Mixing QE and Interest Rate Policies at the Effective Lower Bound: Micro Evidence from the Euro Area*

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First version: June 15, 2021
This version: July 6, 2021

Abstract

Central-bank asset-purchase programs in the presence of negative interest-rate policies and a zero lower bound on deposits crowd out bank lending to the real economy. When banks face a lower bound on customer deposit rates, an asset swap between securities and reserves reduces net worth as the costs of holding reserves cannot be passed through to households. Exploiting euro-area syndicated lending data and the German credit registry, we provide evidence that banks with more exposure to negative monetary-policy rates and large-scale asset purchases reduce corporate lending, have lower stock returns, and rebalance their interbank lending from safe to risky countries.

JEL Codes: E52, E58, G21

Keywords: Negative Interest Rates, Quantitative Easing, Unconventional Monetary Policy, Bank Lending Channel

*Most recent version (soon available) here. We thank Yiming Ma and Skander Van den Heuvel for comments. The views expressed in the paper are those of the authors and do not necessarily represent the views of the IMF or the Deutsche Bundesbank.

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1 Introduction

Since the Great Financial Crisis the policy space for conventional, rate-based monetary stimulus has become increasingly limited. Central banks around the world have responded to this challenge by employing unconventional monetary policies. Most prominently, they have implemented large-scale asset purchases, or quantitative easing (QE), to inject liquidity into the economy. As asset-purchase programs tend to take place in low-rate environments, when the limit of conventional monetary stimulus has been reached, or are used to smooth short-term rates, quantitative easing and conventional rate-setting monetary policy seem inextricably linked. This renders it unclear how lower rates and quantitative easing interact, and whether they substitute or complement each other.

In this paper, we approach this question through the lens of a bank-based transmission channel of monetary policy. We do so by focusing on the euro area where monetary-policy rates broke through what was believed to be the zero lower bound (ZLB) in 2014—a clear expression of nearing the limits of conventional monetary stimulus—before the implementation of quantitative easing. The latter leads to swapping commercial banks' securities with central bank deposits. Cutting interest rates on these same deposits below zero effectively taxes newly created deposits at the central bank. To disentangle the effect of banks' exposure to asset purchases from the transmission of monetary-policy rates, we exploit variation in the pass-through of negative monetary-policy rates to banks' funding costs across countries and banks. First, since the European sovereign debt crisis banks' funding costs differ significantly across euro area countries, especially so for local deposit markets.[1] When the respective rates are closer to the ZLB in a given country, pass-through of monetary-policy rates to banks' funding costs is more likely to be impaired. Second, when banks' funding costs are already close to the ZLB, the pass-through of even lower, negative monetary-policy rates is impaired primarily for retail deposits rather than other types of funding, such as wholesale market funding. Indeed, banks seem reluctant, or unable, to pass on negative rates to their depositors (Heider, Saidi, and Schepens, 2019; Eggertsson, Juelsrud, Summers, and Wold, 2019). This allows us to define banks' exposure to negative monetary-policy rates as a function of their funding structure, as the ZLB on retail deposit rates implies that deposit-funded banks incur higher funding costs than do otherwise-funded banks.

We find that banks whose asset portfolios are more exposed to QE reduce their credit sup-

[1] See, for instance, Bittner, Bonfim, Heider, Saidi, Schepens, and Soares (2020).

ply to the real economy when they are funded more by deposits. These high-deposit banks do not only yield negative rates on central-bank reserves on their asset side, but also incur higher funding costs in comparison to banks whose cost of funding is more aligned with the monetary-policy rate. When quantitative easing is implemented under negative rates, pass-through of lower monetary-policy rates to banks' asset side remains strong, or becomes even stronger, as long-term assets are replaced by central-bank reserves.[2] However, high-deposit banks do not see a drop in their funding costs, which in turn inhibits their ability to lend out to the non-financial sector. Empirically, we find evidence of such reversal for high-deposit banks. This is consistent with the rationale laid out by Repullo (2020), in that banks' funding costs determine their response to counteract what would otherwise constitute an adverse shock to their profitability.

To test how banks' exposure to negative monetary-policy rates and QE affects their asset portfolios, we use granular data on syndicated lending by euro area banks. To capture banks' exposure to negative monetary-policy rates, we use information on their funding structure, in particular their customer deposit share (Heider, Saidi, and Schepens, 2019). This reflects our rationale that high-deposit banks, unlike low-deposit banks, incur higher funding costs during the negative interest-rate period. To measure banks' exposure to QE during that period, we use the ex-ante relative prevalence of securities on their books (Rodnyansky and Darmouni, 2017). Finally, the resulting distinction between high- vs. low-deposit and high- vs. low-security banks is interacted with time variation in the ECB's asset purchases.

Irrespective of how we define the ECB's asset purchases to spill over to euro area banks' balance sheets, we find that high-deposit banks that are more strongly exposed to QE reduce their credit supply when large-scale asset purchases are implemented. We obtain our results controlling for time-invariant unobserved heterogeneity at the bank level, time-varying unobserved heterogeneity at the level of the countries in which these banks are incorporated, and for time-varying unobserved heterogeneity at the firm level by including firm-time fixed effects. This within-firm estimator controls sufficiently well for credit demand, and can rule out negative firms' credit demand shocks as a driver of our results (Khwaja and Mian, 2008; Jiménez, Ongena, Peydró, and Saurina, 2014). In our preferred specification, a bank with a ten percentage point lower security and deposit ratio lends around 8.55% less in response to a one standard deviation increase in asset purchases.

[2] According to Brunnermeier and Koby (2018), this implies that QE should optimally be employed only after the room for lowering rates is exhausted, and gives rise to what they dub the "reversal interest rate" below which further rate cuts depress bank lending.

We examine two relevant channels by which large-scale asset purchases exert an influence on banks' proclivity to lend in the presence of a negative interest rate policy. The first channel is the standard "net worth channel," which sets in when asset purchases positively impact security prices. In turn, this price effect increases the mark-to-market value of bank security holdings and raises bank net worth, a mechanism also known as a "stealth recapitalization" (Brunnermeier and Sannikov (2014)). We find that this net worth channel is limited if at all discernible in the euro area during QE, a result consistent with the observation that large-scale asset purchases had a small overall impact on sovereign bond prices.[3] At the same time, in both the wider euro area bank data and the German microdata, we find a pronounced "liquidity channel" of QE—once the ECB begins with the interventions in March 2015, banks start to swap their securities for reserves. In an environment where QE is the only major unconventional monetary policy, this influx of liquidity would presumably stimulate lending as banks would become less hesitant to issue illiquid loans (see Rodnyansky and Darmouni (2017)).

However, in the presence of a negative interest rates policy on excess reserves, this mechanism is confounded by a third negative force on the liability side. For the effective swap between securities and central-bank reserves to lead to a reduction in net worth under negative monetary-policy rates, banks' funding costs should be stuck at zero. This is the case if banks are highly dependent on deposit funding, and if retail deposit rates are already close to the ZLB, as there is otherwise still room for them to drop. We show this to hold true in low-rate environments such as the core of the euro area, while this is not the case in other countries of the euro area where sovereign yields (and deposit rates) are higher (Bittner, Bonfim, Heider, Saidi, Schepens, and Soares, 2020). For the largest economy in the euro area, Germany, we can zoom in on the mechanism by using administrative data from the Bundesbank.

Using credit-registry data, we, first, corroborate our baseline result that banks with higher security and deposit ratios reduce their credit supply to firms when QE is implemented. This confirms that the negative credit-supply effects are not limited to syndicated loans, but extend to private credit attained by both small and large firms. Economically, we find comparable but larger effects for Germany than for the whole panel of euro area banks, consistent with the idea that Germany is closer to the zero lower bound on deposits. Combining the German credit-registry data with more detailed balance-sheet data than is available for the panel of euro area banks allows us to differentiate between household deposits, the rates on which face a hard ZLB,

[3]See Figure XXX displaying several Eurozone Sovereign Bond Indexes.

and corporate deposits, which see more pass-through of negative policy rates (Heider, Saidi, and Schepens, 2019; Altavilla, Burlon, Giannetti, and Holton, 2021). This enables us to compare banks with similar deposit ratios that differ only in the source of their deposits. In this manner, we find that banks with high security and high deposit ratios reduce their credit supply only if they are funded by household deposits, reaffirming the importance of the ZLB on retail deposit rates.

Second, we use data on German banks' security holdings to examine their trading of securities around the large-scale asset purchases. We find that banks with ex ante more securities sell more securities during the QE period, but their purchases are not significantly different from banks with less security holdings. Using the net sales of securities as an alternative measure of banks' exposure to QE, we corroborate our findings that banks that are more exposed to QE and have a higher deposit share reduce their credit supply. This evidence addresses the potential concern that the pre-existing share of securities of total assets does not proxy well banks' exposure to QE and, as such, may be driven by other bank-specific factors unrelated to the asset purchases.

Having shown that affected banks reduce their lending to the real sector, we consider the possibility that they rebalance their asset side by, instead, increasing their portion of liquid assets. To this end, we scrutinize German banks' interbank positions and find that consistent with precautionary liquidity hoarding, high-deposit banks that are more exposed to QE increase their interbank lending, with possible implications for the distribution of interbank liquidity in the euro area. Using bilateral country-level banking flows, we present evidence that lends support to the idea that financial dependence of periphery banks from the core may have increased during the ECB's large-scale asset purchases.

Related literature. Our paper contributes to various strands of the literature. First, we contribute to the strand on the effects of negative interest rates. Brunnermeier and Koby (2018) show theoretically that when interest rates decline below a "reversal rate," a decline in interest rates can become contractionary. Ulate (2021) studies the effects of negative rates in a new DSGE model where banks intermediate the transmission of monetary policy. Heider, Saidi, and Schepens (2019) shows that banks with higher deposit rates reduce credit supply in response to the introduction of negative interest rate policy in the euro area. Eggertsson, Juelsrud, Summers, and Wold (2019) show that retail household deposit rates in Sweden are subject to a lower bound and that once this bound is reached, the pass-through to lending rates and credit volumes is substantially lower, and bank equity values decline in response to further policy rate cuts. Bottero, Minoiu, Peydró, Polo, Presbitero, and Sette (2020) show that that negative interest rate policies have expansionary effects on bank credit supply and firm outcomes through a portfolio rebalancing channel. Ampudia and Van den Heuvel (2018) show that during the period of negative interest rates in the euro area, stock prices of banks declined in response to accommodative monetary policy announcement, and even more so for banks that have a high reliance on deposit funding. See Heider, Saidi, and Schepens (2020) for a summary on the negative interest rate literature. Relative to the negative interest rate literature, we explore the interaction of negative interest with QE.

We also contribute to the literature on large-scale asset purchases. Krishnamurthy and Vissing-Jorgensen (2011) study the effect of QE on interest rates in the United States. Koijen, Koulischer, Nguyen, and Yogo (2021) show that banks sold purchase-eligible government bonds during month-year QE. Rodnyansky and Darmouni (2017) define banks' exposure to QE by measuring the relative prevalence of mortgage-backed securities on their books and show that in the U.S. banks that were strongly exposed to QE increased their lending in response to it. Di Maggio, Kermani, and Palmer (2019) find that after QE1, originations of mortgages qualifying for inclusion in eligible securities for Fed purchases increased a lot more than those of non-qualifying mortgages. On the other hand, Chakraborty, Goldstein, and MacKinlay (2020) document that more exposed banks increased mortgage lending but contracted their commercial lending. Luck and Zimmermann (2020) study the employment effects of the transmission of QE to bank lending in the US.

De Fiore, Hoerova, and Uhlig (2018) and Corradin, Eisenschmidt, Hoerova, Linzert, Schepens, and Sigaux (2020) show that asset purchases induce a scarcity effect which induces money market frictions and can have negative effects on lending. Bianchi and Bigio (2014) show theoretically that purchases of liquid assets (the ones we study) can be ineffective and purchases of more illiquid assets (such as loans) can be more effective. Diamond, Jiang, and Ma (2021) show that the central bank reserve creation through QE crowds out bank lending. This result is in line with our findings as the central bank replaces liquid assets with other liquid assets and does therefore not encourage lending. Relative to most papers in the QE literature we differ that we specifically study whether lending effects differ for banks that are exposed strongly to both QE and negative interest rates. Another difference to most of the QE literature is that while other papers focus on the announcement of QE we study the implementation.

One exception in the literature that studies the interaction between negative interest rates and QE is Brunnermeier and Koby (2018) who argue that QE should only employed after interest rate cuts are exhausted. They argue that when the central bank reduces interest rates the capital gains on banks' deposits are expansionary and banks with large security holdings benefit disproportionately from these capital gains. Empirically, we find that banks that have large security holdings do not benefit disproportionately more but less when they have a large deposit share and QE is conducted.

