Did QE lead banks to relax their lending standards? Evidence from the Federal Reserve's LSAPs *

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Abstract

Using confidential loan officer survey data on lending standards and internal risk ratings on loans, we document an effect of large-scale asset purchase programs (LSAPs) on lending standards and risk-taking. We exploit cross-sectional variation in banks' holdings of mortgage-backed securities to show that the first and third round of quantitative easing (QE1 and QE3) significantly lowered lending standards and increased loan risk characteristics. The magnitude of the effects is about the same in QE1 and QE3, and is comparable to the effect of a one percentage point decrease in the Fed funds target rate.

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1 Introduction

Following the 2007-08 financial crisis, central banks have undertaken various unconventional monetary policies, including aggressive liquidity measures, referred to as large-scale assets purchase programs (LSAPs). The widespread use of these measures has led to debates among academic economists and policy makers about their effects on economic outcomes in general, and financial stability in particular. Proponents of LSAPs tend to emphasize that such interventions increased confidence and risk-taking and therewith overall economic activity. According to this view, the recovery after the crisis was much faster than it would have been without unconventional monetary policy.[1] Critics, however, argue that unconventional monetary policy was ineffective or inefficient, and argue that LSAPs have potentially been setting the stage for the next financial crisis by encouraging excessive risk-shifting, fueling asset bubbles, and inducing incentives to "reach for yield."[2]

This paper provides evidence on how the Federal Reserve's LSAPs, referred to as QE, affected lending standards. Using confidential datasets on banks' lending standards and internal risk-ratings on new loans to businesses, we provide evidence that the first and third round of quantitative easing (QE1 and QE3) led to a lowering of lending standards and increased risk-taking by those banks that had relatively more mortgage-backed securities (MBS) on their books. The effect is roughly comparable to the effect of a one percentage point decrease in the Fed funds target rate during times of conventional monetary policy.

Our empirical analysis combines a standard, public data set of bank balance sheet data with two confidential surveys with established measures of bank risk-taking: At the bank level, we use the Federal Reserve Board's Senior Loan Officer Opinion Survey on Bank Lending Practices (SLOOS) that surveys bank loan officers on how their banks' lending standards and loan demand have changed over the previous quarter in a number of loan categories that can broadly be grouped into lending to businesses and lending to households. We complement our analysis with loan-level data provided by the Survey of

[1] E.g., John Williams (2012), the chairman of the Federal Reserve Bank of San Francisco, expressed the view that asset purchases by the Federal Reserve enhanced the recovery: *Thanks in part to emergency first aid by the Fed, financial conditions stabilized and began to recover. By mid-2009, the economy was growing again.*, as well as *[...] we have had to find other ways to stimulate the economy. One form of monetary stimulus we've turned to is known as large-scale asset purchases. [...]. These large-scale asset purchase programs work by raising demand for longer-term Treasury securities. As demand goes up, the prices of those securities rise and yields come down. The effects extend to other longer-term securities, pushing down longer-term interest rates across the board*

[2] Key actors within the Federal Reserve System itself suggested that unconventional policy is not without risk. For example, Ben Bernanke (2013) in his congressional testimony on May 22nd, 2013 noted: *[...] Another cost, one that we take very seriously, is the possibility that very low interest rates, if maintained too long, could undermine financial stability. For example, investors or portfolio managers dissatisfied with low returns may "reach for yield" by taking on more credit risk, duration risk, or leverage.* Moreover, Eric Rosengren (2015), the chairman of the Federal Reserve Bank of Boston, in a speech in 2015 argued that prolonged stimulus has been potentially leading to "reaching-for-yield behavior" in commercial real estate market.

Terms of Business Lending (STBL) that surveys banks on their newly issued loans to businesses and contains, among other variables, information on loan size, spreads, as well as internal risk ratings.

In order to identify the effect of QE on bank lending standards and risk-taking, we exploit the considerable cross-sectional variation across holdings of mortgage-backed securities (MBS) for U.S. commercial banks in our sample. To give a sense of the amount of variation, prior to QE1, the difference between the ratio of MBS over total securities between a bank at the 75th percentile of the MBS share distribution and the 25th percentile of the MBS share distribution is around 30 percentage points. Importantly, while there is substantial variation in banks' MBS holdings, the banks in our main sample are otherwise similar with respect to various other balance-sheet characteristics.

We employ a difference-in-differences design with a continuous treatment, where the treatment variable is a bank's average ratio of MBS holdings over total securities prior to a respective round of QE. We then test the extent to which banks with MBS holdings as a larger share of their portfolio change their lending standards and internal risk-ratings on new loans subsequent to a respective round of QE. The identification rests on the idea that the MBS portfolios of banks are affected differentially in response to Fed's MBS asset purchases. Our identification is supported by the observation that, although the QE programs affected a broad range of asset prices in a similar manner to conventional policy, evidence suggests that QE operated through a "narrow channel" (see, e.g., Krishnamurthy and Vissing-Jorgensen (2013)). Most relevant for our identification strategy, QE policies affected the liquidity and returns of the assets targeted in the purchases more than other assets. Given that the Federal Reserve purchased MBS only in the first and third round of QE, but not in the second, we expect differential effects for banks in QE1 and QE3 only, while QE2 can serve as a placebo test since banks with different MBS holdings should not be differentially affected.

