ln(Holdings)	(6) Ln(Holdings)
Post		-0.338*			-0.351	
		(0.191)			(0.244)	
Maturity	(7.94e-06)	(0.000454)	(0.000378)			
	2.59e-05***	-0.000268	-0.000308			
Herfindal				-0.320*	-1.928***	-0.0226
				(0.171)	(0.349)	(0.160)
Post*Maturity	-1.36e-05	-8.57e-07	0.000134			
	(1.01e-05)	(5.00e-06)	(0.000578)			
Post*Herfindal				-0.576***	0.101	-1.333***
				(0.214)	(0.205)	(0.334)
Observations	402,649	386,551	276,939	402,649	386,551	276,939
R-squared	0.219	0.580	0.327	0.222	0.582	0.332
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Security FE	No	Yes	No	No	Yes	No
Time FE	Yes	No	–	Yes	No	–
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Maturity*Rating*Time FE	No	No	Yes	No	No	Yes

Robust standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$