2 Hypothesis Development

We follow Brunnermeier and Koby (2018) in defining $L + S + R = D + E$ as the balance sheet identity of the bank where L are bank loans, S are fixed-income securities, R are central bank reserves, D are deposits, and E is equity.

Banks face a liquidity constraint $S + R \geq \psi$ that is banks fixed-income securities and reserves must cover a certain fraction of deposits.

Banks' net interest income is given by:

$$NII = \underbrace{(1 + i^L)L + (1 + i^R)R + (1 + i^S)S}_{\text{Interest Income}} - \underbrace{(1 - i^d)D}_{\text{Interest Expense}} \tag{1}$$

Banks' net interest income is a rising function of interest rates on loans, reserves and securities and a negative function of interest rates on deposits. Hence a lower rate of deposits increases banks' net interest margin. If banks' interest rate on deposits is bound by zero, and interest income on loans, reserves and securities fall, this reduces banks' net interest income and therefore their equity.

$$N_1 = (1 + i^L)L + (1 + i^R)R + (1 + i^S)S - (1 + i^d)D \tag{2}$$

plugging in $D = L + R + S - E$ and $S = \psi D - R$ as we assume the liquidity constraint binds, we have:

$$N_1 = (1 + i^L)L + (1 + i^R)R + (1 + i^S)(\psi D - R) - (1 + i^d)(L + R + S - E) \tag{3}$$

As central bank asset purchases can be seen as an increase in bank reserves, we take the derivative with respect to R.

$$\frac{\partial N_1}{\partial R} = (1 + i^R) - (1 + i^S) - (1 + i^d) \tag{4}$$

As QE swaps securities with central bank reserves it reduces investment income if $(1 + i^R) < (1 + i^D) + (1 + i^S)$.

The higher reserves on banks' balance sheets also lead to an increase in deposits at the same time. If the deposit rate can be reduced an increase in the balance sheet does not affect banks' profits negatively. However, if banks deposit rate is bound at a certain rate an increase in reserves at a rate lower than the rate on deposits, lowers banks' profits.

In order to counteract a reduction in investment income, banks could lend out their additional central bank reserves to non-financial companies at higher yields. However, loans to non-financial companies are illiquid and risky and under a liquidity constraint that is binding the increase in reserves cannot be counteracted by an increase in lending.

The effect of QE (replacing securities with central bank reserves on banks' balance sheet) can therefore reduce banks' lending through lower profitability.

3 Data

3.1 Bank Lending and Balance-Sheet Data

In the first part of the paper, we analyze credit supply in the syndicated-loan market in the euro area using data on syndicated-loan transactions from DealScan. For a syndicated loan, different banks form a syndicate and then lend to firms. The lead arranger in a syndicate is usually responsible for monitoring of the loan and various other responsibilities that are associated with risk management, see Ivashina and Scharfstein (2010). Lead arrangers tend to hold on to their loan shares, while other syndicate members (participants) can and do sell their shares in the secondary market. In the DealScan data, we only see the facility amount, the banks that participate in the syndicate, and whether they act as lead arrangers or other participants. However, banks' individual contributions are not properly recorded most of the time. We therefore follow the literature, and split two-thirds vs. one-third of the total loan amount equally among all lead arrangers and other participants, respectively.[4]

We then merge the syndicated-loan data with Bankscope data where we observe the balance-sheet characteristics of the banks. In particular, we use data on banks' security holdings, their customer deposits, as well as various other control variables.

[4] See, for example, Chodorow-Reich (2014). The results are robust to other choices.

3.2 Bundesbank Micro-Level Data

We complement our analysis of syndicated lending in the euro area with administrative credit-registry data from Germany (Schmieder, 2006). Banks domiciled in Germany are required to report all loans exceeding one million euros. The dataset contains the loan amount outstanding to the respective borrower on a quarterly basis.

In addition, we use the Securities Holdings Statistics, SHS-Base plus, formerly known as WpInvest (Blaschke, Sachs, and Yalcin, 2020). The dataset covers all securities held by banks on their own behalf domiciled in Germany (full census). Banks report the holdings amount on a security-by-security level.[5] We enrich this dataset by merging security master data from the Centralised Securities Database (CSDB) (Bade, Flory J., and Schnellbach, 2018). The purpose of the CSDB is to cover all securities likely to be held or transacted by euro area residents. With its high quality and coverage of more than ten million securities per timestamp, we incur almost no loss of observations from merging.

Finally, we use the Monthly Balance Sheet Statistics (BISTA) including banks' asset and liability positions (Gomolka, Schäfer, and Stahl, 2020). This allows us to construct banks' deposit ratios (deposits over total assets) and security ratios (securities over total assets).

4 Stylized Facts

We start with graphical evidence suggesting which balance-sheet characteristics determine the extent to which euro area banks are affected by quantitative easing, bearing in mind that the ECB's preceding introduction of negative monetary-policy rates in 2014 may have affected the transmission channels of quantitative easing thereafter.

Figure 1 shows that between 2013 and 2016, when the ECB kicked off its asset-purchase programs, banks' security holdings declined substantially (based on Bankscope data). In 2013 and 2014 security holdings of banks remained relatively stable, but once the ECB started purchasing assets at a large scale, security holdings of banks declined significantly, while at the same time the ECB's security holdings increased sharply. The ECB's security holdings increased by around 400bn euros and security holdings of euro area banks accounted for around 62% of the sales, based on approximately 250bn euros sold.

The asset purchases of the ECB (or the respective central banks) induced an asset swap for

[5] See also Timmer (2018).

banks, which sold securities to the ECB, to central-bank reserves. Indeed, Figure 2 confirms that most banks increased their reserves between 2013 and 2016. The figure plots the correlation between the share of reserves out of total assets in 2013 and 2016. Banks that lie on the 45-degree line have an equal share of reserves on the balance sheet in 2016 and in 2013. Banks that have a larger share of reserves in 2016 than in 2013 are above the 45 degree line and marked in green, and those that have a smaller share of reserves are below the 45 degree line and marked in red. The size of the bubble reflects the size of the reserves. The graph shows that most banks have a larger share of reserves in 2016, which yield negative interest rates, than in 2013, when the ECB's deposit facility rate was still zero.

This increase in reserves was stronger for firms with greater exposure to QE due to higher (pre-determined) security ratios, consistent with the idea that asset purchases swap securities with reserves on banks' balance sheets, as can be seen in the upper left panel of Figure 3. Banks that had more securities in 2013 were more exposed to QE and sold more securities in the course of the QE implementation, leading to a stronger reduction in security holdings, as shown in the bottom right panel. Against this background, we label such banks with higher pre-determined security ratios as "treated" more heavily by the ECB's asset-purchase programs.[6] The upper right panel of Figure 3 and the bottom left panel also show that banks that had larger pre-existing security ratios increased their interbank lending and the sum of interbank lending and reserves by more.

Taken together, these results imply that high-security banks wind up holding more negative interest-rate bearing assets relative to banks with less exposure to QE. In addition, liquid securities are not only replaced by central-bank reserves on affected banks' balance sheets, but the latter also become more active in (liquid) interbank lending. This raises the question to what extent high-security banks' treatment under QE affects their credit provision to the non-financial sector, to which we turn next.

[6] In subsection 3.2, we provide more direct evidence for German banks, and thereby confirm, that pre-existing security holdings predict the selling of securities and a swap of securities with reserves when QE is implemented.

5 Evidence from Syndicated Lending

5.1 Empirical Setup

In this section, we analyze syndicated lending by banks in the euro area. In particular, we study the lending behavior of banks that are differentially exposed to the negative interest-rate policy and to asset-purchase programs. As pointed out by Brunnermeier and Koby (2018) and Heider, Saidi, and Schepens (2019), banks tend to face a zero lower bound on retail deposit rates, as they are either reluctant or it is impossible for them to lower deposit rates to below zero, in spite of the monetary-policy rate having crossed that threshold. If banks set a rate below this "reversal" rate (for example zero), customers may withdraw their deposits. As this friction is not present for wholesale deposits, banks that rely more on retail deposit funding are more likely to be negatively affected by negative interest rates on central-bank reserves. The reduction or even reversal in the net interest margin can then through a reduction in profits halt bank lending. Consequently, and following Heider, Saidi, and Schepens (2019), we define banks' exposure to negative monetary-policy rates by their deposits-to-assets ratio.

Analogously, as argued before, banks that have a higher security ratio are more exposed to asset-purchase programs. First, banks that have a larger share of securities on their balance sheet are more likely to be positively affected through asset-price appreciation than banks with lower security ratios (Brunnermeier and Sannikov, 2016). Second, banks that have higher security ratios are more affected through a substitution of securities with central-bank reserves. For example, if the central bank buys 10% of the securities of each bank, a bank with a security ratio of 10% has 1% of its assets in central-bank reserves, whereas a bank with 20% securities on its balance sheet has 2% of its assets converted into central-bank reserves. If central-bank reserves yield negative rates and banks are unable to pass on the negative interest rates to their customers, a larger exposure to asset-purchase programs can reduce bank profitability and, thus, lead to a reduction in credit supply.

To test whether banks that are more exposed to both QE and negative monetary-policy rates behave differently in terms of their lending behavior, we estimate the following regression specification:

$$
\begin{aligned}
Log(Amount)_{i(l),j(l),t(l)} = {} & \beta_1 QE \times Security\ Ratio_i + \beta_2 QE \times Deposit\ Ratio_i \\
& + \beta_3 QE \times Security\ Ratio_i \times Deposit\ Ratio_i \\
& + \alpha_i + \alpha_{m(t),j} + \alpha_{m(t),c} + \epsilon_{i,j,t},
\end{aligned} \tag{5}
$$

where *Amount*$_{i(l),j(l),t(l)}$ is the amount lent by bank *i* to borrower *j* at date *t* in loan package *l*. QE is a standardized measure of the asset purchases, unless indicated otherwise. *Security Ratio*$_i$ is the share of securities over assets of bank i held in 2012, and *Deposit Ratio*$_i$ is the share of deposits over assets of bank i in 2012. The sample spans the time period from the introduction of negative monetary-policy rates (2014) to 2020. Standard errors are clustered at the bank level.

Importantly, we include borrower-time and (banks') country-time fixed effects to control for credit demand and time-varying unobservable characteristics at the level of the country in which a given bank *i* is incorporated that could drive our results.

5.2 Baseline Results

Table 1 shows the results from estimating (5) with different variations of *QE*. All specifications yield a negative term on β_3, indicating that banks that are more exposed to both QE and negative interest rates lend less in response to asset-purchase programs than their less exposed counterparts. This result is robust to different definitions of *QE*. In columns 1 to 3, we define *QE*$_{c,m(t)}$ as the government-bond purchases of a country in a month, divided by the respective country's banks' total security holdings in 2012. This can be seen as a measure of the absorption of securities relative to a pre-existing stock. This is our baseline measure and is a "flow" measure of QE.[7] In column 3, instead of scaling the asset purchases of government bonds with the 2012 securities held by banks in a given country, we scale the purchases with the one-month lagged security holdings of the banking sector.

Our estimate of β_3 is virtually invariant across the first three columns, where we additionally vary the set of fixed effects. In column 1, we control for bank and borrower-time fixed effects. The latter are included so as to control for time-varying unobserved heterogeneity at the borrower level, including but not limited to loan demand (Jiménez, Ongena, Peydró, and Saurina, 2014; Khwaja and Mian, 2008). Effectively, we identify our effect off firms that borrow in the same

[7] D'Amico and King (2013) show that there are both flow and stock effects of QE.

month from different banks. To the extent that credit demand does not vary across banks, the lending from banks to firms can therefore be attributed to credit supply rather than credit demand. To estimate a regression with such firm-month fixed effects, we implicitly restrict our sample to firms that borrow at least from two banks at the same time. However, as we focus on syndicated loans, which by definition are conducted by a syndicate of banks, this restriction is innocuous. In subsection 3.2, when using micro data on general bank-firm lending relationships, we relax the assumption that firms need to borrow from at least two banks. In all remaining columns, we also include bank i's country by time fixed effects, which control for time-varying unobserved heterogeneity associated with a given bank's country.

In columns 4 and 5, we use the log of the monthly purchases in a country and overall, respectively, instead of the scaled monthly purchases. In columns 6 and 7, we use the log of holdings rather than the purchases, i.e., a stock measure of QE rather than a flow measure, in a country and overall, respectively. Across all specifications, our coefficient ranges from -0.95 to -0.62. In terms of economic magnitudes, a bank with a 50% security and a 50% deposit ratio (0.25) relative to a bank with a 40% security and a 40% deposit ratio (0.16) lends between 8.55% ($= 0.09 \times 0.95$) and 5.58% ($= 0.09 \times 0.62$), multiplied by *QE*, less. To measure an average effect on credit supply, we redefine *QE* in column 8 to be an indicator variable that equals one during the quantitative-easing period. The respective coefficient on the triple interaction implies an almost 20% difference in lending.