Our empirical strategy is similar to the identification method employed by Darmouni and Rodnyansky (2017), who show that QE spurred additional bank lending. However, in contrast to their contribution, we focus on lending standards and the riskiness of bank loans, i.e., measures of the quality of lending, as opposed to measures of the quantity of lending. It is important to emphasize that our measures of lending standards and risk taking are only weakly correlated with changes in lending volume historically and also within our sample. Even though lending standards and lending volume are correlated, the correlation is only roughly 0.07.[3] The low correlation is important as one may argue that banks move up or down a quality curve when reducing or expanding lending volume,

[3]We provide a more detailed analysis of the correlations in the robustness section.

thereby mechanically changing the overall riskiness of their loan portfolios.[4] The fact that the correlation between changes in lending standards and changes in lending volumes is low shows that bank lending standards convey information beyond a mere expansion of bank credit.

In particular, our results show that QE induced banks not only to lend more, but also to re-shuffle their lending activities towards more risky loans, reminiscent of findings on reach for yield behavior (see, e.g., Di Maggio and Kacperczyk (2017)). We find that banks with more MBS holdings chose less tight lending standards after QE1 than banks with low MBS holdings, and that banks with more MBS holdings were more likely to ease their lending standards compared to unaffected banks after QE3. Moreover, consistent with our identification strategy, we find that there was no change in lending standards and risk-taking on new loans across bank MBS holdings after QE2, during which the Federal Reserve bought exclusively Treasuries.

The effects of MBS purchases have about the same economic magnitude for QE1 and QE3. On average, the lending standards index (that can take any value between -1 and 1) of a bank at the 75th percentile of the MBS distribution was 0.07 units lower after QE1 and QE3 than the index of a bank in the 25th percentile. Similarly, the average internal risk rating of newly issued loans (which can take take values in $\{1, ..., 5\}$) extended by a bank at the 75th percentile of the MBS distribution was 0.05 units higher than the average rating of loans at a bank at the 25th percentile.

To put our results in perspective, we compare our estimates from the STBL to those of Dell'Arricia et al. (2017) who estimate the effect of conventional monetary policy on bank risk-taking in the STBL. In their benchmark specification, they find that, on average over all banks, a one percentage point decrease in the Fed funds target rate, increases loan risk ratings by 0.057 units. Hence, our results indicate that MBS purchases had effects on banks' risk-taking behavior roughly comparable to the effect of a one percentage point decrease of the Fed funds target rate during times of conventional monetary policy.[5]

A natural concern with respect to our main results is whether results are actually driven by an increase in bank supply of risky loans, or an increased demand for risky loans. To address this concern, we make use of the fact that the SLOOS data allow us to control for lending demand as perceived by loan officers. We control for demand in all our of specifications at the bank level. While lending standards and perceived demand are indeed correlated, our findings are not altered by controlling for

[4]This is clearly not the only way the overall riskiness of the loan portfolio may change. For instance, banks could change the riskiness of their portfolio while leaving volumes unchanged, e.g., by simply by replacing existing borrowers by riskier borrowers.

[5]This finding is in line with existing evidence. E.g., Gilchrist et al. (2015) document that unconventional monetary policy lowered borrowing cost by about as much as conventional monetary policy.

demand.

Moreover, in order to shed some light on the channel and the transmission mechanism underlying the effects of QE, we make use of the fact that the SLOOS data allow us to not only examine the aggregate standards and demand of individual banks, but also to decompose them by loan category. We show that in QE1, the lowering of lending standards operates mainly through less tightening of real estate loans. In QE3, the effect results mostly from easing standards on C&I loans.

Furthermore, the SLOOS data allow us to track the reasons (as provided by banks) that led to changes in lending standards. In particular, we test whether increased risk-taking is driven by an improved capital position, a "net-worth channel," or by increased liquidity for MBS that facilitates loan portfolio re-balancing, a "liquidity channel." The survey evidence indicates that the effect during QE1 results mostly from an improved capital position and from increased risk appetite, consistent with the "net-worth channel." Furthermore, the balance sheet evidence indicates that banks with more MBS have higher realized and unrealized gains after QE1. The evidence on what is driving risk-taking during QE3 is less conclusive: On the one hand, banks report that neither an improved liquidity position, nor an improved economic outlook or capital position seem to be driving the increased risk taking during QE3. On the other hand, we find that the tapering of QE3 led to tighter lending standards and decreased risk-taking, consistent with a liquidity channel.