One concern in the above specification could be that banks that have a large exposure to QE and negative rates are also different in terms of other characteristics that may govern bank lending over time. To investigate this, in Table 2, we regress bank characteristics in 2012 on the interaction between the security ratio and the deposit ratio in the cross-section of banks. Affected banks, i.e., those with high securities and deposit ratios, do not differ substantially in terms of other common bank characteristics, such as total assets, capitalization, or profitability. As such, it does not come as a surprise that our estimates are robust to including interaction terms of our *QE* measure with the above-mentioned control variables (Table 3).

In Table 4, we re-estimate our baseline specification for a longer time period (starting in 2010), and replace the *QE* treatment variable with an indicator variable that takes on the value one since the start of the introduction of negative interest rates in the euro area (June 11, 2014). Given that the QE and the negative interest rate periods roughly coincide, we effectively replace our QE treatment-intensity variable with a dummy for non-zero asset purchases by the ECB. The results show that banks that are more exposed through their balance sheet (higher deposit and security ratios) to both negative interest rates and QE lend less during the negative interest rate period than before compared to less exposed banks. This holds after controlling for various fixed effects, such as borrower-time and month-country fixed effects. Therefore, we can conclude that banks' exposure to negative interest rates through their funding structure and to quantitative easing is jointly instrumental in explaining their lending behavior: there are no effects on bank lending by banks with high security and deposit ratios prior to the implementation of these monetary policies. In Table 5, we use the actual deposit facility rate as a continuous treatment variable instead of $Post_t$. As expected, and in line with the previous results, the coefficient is positive, implying that a lower deposit facility rate is associated with less lending of exposed relative to less exposed banks.

Figure 4 plots the coefficient on the triple interaction annually between 2010 and 2019. Before the introduction of negative monetary-policy rates, there is no substantial difference in the credit supply as a function of banks' exposure to negative monetary-policy rates and QE. This absence of a pre-trend, combined with a strong decline in the coefficient once negative interest rates (red vertical line) and QE (purple dashed line) are introduced, lends support to our identifying assumption that banks more exposed to QE and negative rates would not have been on different trajectories absent the introduction of these policies.

Brunnermeier and Koby (2018) argue that interest-rate cuts are more effective before QE than after QE, as banks' benefit less from capital gains when fewer securities are on their balance sheet. To test this, Table 6 explores further heterogeneity in terms of the response to negative interest-rate cuts before and after QE was introduced, by estimating a staggered difference-in-differences specification. For this purpose, we split our sample into four periods: (1) a pre-period, (2) an *NIRP CUT BEFORE* QE_t period, (3) a QE_t period, and (4) an *NIRP CUT AFTER* QE_t period.

Table 6 shows, indeed, that banks that are more exposed to QE and negative interest rates do not lend less than their counterparts after the first cut into negative territory without QE implemented at the same time. When in addition to negative interest rates QE is implemented, the treated banks lend less than their counterparties, but the effect becomes even stronger when the ECB cuts the deposit facility rate further into negative territory, i.e., after negative monetary-policy rates have already been implemented and QE has been conducted.

6 Equity Returns

In this section, we estimate the reaction of bank stock prices in response to asset purchases. We exploit heterogeneity in terms of the exposure to the negative interest-rate policy and asset purchases by comparing banks that differ in terms of their deposit and security ratios. As equity returns measure expected future discounted bank profits, the response of equity returns can be indicative of profitability (English, Van den Heuvel, and Zakrajšek, 2018). Ampudia and Van den Heuvel (2018) show that during the period of negative interest rates in the euro area, stock prices of banks declined in response to accommodative monetary-policy announcements, and even more so for banks that rely heavily on deposit funding. In contrast to Ampudia and Van den Heuvel (2018), we study the response of equity returns of high-deposit and high-security banks relative to other banks in response to asset purchases during a period of low interest rates. We estimate the following regression model:

$$\begin{aligned} Return_{i,m} =& \alpha_i + \alpha_m + \beta_1 QE_{c,m} \times Security\ Ratio_i + \beta_2 QE_{c,m} \times Deposit\ Ratio_i \\ &+ \beta_3 QE_{c,m} \times Security\ Ratio_i \times Deposit\ Ratio_i + \epsilon_{i,m}, \end{aligned} \tag{6}$$

where *Return*$_{i,m}$ is the percentage change in the equity prices of bank *i* between month-year *m* and *m-1*. *QE*$_{c,m}$ is the log of the amount purchased of the bonds of country c that bank *i* resides in divided by all banks' total security holdings of country *c* in 2012. *Security Ratio*$_i$ is the share of securities over assets that bank i held in 2012. *Deposit Ratio*$_i$ is the share of deposits over assets of bank i in 2012. The sample period runs from 2010 to 2020. Standard errors are clustered at the bank level.

Table 7 shows the results. Banks with higher security and deposit ratios exhibit lower stock returns in response to implementation of asset purchases. Figure 5 plots the estimated stock return response to a one-standard-deviation increase in asset purchases as a function of banks' security and deposit ratios. Banks that have a high security ratio and high deposit ratio are estimated to have significantly lower stock returns relative to other banks with lower security or deposit ratios. For example, the most exposed bank in our sample with a deposit ratio of 89% and a security ratio of 54% is estimated to have a stock return of -11.53% in response to a one-standard-deviation increase in asset purchases. In contrast, the least exposed bank's stock returns with only 2% securities and a 7% share of deposit funding is insensitive to variations stemming from QE.

Next, we compare stock returns of two hypothetical banks: one that has a high share of deposits and securities (both at the 75$^{\text{th}}$ percentile), relative to a bank that has a deposit and security ratio (at the 25$^{\text{th}}$ percentile). By construction, before the implementation of QE, stock returns of banks with differential exposure to the unconventional monetary-policy tools implemented by the ECB move in parallel. However, once the national central banks in the euro area start buying government bonds, stock returns of banks with a high exposure significantly underperform. Banks that are highly exposed to QE and negative interest rates have persistently lower returns of around -4% during the QE and negative interest-rates period, while banks that are less exposed, as they have a larger wholesale-funding base and rely less on securities on their balance sheet, have constant returns of around -1% and -2%.

Negative interest rates do not bite to the same extent across countries in the euro area, as despite a common nominal interest rate on interbank funds, customer deposits rates can vary widely across euro area countries (Bittner, Bonfim, Heider, Saidi, Schepens, and Soares, 2020; Heider, Saidi, and Schepens, 2020). Countries in which government-bond yields are perceived as relatively risky, overall interest rate levels (including on customer deposits) also exhibit higher interest rates, as government bonds and bank deposits can be seen as substitutes. Consequently, we would expect our channel to be stronger in countries where the zero lower bound on deposits is more binding.

In Table 8, we exploit heterogeneity across countries in terms of their exposure to negative interest rates. First, we confirm that the result is stronger in Germany, a low-deposit-rate country, than in other countries in the euro area. When exploiting the exposure index (that is decreasing in deposit rates prior to the introductio of the negative deposit facility rate) to negative interest rates, as in Bittner, Bonfim, Heider, Saidi, Schepens, and Soares (2020), we see that countries that are less exposed to negative rates (low index) see almost no reaction in stock returns. GIIPS countries (Greece, Italy, Ireland, Spain), which happen to be, on average, less exposed to negative rates, also see a smaller response, but the effect is not statistically significant. In the last column, we show that banks' stock returns in countries that have higher bond yields ex-ante also suffer less. This evidence suggests that the net-worth channel is less important for banks in these countries than for banks in countries that already have low rates before and where an increase in bond prices does not recapitalize banks as much.[8]

[8] In Table A2, we also exploit heterogeneity across countries in the lending response, and find some evidence that the effect is stronger for banks that are based in countries where deposit rates are lower than in countries where deposit rates are higher.

Next, we zoom in on Germany, a country where deposit rates are close to the zero lower bound (high exposure index), and where negative interest rates are thus harder to pass-through to bank customers.

7 Micro Evidence from Germany

The administrative data from the Bundesbank provide us with the possibility not only to observe credit relationships with different counterparties—in particular firms and other banks—over time, but also to observe bank-level outcomes at a higher frequency. In Table 9, we use this feature of our data to confirm that German banks that are highly exposed to both the ECB's asset-purchase programs and the negative interest-rate policy wind up with more central-bank reserves (column 1), but not central-bank liabilities (column 2). This leads to an overall increase in their net central-bank assets (column 3). Finally, there is no discernible increase in deposits (column 4). In line with our estimate in column 1 of Table 8, this confirms that affected banks face an adverse shock to their net worth due to the asset swap of securities with reserves, on which they pay a negative deposit facility rate since June 2014.

We next document whether our exposure measure for QE is actually correlated with changes in security holdings. In Table 10, we use granular data on German banks' security holdings from the Securities Holdings Statistics (SHS). We find that high-security banks indeed sell off securities from their balance sheets, but this is only the case for large banks, which we define as banks with total assets exceeding € 50 bn, with presumably better access to market makers. We leverage the German microdata to both fine-tune the treatment variable and hence sharpen our identification. Besides, knowing that high-security banks are, in fact, more prone to selling off their holdings to the ECB validates existing approaches that generally rely on measuring exposure to QE via the securities-to-asset ratio. In contrast, banks' funding structure, as reflected by their deposit ratio, is not relevant for their security holdings. As such, banks' reliance on deposits affects their funding costs and net worth only through their exposure to the negative interest-rate policy.

In Table 11, we use our credit-registry data at the bank-firm-quarter level (i,j,q), and estimate analogous regressions to those in our baseline Table 1, using the same definition of $QE_{c,q}$ as in the first two columns. The granularity of the data allows us to track a given bank i's loan exposure to firm j over time. As such, we can estimate the effect of banks' exposure to QE and negative rates, while controlling for both time-invariant unobserved heterogeneity at the bank-firm match level and time-varying unobserved heterogeneity at the firm level. In this manner, we can test the effect on banks' intensive margin of lending.

Despite the fact that the inclusion of firm-time fixed effects forces our identification to come from German firms in relationships with multiple banks, the estimated triple-interaction effect is similar in size to that in column 2 of Table 1, where firm-time fixed effects rather capture the fact that multiple banks come together to provide a syndicated loan. This holds, however, only for the subset of large banks in column 1 of Table 11, but not for the remaining banks in column 2. In column 3, we use the pooled sample and find that the difference in the triple-interaction effect is significantly different (at the 1% level) for these two groups of banks. In columns 4 to 6, we re-run the same regressions, except that instead of differentiating by size, we distinguish banks by their access to the repo market. Banks with access to the repo market behave like large banks, in that they reduce their lending when they are exposed to both QE and negative rates through the securities on their asset side and their reliance on deposit funding.

These findings attest to the idea that banks' exposure to QE is contingent on their ability to sell off securities that are purchased by the ECB under the program. This is the case primarily for large banks. As a robustness check, we can replace banks' exposure to $QE_{c,q}$ as a function of their pre-determined $Security\ Ratio_i$ by their actual change in security holdings over the course of one year, without having to limit our analysis to large banks in an attempt to proxy for banks' ability to sell off securities. Doing so, we can confirm in column 1 of Table 12 that high-deposit banks lend less following a drop in their security holdings during the ECB's asset purchases. In column 2, one can see that the effect is confined to household deposits, rather than those of non-financial corporations. This finding once again confirms the importance of the negative interest rate mechanism as the zero lower bound constraint is more binding for households than for corporate deposits.[9] Finally, our results are broadly robust to replacing annual changes in banks' security holdings by quarterly changes (see columns 3 and 4).

In Table 13, we re-run (almost) the same specifications as in the first two columns of Table 12, but limit the variable reflecting security changes to sales (columns 1 and 3) or purchases (columns 2 and 4). In line with high-deposit banks reducing their credit supply only when their securities are swapped with central-bank reserves, we find a statistically and economically significant coefficient on the relevant interaction term only for security sales.

As affected banks reduce their lending to non-financial corporations, this opens up the possi-

[9] See, for example, Altavilla, Burlon, Giannetti, and Holton (2021).

bility that they rebalance their (loan or asset) portfolios, in particular by increasing their portion of liquid assets. This would be consistent with Diamond, Jiang, and Ma (2021) insofar as interbank loans are a means of transferring and redistributing reserves among banks, without increasing the total amount of reserves in the system.

To investigate this, we next consider the interbank portion of the German credit registry, i.e., we consider bank lending to other banks, rather than firms. In columns 1 and 3 of Table 14, we re-run analogous specification to those in columns 1 and 2 of Table 11. Large banks that are exposed to QE and negative rates, and as such have been shown to reduce their credit supply to non-financial corporations, instead expand their provision of interbank loans. In column 2, the effect is somewhat stronger, albeit insignificantly so, for interbank lending to high-yield countries. In the last two columns, we replace $\textit{Security Ratio}_i \times \textit{QE}_{c,q}$ by the actual change in security holdings over the course of one year, and find that high-deposit banks that sold off their securities during the QE period lent more to banks in high-yield countries (column 6), but not on average (column 5).

These estimates suggest that affected banks replace illiquid loans to the real sector with liquid interbank loans on their asset side. When doing so, they possibly reach for yield in response to the adverse shock to net worth that they incur due to the negative deposit facility rate charged on their additional central-bank reserves. In Table 15, we differentiate interbank lending by large and small banks within (columns 1 and 3) and outside the euro area (columns 2 and 4). The differential lending response is confined to large affected banks and their lending to other euro area banks. In columns 5 and 6, we test whether the lending response is significantly different for large versus small banks, and this is the case only for interbank lending within the euro area (column 5).

8 Cross-Border Interbank Flows

We next zoom in on the implications of QE under negative policy rates for the distribution of interbank liquidity in the euro area. The micro-level results in Tables 14 and 15 suggest that while German banks with greater exposure to QE and negative rates reduce their credit supply to the real sector, they expand their lending to other banks, and especially in the euro area. To investigate whether this potential reaching-for-yield behavior has any meaningful explanatory power for interbank flows between the core and the periphery in the euro area, we use aggregate data from the Bank for International Settlements, and estimate the following regression specification at the country-pair level:

$$Flow_{c,j,q} = \alpha_{i,q} + \alpha_{j,q} + \beta_1 Core_c \times GIIPS_j + \beta_2 QE_{c,t} \times Core_c \times GIIPS_j + \epsilon_{c,j,q}, \quad (7)$$

where $Flow_{c,j,q}$ is the percentage change in bank claims of (source) country *c* to (recipient) country *j*. $QE_{c,q}$ is the amount purchased of the bonds of country c divided by the banks' total security holdings of country c in 2012. The sample starts in 2014. $Core_c$ is an indicator variable for whether the lending country *c* is Germany, Finland, the Netherlands, or Austria. $GIIPS_j$ is an indicator variable for whether the borrowing country *j* is Greece, Italy, Ireland, Spain, or Portugal. Standard errors are double-clustered at the lender and borrower-country levels.

Table 16 shows the results of estimating (7). When QE is conducted, core-country banks—not only in Germany—lend more to GIIPS country banks. Figure 7 plots the share of borrowing of GIIPS banks from core banks in red. The black dashed line shows the ECB bond holdings of core countries. There is a strong correlation between the two measures, suggesting that QE during the negative interest-rate policy period may have led to greater financial dependence of periphery banks from the core.

9 Conclusion

This paper studies the consequences of the interaction between negative monetary-policy rates and large-scale asset purchases. We provide evidence that absorbing a large amount of securities from the banking sector in the presence of a zero lower bound on deposit rates *reduces* credit supply. Our results point to some important policy implications for monetary policy. As QE can exacerbate the detrimental effects of negative interest-rate policies on banks' profitability, central bankers should be cautious in combining various unconventional policies. In addition, affected banks may counteract this adverse shock to their net worth by reaching for yield in the liquid interbank market. We present suggestive evidence that this may have led to interbank flows from the core to the periphery in the euro area during the ECB's large-scale asset purchases.

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Tables

Table 1: Asset Purchases

	Dependent Variable: Lending							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
QE × Security Ratio × Deposit Ratio	-0.815**	-0.938**	-0.950**	-0.949***	-0.954***	-0.633**	-0.622**	-2.006**
	(0.309)	(0.448)	(0.468)	(0.347)	(0.332)	(0.286)	(0.273)	(0.804)
R-squared	0.975	0.976	0.976	0.975	0.975	0.976	0.976	0.976
N	6382	6311	6311	5913	5863	6311	6311	6311
Bank FE	✓	✓	✓	✓	✓	✓	✓	✓
Borrower × Month FE	✓	✓	✓	✓	✓	✓	✓	✓
Country × Month FE	–	✓	✓	✓	✓	✓	✓	✓
Specification	$\frac{App_{c(i),m(t)}}{BSecH_{c(i),2012}}$	$\frac{App_{c(i),m(t)}}{BSecH_{c(i),2012}}$	$\frac{App_{c(i),m(t)}}{BSecH_{c(i),m(t)-1}}$	$ln(App_{c(i),m(t)})$	$ln(App_{m(t)})$	$ln(H_{c(i),m})$	$ln(H_{m(t)})$	$QEDummy$

Notes: The level of observation is credit to firm *j* by bank *i* in country *c* on day *t*. The sample period is 2014 to 2020. The dependent variable is the natural logarithm of the euro amount of debt issued between firm *j* and bank *i* on day *t*. QE measures the implementation of the Public sector purchase programme (PSPP) of the ECB. In column (1)-(2) $QE_{c,m(t)}$ is the amount purchased of government bonds by the ECB country *c* in month-year *m(t)* divided by the banks' total security holdings of country *c* in 2012. In column (3), $QE_{c,m(t)}$ the same numerator is scaled by the banks' total security holdings of country *c* in the previous month-year. In column (4), $QE_{m(t)}$ is the log amount purchased of government bonds by the ECB of country *c* in month-year *m(t)*. In column (5), $QE_{m(t)}$ is the log amount purchased of all government bonds by the ECB in month-year *m(t)*. In column (6), $QE_{c,m(t)}$ is the log of the amount *held* of government bonds by the ECB of country *c* in month-year *m(t)*. In column (7), $QE_{m(t)}$ is the log of the amount *held* of all government bonds by the ECB in month-year *m(t)*. In column (8), $QE_{m(t)}$ is a dummy equal to one after March 2015. $Security\ Ratio_i$ is the share of securities over assets a bank held in 2012. $Deposit\ Ratio_i$ is the share of deposits over assets of a bank in 2012. The various double interactions between the three variables $Deposit\ Ratio_i$, $Security\ Ratio_i$ and $QE_{(c,)m(t)}$ are included in the regression but are not reported in the table. Standard errors are clustered at the bank level.

Table 2: Balance Table

	(1)	(2)	(3)	(4)	(5)
	Log(Assets)	Capital Ratio	T1 Capital Ratio	RoA	RoC
Security Ratio	3.228	0.00289	-0.0208	-0.0476	93.28
	(3.865)	(0.096)	(0.064)	(0.030)	(223.547)
Deposit Ratio	-2.028	0.0308	0.0442**	-0.0120	-27.46
	(1.532)	(0.030)	(0.020)	(0.012)	(69.741)
Security Ratio $\times$ Deposit Ratio	-4.821	0.0523	-0.00358	0.0848	47.59
	(6.988)	(0.153)	(0.102)	(0.054)	(356.948)
R-squared	0.171	0.114	0.230	0.0471	0.0255
N	66	60	50	66	52

Notes: The level of observation is at the bank-level in 2012. The dependent variable is (1) log assets ($Log(Assets_i)$), (2) the simple capital ratio ($Capital\ Ratio_i$), (3) the Tier 1 capital ratio ($T1\ Capital\ Ratio_i$), (4) return on assets (RoA_i), (5) return on capital (RoC_i). $Security\ Ratio_i$ is the share of securities over assets a bank held in 2012. $Deposit\ Ratio_i$ is the share of deposits over assets of a bank in 2012.

Table 3: Asset Purchases with Controls

	Dependent Variable: Lending							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
QE × Security Ratio × Deposit Ratio	-1.227**	-1.100**	-1.143**	-1.141**	-1.117**	-0.808**	-0.790**	-2.434**
	(0.462)	(0.506)	(0.532)	(0.432)	(0.433)	(0.376)	(0.360)	(0.994)
R-squared	0.975	0.976	0.976	0.975	0.975	0.976	0.976	0.976
N	6362	6291	6291	5893	5844	6291	6291	6291
Bank FE	✓	✓	✓	✓	✓	✓	✓	✓
Borrower × Month FE	✓	✓	✓	✓	✓	✓	✓	✓
Country × Month FE	–	✓	✓	✓	✓	✓	✓	✓
Specification	$\frac{App_{c(i),m(t)}}{BSecH_{c(i),2012}}$	$\frac{App_{c(i),m(t)}}{BSecH_{c(i),2012}}$	$\frac{App_{c(i),m(t)}}{BSecH_{c(i),m(t)-1}}$	$ln(App_{c(i),m(t)})$	$ln(App_{m(t)})$	$ln(H_{c(i),m})$	$ln(H_{m(t)})$	$QEDummy$
Interacted Controls	✓	✓	✓	✓	✓	✓	✓	✓

Notes: The level of observation is credit to firm *j* by bank *i* in country *c* on day *t*. The sample period is 2014 to 2020. The dependent variable is the natural logarithm of the euro amount of debt issued between firm *j* and bank *i* on day *t*. QE measures the implementation of the Public sector purchase programme of the ECB In column (1)-(2) $QE_{c,m(t)}$ is the amount purchased of government bonds by the ECB country *c* in month-year *m(t)* divided by the banks' total security holdings of country *c* in 2012. In column (3) $QE_{c,m(t)}$ the same nominator is scaled by banks total security holdings of country *c* in the previous month-year. In column (4) $QE_{m(t)}$ is the log amount purchased of government bonds by the ECB of country *c* in month-year *m(t)*. In column (5) $QE_{m(t)}$ is the log amount purchased of all government bonds by the ECB in month-year *m(t)*. In column (6) $QE_{c,m(t)}$ is the log of the amount *held* of government bonds by the ECB of country *c* in month-year *m(t)*. In column (7) $QE_{m(t)}$ is the log of the amount *held* of all government bonds by the ECB in month-year *m(t)*. In column (8) $QE_{m(t)}$ is a dummy equal to one after March 2015. $Security\ Ratio_i$ is the share of securities over assets a bank held in 2012. $Deposit\ Ratio_i$ is the share of deposits over assets of a bank in 2012. The various double interactions between the three variables $Deposit\ Ratio_i$, $Security\ Ratio_i$ and $QE_{(c,)m(t)}$ are included in the regression but are not reported in the table. All regressions include the interaction between $QE_{(c,)m(t)}$ and the following control variables as of 2012: (1) log assets ($Log(Assets_i)$), (2) the simple capital ratio ($Capital\ Ratio_i$), (3) the Tier 1 capital ratio ($T1\ Capital\ Ratio_i$), (4) Return on Assets (RoA_i), (5) Return on Capital (RoC_i). Standard errors are clustered at the bank level.

Table 4: Post NIRP

	Dependent Variable: Lending		
	(1)	(2)	(3)
Post $\times$ Security Ratio $\times$ Deposit Ratio	-1.136**	-1.190**	-1.517**
	(0.473)	(0.551)	(0.617)
R-squared	0.977	0.978	0.978
N	10278	10148	10116
Bank FE	✓	✓	✓
Borrower $\times$ Month FE	✓	✓	✓
Country $\times$ Month FE	-	✓	✓
Interacted Controls	-	-	✓

Notes: The level of observation is credit to firm *j* by bank *i* in country *c* on day *t*. The sample period is 2014 to 2020. The dependent variable is the natural logarithm of the euro amount of debt issued between firm *j* and bank *i* on day *t*. $Post_t$ is a dummy that equals one after the ECB introduced negative interest rates (June 11, 2014). $Security\ Ratio_i$ is the share of securities over assets a bank held in 2012. $Deposit\ Ratio_i$ is the share of deposits over assets of a bank in 2012. The various double interactions between the three variables $Deposit\ Ratio_i$, $Security\ Ratio_i$ and $QE_{(c,)m(t)}$ are included in the regression but are not reported in the table. Column (3) includes the interaction between $QE_{(c,)m(t)}$ and the following control variables as of 2012: (1) log assets ($Log(Assets_i)$), (2) the simple capital ratio ($Capital\ Ratio_i$), (3) the Tier 1 capital ratio ($T1\ Capital\ Ratio_i$), (4) Return on Assets (RoA_i), (5) Return on Capital (RoC_i). Standard errors are clustered at the bank level.

Table 5: ECB Deposit Facility

	Dependent Variable: Lending		
	(1)	(2)	(3)
Deposit Facility $\times$ Security Ratio $\times$ Deposit Ratio	3.154*	3.516	4.571**
	(1.704)	(2.105)	(2.239)
R-squared	0.975	0.976	0.976
N	8311	8213	8181
Bank FE	✓	✓	✓
Borrower $\times$ Month FE	✓	✓	✓
Country $\times$ Month FE	-	✓	✓
Interacted Controls	-	-	✓

Notes: The level of observation is credit to firm *j* by bank *i* in country *c* on day *t*. The sample period is 2014 to 2020. The dependent variable is the natural logarithm of the euro amount of debt issued between firm *j* and bank *i* on day *t*. $Deposit\ Facility_t$ is the ECB's deposit facility rate. $Security\ Ratio_i$ is the share of securities over assets a bank held in 2012. $Deposit\ Ratio_i$ is the share of deposits over assets of a bank in 2012. The various double interactions between the three variables $Deposit\ Ratio_i$, $Security\ Ratio_i$ and $QE_{(c,)m(t)}$ are included in the regression but are not reported in the table. Column (3) includes the interaction between $QE_{(c,)m(t)}$ and the following control variables as of 2012: (1) log assets ($Log(Assets_i)$), (2) the simple capital ratio ($Capital\ Ratio_i$), (3) the Tier 1 capital ratio ($T1\ Capital\ Ratio_i$), (4) Return on Assets (RoA_i), (5) Return on Capital (RoC_i). Standard errors are clustered at the bank level.

Table 6: Staggered Diff-in-Diff

	Dependent Variable: Lending		
	(1)	(2)	(3)
1 NIRP CUT BEFORE QE × Security Ratio × Deposit Ratio	0.0390	-0.0785	-0.0728
	(0.656)	(0.924)	(0.922)
2 QE × Security Ratio × Deposit Ratio	-2.404***	-2.278*	-2.461*
	(0.804)	(1.239)	(1.243)
3 NIRP CUT AFTER QE × Security Ratio × Deposit Ratio	-1.191**	-1.280**	-1.264**
	(0.576)	(0.534)	(0.533)
R-squared	0.977	0.978	0.978
N	10278	10148	10116
Bank FE	✓	✓	✓
Borrower × Month FE	✓	✓	✓
Country × Month FE	-	✓	✓
Interacted Controls	-	-	✓

The level of observation is credit to firm *j* by bank *i* in country *c* on day *t*. The sample period is 2014 to 2020. The dependent variable is the natural logarithm of the euro amount of debt issued between firm *j* and bank *i* on day *t*. $NIRP\ CUT\ BEFORE\ QE_t$ is a dummy that equals 1 since negative interest rates were introduced and before QE was implemented. QE_t is a dummy that equals 1 since QE is implemented and before further interest rate cuts (after QE) were implemented. $NIRP\ CUT\ AFTER\ QE_t$ is a dummy that equals 1 since further interest rate cuts (after QE) were implemented. $Security\ Ratio_i$ is the share of securities over assets a bank held in 2012. $Deposit\ Ratio_i$ is the share of deposits over assets of a bank in 2012. The various double interactions between the three variables $Deposit\ Ratio_i$, $Security\ Ratio_i$ and $QE_{(c,)m(t)}$ are included in the regression but are not reported in the table. Column (3) includes the interaction between $QE_{(c,)m(t)}$ and the following control variables as of 2012: (1) log assets ($Log(Assets_i)$), (2) the simple capital ratio ($Capital\ Ratio_i$), (3) the Tier 1 capital ratio ($T1\ Capital\ Ratio_i$), (4) Return on Assets (RoA_i), (5) Return on Capital (RoC_i). Standard errors are clustered at the bank level.

Table 7: Profits

	Dependent Variable: Stock Return				
	(1)	(2)	(3)	(4)	(5)
QE × Security Ratio × Deposit Ratio	-0.341**	-0.327**	-0.314**	-0.342***	-0.374**
	(0.160)	(0.145)	(0.130)	(0.104)	(0.166)
R-squared	0.0102	0.0250	0.323	0.337	0.342
N	2013	2013	2013	2013	1925
Bank FE	-	✓	-	✓	✓
Time FE	-	-	✓	✓	✓
Interacted Controls	-	-	-	-	✓

The level of observation is the monthly stock return of bank *i* in country *c* in in month-year *m*. The sample period is 2010 to 2020. $QE_{c,m}$ is the amount purchased of government bonds by the ECB country *c* in month-year *m* divided by the banks' total security holdings of country *c* in 2012. $Security\ Ratio_i$ is the share of securities over assets a bank held in 2012. $Deposit\ Ratio_i$ is the share of deposits over assets of a bank in 2012. The various double interactions between the three variables $Deposit\ Ratio_i$, $Security\ Ratio_i$ and QE_m are included in the regression but are not reported in the table. Column (5) includes the interaction between QE_m and the following control variables as of 2012: (1) log assets ($Log(Assets_i)$), (2) the simple capital ratio ($Capital\ Ratio_i$), (3) the Tier 1 capital ratio ($T1\ Capital\ Ratio_i$), (4) Return on Assets (RoA_i), (5) Return on Capital (RoC_i). Standard errors are clustered at the bank level.

Table 8: Profits – Heterogeneity across Countries

	Dependent Variable: Stock Return			
	(1)	(2)	(3)	(4)
QE × Security Ratio × Deposit Ratio	-3.352***	-1.296**	-0.380**	-1.970***
	(0.428)	(0.494)	(0.159)	(0.538)
QE × Security Ratio × Deposit Ratio × Risky	3.011***	1.000**	0.663	0.542*
	(0.490)	(0.391)	(0.550)	(0.289)
R-squared	0.343	0.343	0.343	0.366
N	1925	1925	1925	1673
Bank FE	✓	✓	✓	✓
Month FE	✓	✓	✓	✓
Interacted Controls	✓	✓	✓	✓
Risky	Not Germany	Low Index	GIIPS	Bond Yields

The level of observation is the monthly stock return of bank *i* in country *c* in in month-year *m*. The sample period is 2010 to 2020. $QE_{c,m}$ $QE_{c,m}$ is the amount purchased of government bonds by the ECB country *c* in month-year *m* divided by the banks' total security holdings of country *c* in 2012. $Security\ Ratio_i$ is the share of securities over assets a bank held in 2012. $Deposit\ Ratio_i$ is the share of deposits over assets of a bank in 2012. The various double interactions between the three variables $Risky_c$ captures the riskyness of the country where the bank *is* located. $Risky_c$ is defined as all countries except for Germany in column (1), a dummy for a low (below median) Bittner, Bonfim, Heider, Saidi, Schepens, and Soares (2020) index in column (2) that indicates low exposure to negative interest rates, a dummy for a GIIPS (Greece, Italy, Ireland, Spain) country in column (3) and the government bond yield of the country in 2014 in column (4). $Deposit\ Ratio_i$, $Risky_c$, $Security\ Ratio_i$ and $QE_{c,m}$ are included in the regression but are not reported in the table. Column (5) includes the interaction between $QE_{c,m}$ and the following control variables as of 2012: (1) log assets ($Log(Assets_i)$), (2) the simple capital ratio ($Capital\ Ratio_i$), (3) the Tier 1 capital ratio ($T1\ Capital\ Ratio_i$), (4) Return on Assets (RoA_i), (5) Return on Capital (RoC_i). Standard errors are clustered at the bank level.

Table 9: Bank Balance Sheets DE

	CB assets	CB liabilities	CB net assets	deposits
	(1)	(2)	(3)	(4)
QE × Security Ratio × Deposit Ratio	0.0297**	0.000787	0.0238*	0.0133
	(0.0138)	(0.00535)	(0.0139)	(0.00915)
R-squared	0.648	0.721	0.661	0.953
N	19285	19285	19091	19283
Bank FE	✓	✓	✓	✓
Time FE	✓	✓	✓	✓

The level of observation is bank *i* in quarter *q*. The sample period spans from the first time negative interest rates are introduced (2014q3) to 2018q4. The dependent variable in column (1) $CB\ assets_{i,q}$ is defined as central bank assets of bank *i* at quarter *q* divided by total assets of bank *i* in 2012. In the same way the dependent variables in column (2)-(4) are constructed, where the numerator is central bank liabilities of bank *i* at quarter *q* ($CB\ liabilities_{i,q}$ column 2), central bank assets minus liabilities of bank *i* at quarter *q* ($CB\ net\ assets_{i,m}$ column 3) and deposits ($Deposits_i$ column 4). $QE_{c,q}$ is the amount purchased of government bonds by the ECB country *q* in quarter *q* divided by the banks' total security holdings of country *q* in 2012. $Security\ Ratio_i$ is the share of securities over assets a bank held in 2012. $Deposit\ Ratio_i$ is the share of deposits over assets of a bank in 2012. Standard errors are clustered at the bank level.

Table 10: Security Holdings DE

	Dependent Variable: Security Holdings					
	(1)	(2)	(3)	(4)	(5)	(6)
QE × Security Ratio	-0.150***	-0.162***	-0.266***	-0.290***	-0.112	-0.135
	(0.047)	(0.046)	(0.077)	(0.075)	(0.094)	(0.099)
R-squared	0.952	0.974	0.932	0.950	0.955	0.985
N	3625419	3602180	1797212	1787733	1825439	1814447
Bank FE	✓	-	✓	-	✓	-
Security FE	✓	-	✓	-	✓	-
Time FE	✓	✓	✓	✓	✓	✓
Bank × Security FE	-	✓	-	✓	-	✓
Sample	full	full	large banks	large banks	small banks	small banks

The level of observation is banks i holdings in security s in quarter q. The sample period spans from the first time negative interest rates are introduced (2014q3) to 2018q4. The dependent variable is the natural logarithm of the euro amount held in securities s by bank i in quarter q. QE measures the implementation of the Public sector purchase programme of the ECB $QE_{c,q}$ is the amount purchased of government bonds by the ECB country c in quarter q divided by the banks' total security holdings of country c in 2012. $Security\ Ratio_i$ is the share of securities over assets a bank held in 2012. A bank i is considered to be a $Large\ Bank_i$ when total assets exceed € 50 bn. in 2012, else being a $Small\ Bank_i$. Standard errors are clustered at the bank level and security level.

Table 11: Lending DE

	Dependent Variable: Lending					
	(1)	(2)	(3)	(4)	(5)	(6)
QE × Security Ratio× Deposit Ratio	-2.071**	0.0358	0.0360	-3.166***	0.0785	0.0749
	(0.720)	(0.057)	(0.058)	(0.333)	(0.062)	(0.064)
Large Bank × QE × Security Ratio × Deposit Ratio			-2.113***			
			(0.802)			
Repo Bank × QE × Security Ratio × Deposit Ratio						-3.665***
						(0.369)
R-squared	0.920	0.945	0.934	0.917	0.946	0.934
N	353363	1272435	1963138	307312	1342966	1963138
Bank × Firm FE	✓	✓	✓	✓	✓	✓
Firm × Time FE	✓	✓	✓	✓	✓	✓
Sample	large banks	small banks	full	repo banks	non repo banks	full

The level of observation is credit to firm j by bank i (required to report in the German credit register) in quarter q. The sample period spans from the first time negative interest rates are introduced (2014q3) to 2018q4. The dependent variable is the natural logarithm of the euro amount outstanding between firm j and bank i in quarter q. QE measures the implementation of the Public sector purchase programme of the ECB $QE_{c,m(t)}$ is the amount purchased of government bonds by the ECB country c in quarter q divided by the banks' total security holdings of country c in 2012. $Security\ Ratio_i$ is the share of securities over assets a bank held in 2012. $Deposit\ Ratio_i$ is the share of deposits over assets of a bank in 2012. A bank is considered to be a $Large\ Bank_i$ when total assets exceed € 50 bn. in 2012, else being a $Small\ Bank_i$. Alternatively, a bank is considered a $Repo\ Bank_i$ when the bank conducts repo transactions, else being a $Non\ Repo\ Bank_i$. Standard errors are clustered at the bank level.

Table 12: Lending DE - refined exposure variable

	Dependent Variable: Lending			
	(1)	(2)	(3)	(4)
Deposit Ratio × Δ log securities (one year)	0.127*			
	(0.070)			
Deposit Ratio HH × Δ log securities (one year)		0.130*		
		(0.076)		
Deposit Ratio NFC × Δ log securities (one year)		0.0886		
		(0.229)		
Deposit Ratio × Δ log securities (one quarter)			0.125	
			(0.082)	
Deposit Ratio HH × Δ log securities (one quarter)				0.168**
				(0.081)
Deposit Ratio NFC × Δ log securities (one quarter)				-0.456**
				(0.205)
R-squared	0.938	0.938	0.938	0.938
N	1671560	1671560	1714208	1714208
Bank × Firm FE	✓	✓	✓	✓
Firm × Time FE	✓	✓	✓	✓

The level of observation is credit to firm *j* by bank *i* (required to report in the German credit register) in quarter *q*. The sample period spans from the first time negative interest rates are introduced (2014q3) to 2018q4. The dependent variable is the natural logarithm of the euro amount outstanding between firm *j* and bank *i* in quarter *q*. Δ $Securities_{i,q}$ is the change in log security holdings of bank *i* from *q* to *q* minus one year (one quarter respectively). $Deposit\ Ratio_i$ is the share of deposits over assets of a bank in 2012. This term is split up into household deposits ($Deposit\ RatioHH_i$) and deposits from non-financial corporates ($Deposit\ Ratio\ NFC_i$). Standard errors are clustered at the bank level.

Table 13: Lending DE - refined exposure variable, split by sell and buy

	Dependent Variable: Lending			
	(1)	(2)	(3)	(4)
Deposit Ratio × Δ log securities (one year)	0.201**	0.0232		
	(0.080)	(0.059)		
Deposit Ratio HH × Δ log securities (one year)			0.202**	0.0287
			(0.088)	(0.056)
Deposit Ratio NFC × Δ log securities (one year)			0.188	-0.0665
			(0.277)	(0.334)
R-squared	0.943	0.949	0.943	0.949
N	780780	633571	780780	633571
Bank × Firm FE	✓	✓	✓	✓
Firm × Time FE	✓	✓	✓	✓
change in securities	sell	buy	sell	buy

The level of observation is credit to firm *j* by bank *i* (required to report in the German credit register) in quarter q. The sample period spans from the first time negative interest rates are introduced (2014q3) to 2018q4. The dependent variable is the natural logarithm of the euro amount outstanding between firm *j* and bank *i* in quarter q. $\Delta\ Securities_{i,q}$ is the change in log security holdings of bank *i* from q to q minus one year. $Deposit\ Ratio_i$ is the share of deposits over assets of a bank in 2012. This term is split up into household deposits ($Deposit\ Ratio\ HH_i$) and deposits from non-financial corporates ($Deposit\ Ratio\ NFC_i$). The analysis is split for banks selling securities ($\Delta\ Securities_{i,q} < 0$, column (1) and (3)) and banks buying securities ($\Delta\ Securities_{i,q} > 0$, column (2) and (4)). Standard errors are clustered at the bank level.

Table 14: Interbank DE by large and small banks including risk analysis and refined variable

	Dependent Variable: Lending					
	(1)	(2)	(3)	(4)	(5)	(6)
QE × Security Ratio × Deposit Ratio	4.334*	4.890*	-0.0959	-0.0353		
	(2.021)	(2.248)	(0.114)	(0.186)		
QE × Security Ratio × Deposit Ratio × Yield		0.129		-0.0463		
		(0.662)		(0.126)		
Δ log Security Ratio (one year) × Deposit Ratio					0.0449	0.132
					(0.181)	(0.184)
Δ log Security Ratio (one year) × Deposit Ratio × Yield						-0.0862**
						(0.0414)
R-squared	0.881	0.881	0.893	0.893	0.894	0.894
N	40794	40794	524170	524170	514486	514486
Bank (lender) × Bank (borrower) FE	✓	✓	✓	✓	✓	✓
Bank (borrower) × Time FE	✓	✓	✓	✓	✓	✓
Sample	large banks	large banks	small banks	small banks	full	full

The level of observation is credit to bank (borrower) j by bank (lender) i (required to report in the German credit register) in quarter q. The sample period spans from the first time negative interest rates are introduced (2014q3) to 2018q4. The dependent variable is the natural logarithm of the euro amount outstanding between bank j (borrower) and bank *i* (lender) in quarter q. QE measures the implementation of the Public sector purchase programme of the ECB $QE_{c,m}$ is the amount purchased of government bonds by the ECB country *c* in quarter *q* divided by the banks' total security holdings of country *c* in 2012. $Security\ Ratio_i$ is the share of securities over assets a bank (lender) held in 2012. $Deposit\ Ratio_i$ is the share of deposits over assets of a bank (lender) in 2012. $Yield_c$ is the yield of long-term (10 year) government bonds of the borrowers' country prior to the introduction of negative policy rates. $\Delta\ Securities_{i,q}$ is the change in log security holdings of bank (lender) i from q to q minus one year. A bank (lender) is considered to be a $Large\ Bank_i$ when total assets exceed € 50 bn. in 2012, else being a $Small\ Bank_i$. Standard errors are clustered at the bank (lender) level.

Table 15: Interbank DE by large and small banks split for borrowing banks in and outside the Euro Area

	Dependent Variable: Lending					
	(1)	(2)	(3)	(4)	(5)	(6)
QE $\times$ Security Ratio $\times$ Deposit Ratio	5.387*	2.910	-0.145	0.0800	-0.140	0.102
	(2.423)	(2.246)	(0.124)	(0.197)	(0.123)	(0.196)
Large Bank $\times$ QE $\times$ Security Ratio $\times$ Deposit Ratio					4.390*	2.698
					(2.258)	(1.978)
R-squared	0.882	0.879	0.893	0.884	0.892	0.884
N	25508	15286	419618	104552	449130	121014
Bank (lender) $\times$ Bank (borrower) FE	✓	✓	✓	✓	✓	✓
Bank (borrower) $\times$ Time FE	✓	✓	✓	✓	✓	✓
Sample	large banks	large banks	small banks	small banks	full	full
Scope	EA	non-EA	EA	non-EA	EA	non-EA

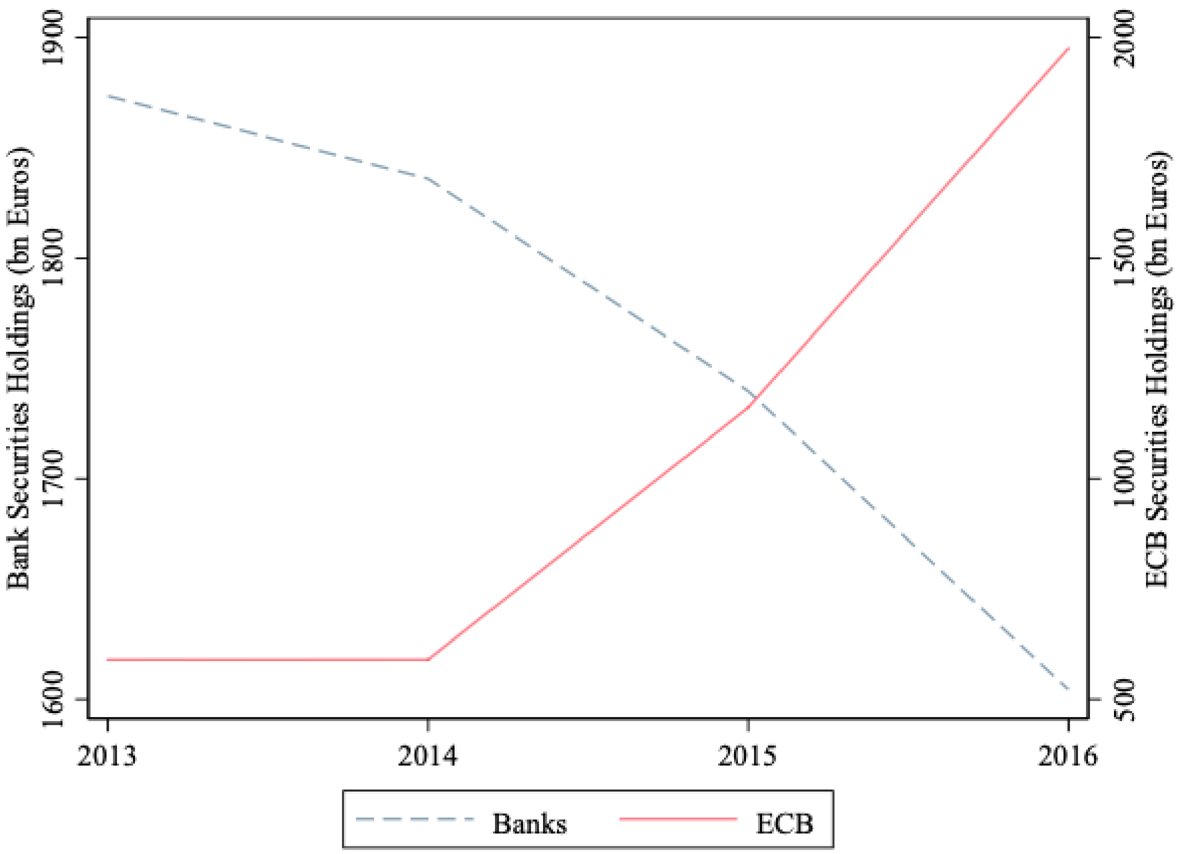
The level of observation is credit to bank (borrower) j by bank (lender) i (required to report in the German credit register) in quarter *q*. The sample period spans from the first time negative interest rates are introduced (2014q3) to 2018q4. The dependent variable is the natural logarithm of the euro amount outstanding between bank (borrower) j and bank (lender) i in quarter *q*. QE measures the implementation of the Public sector purchase programme of the ECB $QE_{c,m(t)}$ is the amount purchased of government bonds by the ECB country *c* in quarter *q* divided by the banks' total security holdings of country *c* in 2012. $Security\ Ratio_i$ is the share of securities over assets a bank (lender) held in 2012. $Deposit\ Ratio_i$ is the share of deposits over assets of a bank (lender) in 2012. A bank (lender) is considered to be a $Large\ Bank_i$ when total assets exceed € 50 bn. in 2012, else being a $Small\ Bank_i$. In column (1), (3) and (5) only lending to banks (borrower) within the euro area (EA) is considered, whereas in column (2), (4) and (6) only lending to banks (borrower) outside the euro area (non-EA) is considered. Standard errors are clustered at the bank (lender) level.

Table 16: Cross-Border Banking Flows

	Dependent Variable: Bilateral Cross-Border Bank Lending					
	(1)	(2)	(3)	(4)	(5)	(6)
QE $\times$ Core $\times$ GIIPS	2.566***			1.836***		
	(0.421)			(0.035)		
QE $\times$ Core $\times$ High Yield		2.838*			3.654***	
		(1.413)			(1.299)	
QE $\times$ Core $\times$ Low Index			2.617			2.010
			(1.800)			(1.732)
R-squared	0.0535	0.0535	0.0535	0.127	0.127	0.127
N	65533	65533	65533	65441	65441	65441
Lender $\times$ Borrower FE	✓	✓	✓	✓	✓	✓
Lender $\times$ Month FE	✓	✓	✓	✓	✓	✓
Borrower $\times$ Month FE	-	-	-	✓	✓	✓

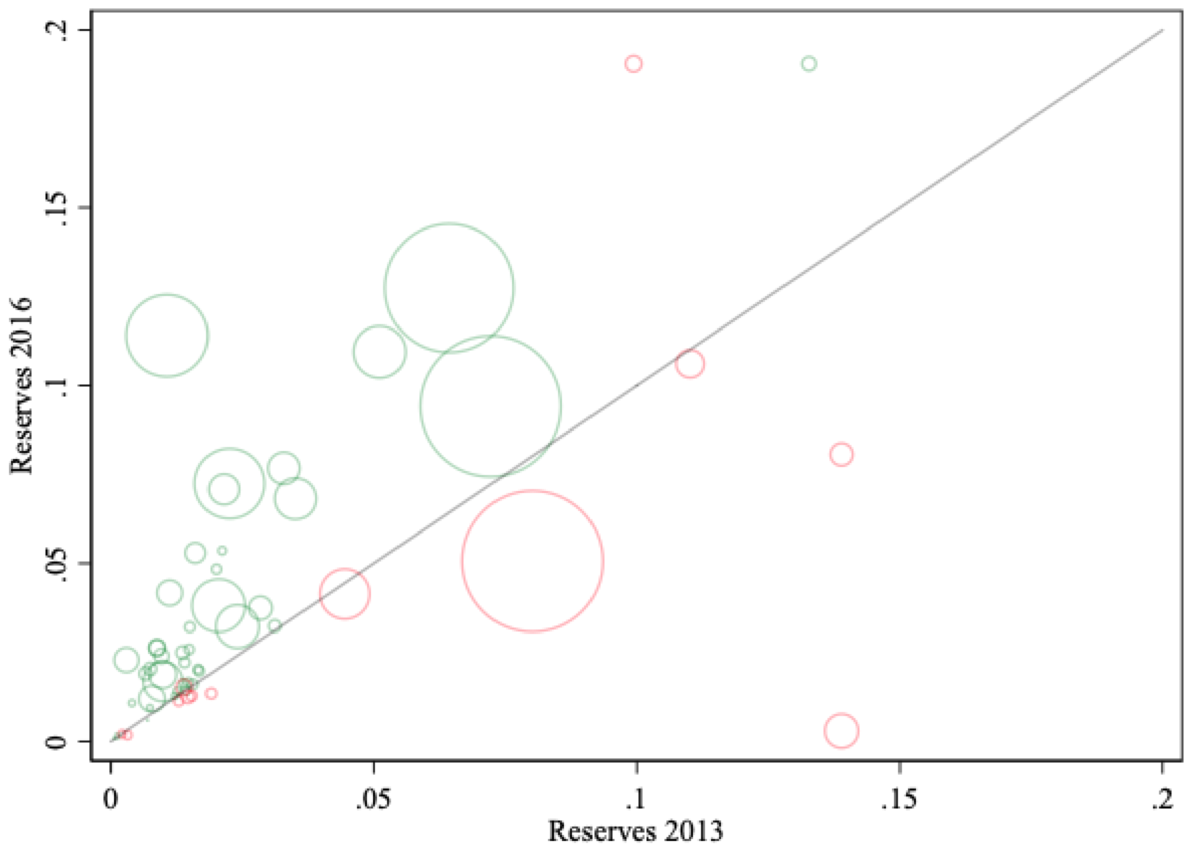
The level of observation is the monthly bilateral banking flow from country *c* to country j in quarter *q*. The dependent variable is is the percentage change in bank claims of country *c* to country j. The sample period is 2014 to 2020. $QE_{i,q}$ is the amount purchased of the bonds of the country *c* divided by the banks' total security holdings of country *c* in 2012. $Core_i$ is a dummy if the Lending country *c* is "Germany", "Finland", "Netherlands", "Austria". $GIIPS_j$ is a dummy if the Borrowing country *c* is "Greece", "Italy", "Ireland", "Spain", "Portugal". $High\ Yield_j$ is a dummy if the borrowing country has a high (above median) sovereign yield in 2014. $Low\ Index_j$ is a dummy for a low (below median) Bittner, Bonfim, Heider, Saidi, Schepens, and Soares (2020) index of low exposure to negative interest rates. Standard errors are double clustered at the lender and borrower country.

Figure 1: Security Holdings



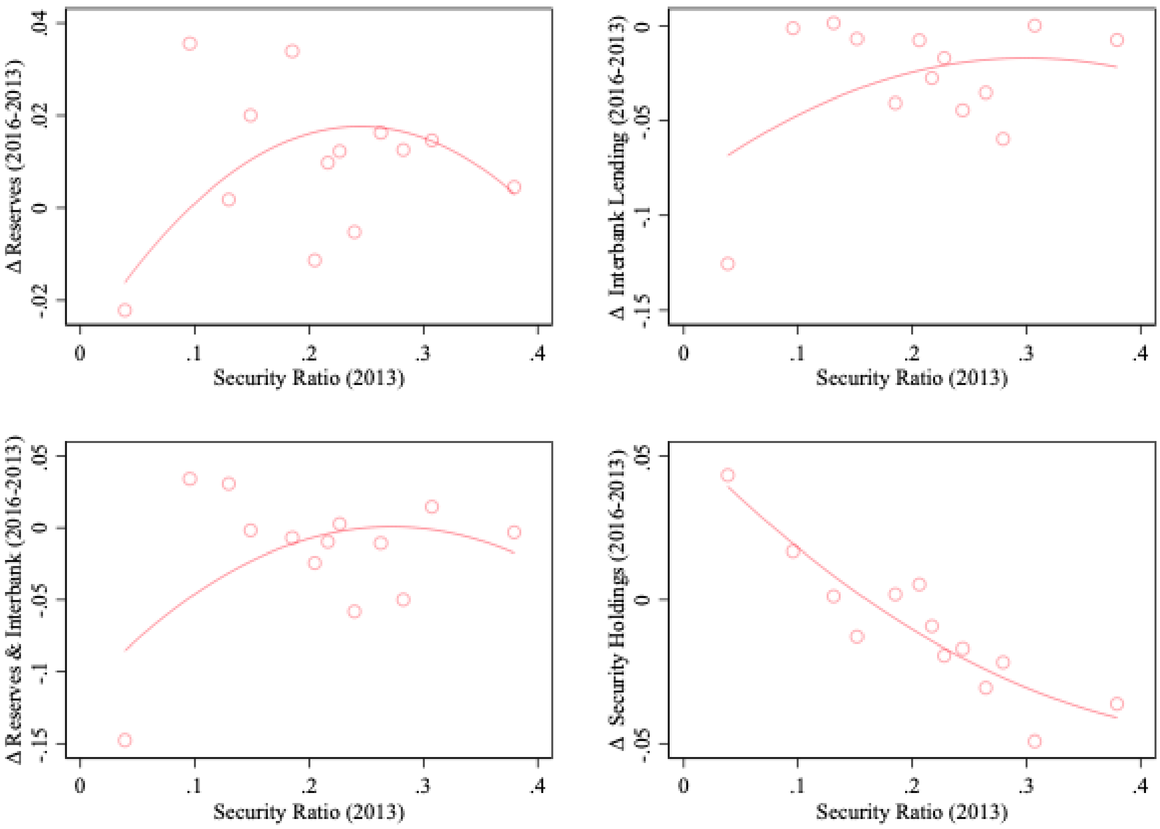
This graph shows the security holdings of banks and the ECB in bn Euros. The security holdings of banks are shown in the dashed blue line referring to the left y-axis. The security holdings of the ECB are shown in the solid red line referring to the right y-axis.

Figure 2: Reserves before and after QE



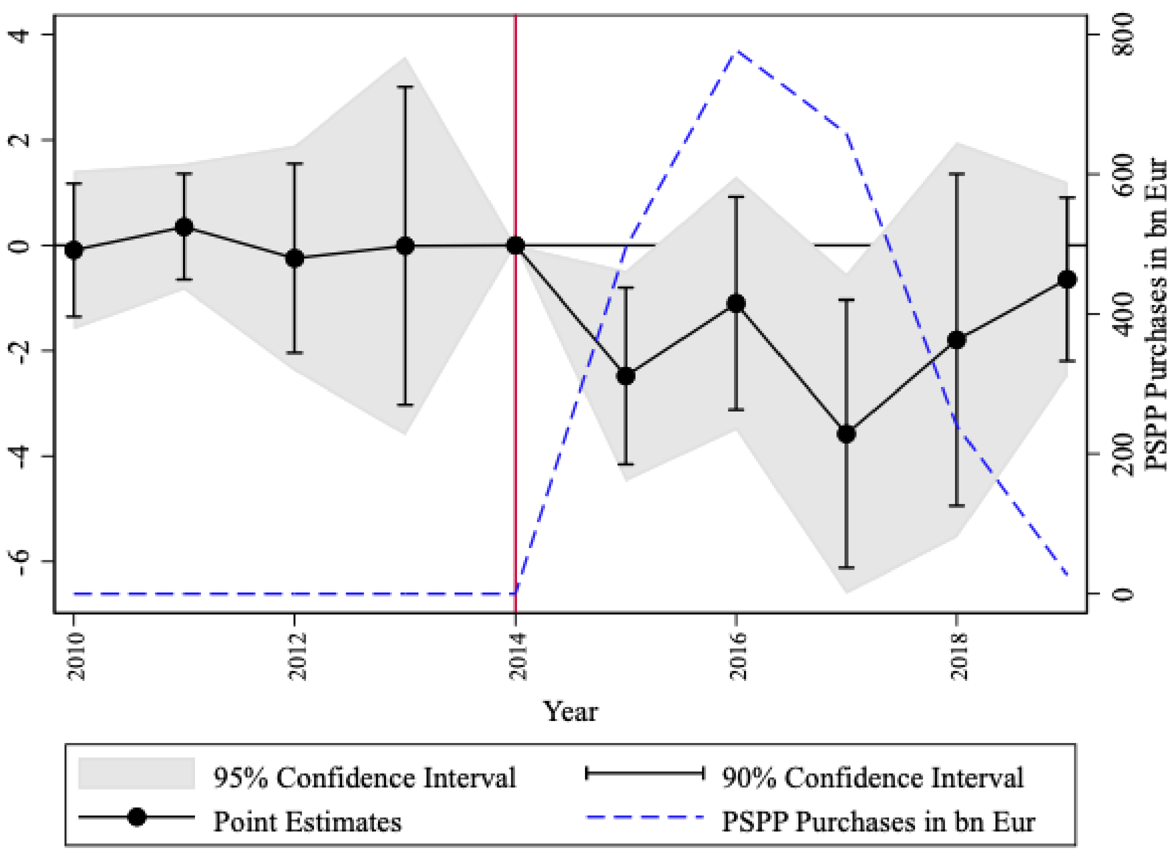
This graph shows the share of reserves of total assets in 2013 (x-axis) vs. 2016 (y-axis) as total assets. The green (red) circles reflect banks that increased (decreased) their total reserve holdings. The size of the circle reflects the size of the reserves.

Figure 3: Δ Bank Variables against Securities Exposure



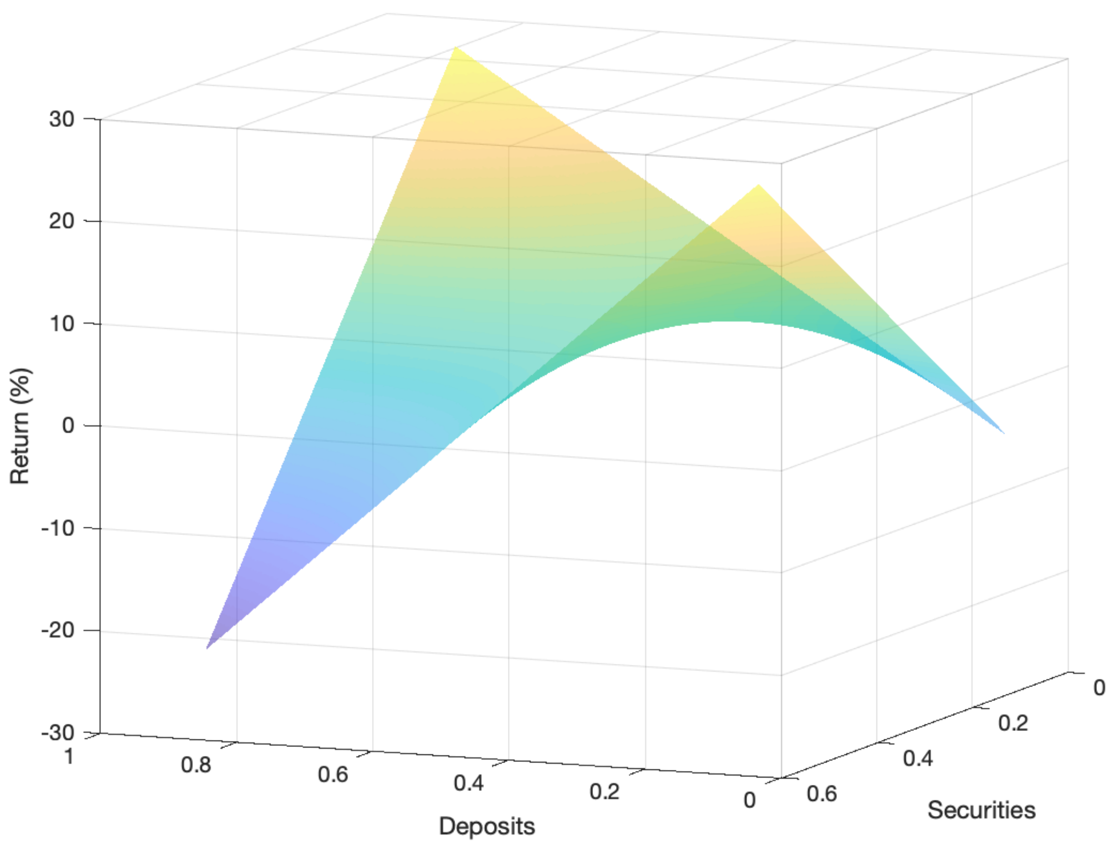
The upper left panel shows a scatterplot between the change in reserves over total assets between 2016 and 2013 on the y-axis and the security ratio in 2013 on the x-axis. The upper right panel shows the change in interbank lending over total assets on the y-axis and the security ratio in 2013 on the x axis. The bottom left panel shows the change in reserves and interbank lending over total assets on the y-axis and the security ratio in 2013 on the x axis. The bottom right panel shows the change in the security holdings over total assets on the y-axis and the security ratio in 2013 on the x axis.

Figure 4: Time-Varying Coefficient



This figure plots β_3 of $Log(Amount)_{i(l),j(l),t(l)} = \alpha_i + \alpha_{m(t),j} + \alpha_{m(t),c} + \sum_{\tau \neq 2014} \beta_{1,\tau} \times Security\ Ratio_i \times 1[t = \tau] + \sum_{\tau \neq 2014} \beta_{2,\tau} \times Deposit\ Ratio_i \times 1[t = \tau] \sum_{\tau \neq 2014} \beta_{3,\tau} \times Security\ Ratio_i \times Deposit\ Ratio \times 1[t = \tau] + \epsilon_{i,j,t}$ referring to the left y-axis. The blue dashed line shows the public sector purchases of the ECB in bn Euros referring to the right y-axis.

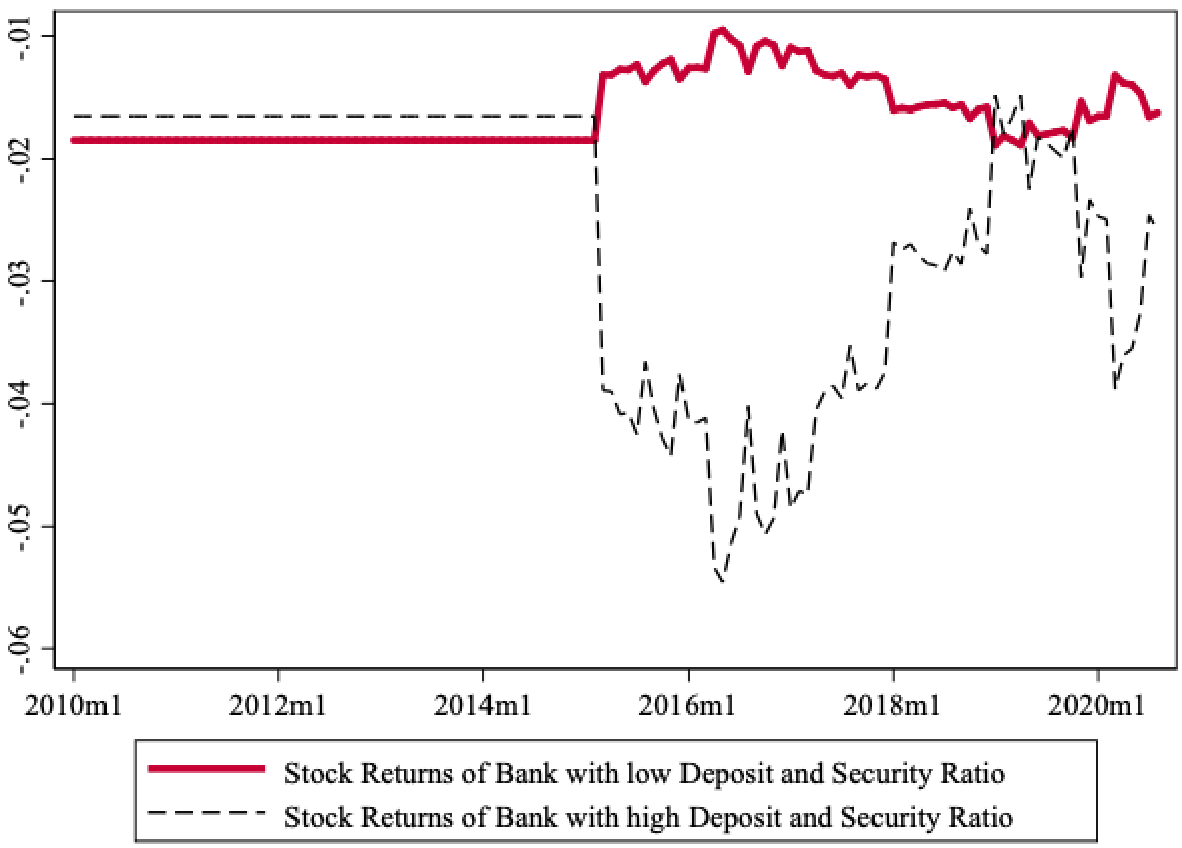
Figure 5: Stock Return Response to 1 StD QE Purchases



This graph shows the predicted stock returns as a function of the deposit and the security ratio. The predicted stock returns come from the following regression (where QE is a one standard deviation QE implemention):

$$Return_{i,m} = \alpha_i + \alpha_m + \beta_1 QE_{c,m} \times \textit{Security Ratio}_i + \beta_2 QE_{c,m} \times \textit{Deposit Ratio}_i + \beta_3 QE_{c,m} \times \textit{Security Ratio}_i \times \textit{Deposit Ratio}_i + \epsilon_{i,j,t}$$

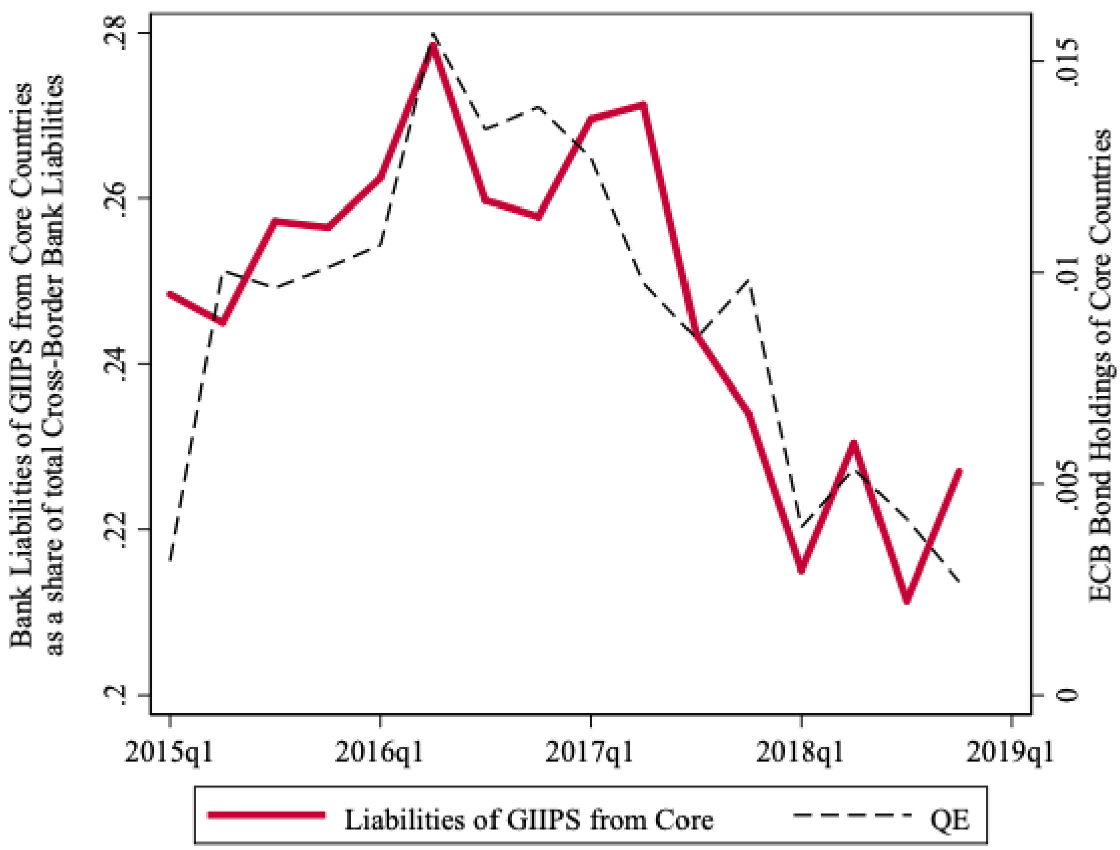
Figure 6: Estimated Stock Return



This graph shows the predicted stock returns for banks with a both low (high) measured as 25th (75th) percentile deposit and security ratio in red (black) solid (dash). The predicted stock returns come from the following regression (where QE is a one standard deviation QE implemention):

$$Return_{i,m} = \alpha_i + \alpha_m + \beta_1 QE_{c,m} \times \textit{Security Ratio}_i + \beta_2 QE_{c,m} \times \textit{Deposit Ratio}_i + \beta_3 QE_{c,m} \times \textit{Security Ratio}_i \times \textit{Deposit Ratio}_i + \epsilon_{i,j,t}$$

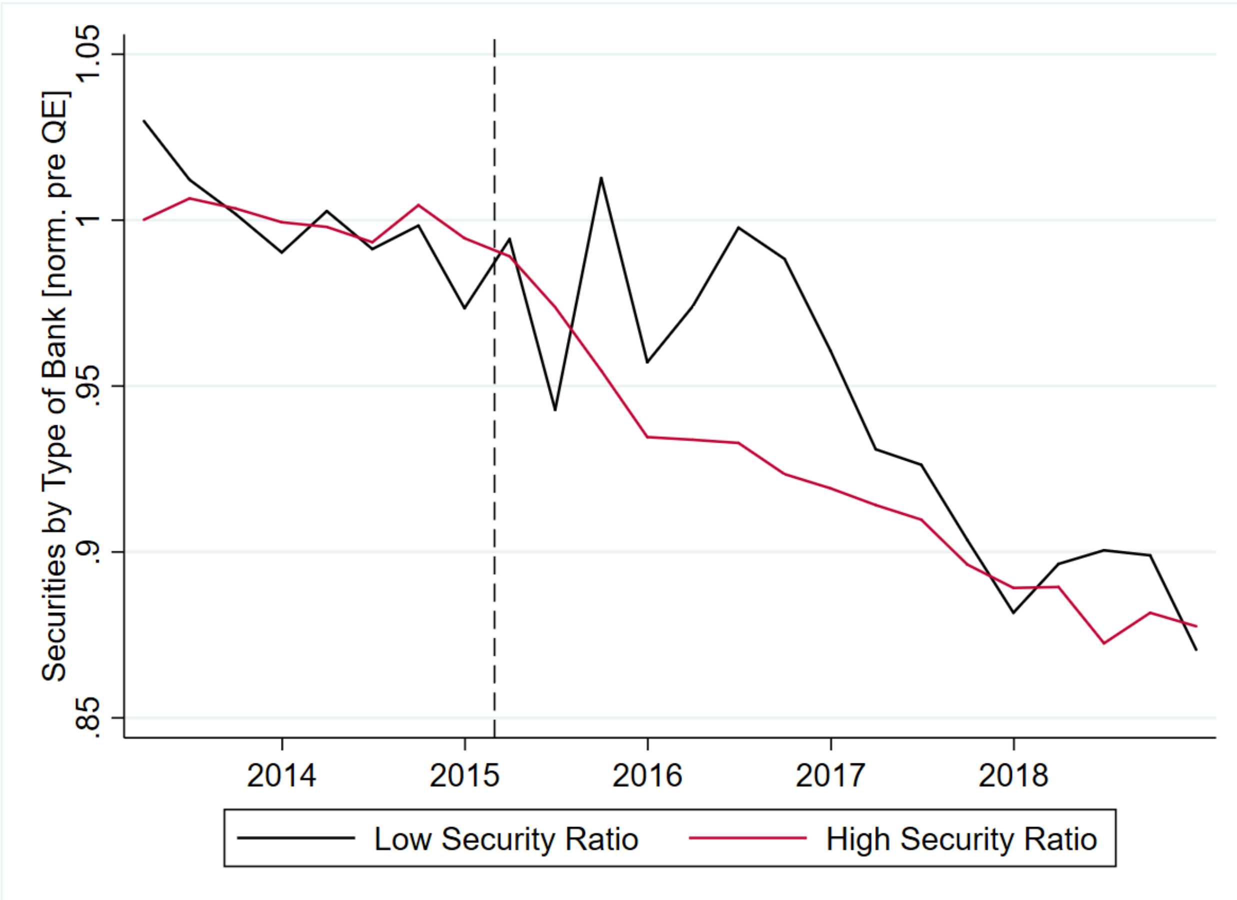
Figure 7: Cross-Border Banking Flows



This graph shows the banking capital flows from Core to GIIPS Countries and the ECB Bond Holdings of Core Countries.

Appendix

Figure A1: Security Holdings DE



This graph shows the security holdings of high and low security ratio banks.

Table A1: Descriptive Statistics: Lending DE

	mean	sd	p25	p75	count
Lending	6.809	2.061	5.948	8.017	4409608
Securities	0.162	0.105	0.073	0.214	4409608
Deposit	0.406	0.206	0.175	0.569	4409608
DepositHH	0.326	0.198	0.093	0.483	4409608
DepositNFC	0.080	0.046	0.056	0.089	4409608
APP	0.039	0.971	-0.844	0.501	4409608
Δ log securities (one year)	0.003	0.244	-0.102	0.078	4355468
Δ log securities (one quarter)	0.002	0.119	-0.037	0.030	4356233

Table A2: Split by Country Deposit Rate Asset Purchases

	Dependent Variable: Lending					
	(1)	(2)	(3)	(4)	(5)	(6)
QE $\times$ Security Ratio $\times$ Deposit Ratio	-1.467**	-1.368**	-1.743*	-1.491**	-2.068**	-1.988**
	(0.643)	(0.554)	(0.906)	(0.608)	(1.011)	(0.801)
QE $\times$ Security Ratio $\times$ Deposit Ratio $\times$ Risky	0.619	0.956	0.523	-6.926	2.091*	1.758
	(1.679)	(1.994)	(1.001)	(4.137)	(1.077)	(2.308)
R-squared	0.976	0.976	0.976	0.976	0.976	0.976
N	6291	6291	6291	6291	6291	6291
Bank FE	✓	✓	✓	✓	✓	✓
Borrower $\times$ Month FE	✓	✓	✓	✓	✓	✓
Country $\times$ Month FE	✓	✓	✓	✓	✓	✓
Interacted Controls	✓	✓	✓	✓	✓	✓
Specification	H Deposit Rate	Yield	High Yield	GIIPS	Not Germany	Low Index

where Amount is the amount lent of bank i to borrower j at date t in loan package l . App is a dummy that equals one after the ECB introduced negative interest rates (June 11, 2014). Securities is the share of securities over assets a bank held in 2012. Deposits is the share of deposits over assets of a bank in 2012. High Deposit Rate is a dummy that equals one if the country has an above median bank deposit interest rate over the period 2014 and 2020. Controls include the lagged Tier 1 capital ratio, the return on capital, and the log of total assets. The interacted controls include the same variables as of 2012 interacted with a post dummy. The sample spans from 2014 to 2020. Standard errors are clustered at the bank level.