Our results survive various robustness checks. First, we show that results are not driven by an expansion of lending. This reflects the low correlation between our risk taking measures and loan growth in the data. Second, in an additional specification, we use banks' U.S. Treasuries holdings as the treatment variable. Our results show that the purchase of Treasuries did not have an effect on lending standards and risk-taking during any round of QE. This supports our main finding that QE mostly worked via MBS purchases. Third, we further test our results under various alternative definitions of our MBS measure, including varying the time period over which pre-QE MBS holdings are calculated, and our findings are unaltered. Such tests are important to address the endogeneity concern that some banks may be potentially systematically buying MBS in anticipation of QE, and we are able to present evidence against such systematic sorting prior to QE. The robustness of our treatment variable to this endogeneity concern follows from a fact we demonstrate: MBS holdings within banks in our sample are highly autocorrelated.

The rest of the paper is organized as follows: After briefly discussing the related literature, we describe our data as well as the empirical strategy in Section 2. Section 3 describes and discusses the main results, while Section 4 provides robustness checks. Section 5 and Section 6 discuss the mechanisms and conclude.

1.1 Related literature

Starting with Krishnamurthy and Vissing-Jorgensen (2013) and Chodorow-Reich (2014), there is now a fast-growing literature that investigates the effects of LSAPs on economic outcomes. Most relevant to our paper is the study by Darmouni and Rodnyansky (2017) that employs a similar identification strategy to analyze the effects of LSAPs on the quantity of bank lending. They find that higher MBS exposure in QE1 and QE3 led to stronger expansion of bank lending. Compared to their study, we focus on the quality characteristics of bank lending, i.e. lending standards and the riskiness of bank loans. As emphasized above, this is an important complementary channel as banks can take on more risk without expanding lending volume and vice versa.

Three other papers are closely related: Di Maggio et al. (2016) identify an effect of LSAPs on volume of new mortgages issued and show that the issuance of mortgages eligible for sale to the Federal Reserve increased after QE. Chakraborty et al. (2016) document that MBS and U.S. Treasury purchases have asymmetric effects. Specifically, their results suggest that the purchase of MBS may have been distortionary to the structure of the banking industry as they find that banks with larger activity in the MBS market reduce commercial lending subsequent to QE, inducing the firms borrowing from these banks to reduce investment. Kandrac and Schlusche (2016) show that QE induced an expansion of the monetary base, and document a financial stimulus effect.

Another, closely related strand of the literature studies the effects of low-interest environments on risk-taking. Di Maggio and Kacperczyk (2017) find that in response to policies that maintain low interest rates, money funds change their product offerings by investing in riskier asset classes. Moreover, money funds are more likely to exit the market and reduce the fees they charge to their investors. Complementary to their paper, we show that QE lowered lending standards at the commercial bank level, making bank assets more risky. Aramonte et al. (2015) find that insurance companies, pension funds, and, in particular, structured-finance vehicles take higher credit risk when investors expect interest rates to remain low. Moreover, Heider et al. (2016) analyze risk-taking behavior of European banks in an environment with negative interest rates on reserves and document that banks with relatively more deposit funding take on more risk.

Finally, our paper also relates to the literature on the effects of monetary policy on bank risk-taking during times of conventional monetary policy (see e.g. Altunbas et al. (2010), Adrian and Shin (2010), Maddaloni and Peydró (2011), Jimenez and Ongena (2012), Bruno and Shin (2013), Jiménez et al. (2014) and Ioannidou et al. (2014)). This literature builds on the logic that bank financing costs and asset values are closely related to the policy rate, allowing for monetary policy to directly impact the risk-taking behavior of the banking sector. We compare the magnitude of our findings to those in Dell'Arricia et al. (2017), who show that risk taking as measured by the STBL is negatively associated with increases in the federal funds rate, and the effect is less pronounced for bank with low levels of capital.

2 Data

The paper relies on three data sets: First, we use the confidential Senior Loan Officer Opinion Survey on Bank Lending Practices (SLOOS) to obtain information on bank lending standards and loan demand. Second, we use the confidential loan-level data from the Federal Reserve's Survey of Terms of Business Lending (STBL) to construct a measure of bank risk-taking. Third, we use the merger-adjusted Consolidated Reports of Condition and Income for commercial banks in the United States (Call reports, based on Forms FFIEC 031 and FFIEC 041). The next subsections discuss the data sets and our empirical strategy.

2.1 SLOOS

The Federal Reserve's Senior Loan Officer Opinion Survey of Bank Lending practices queries banks about changes in their lending standards and loan demand for different categories of loans. In the present study, we focus on five broad lending categories that are part of the SLOOS: Commercial and Industrial (C&I) loans, commercial real estate loans, residential real estate loans, home equity lines of credit, and consumer loans. While survey microdata exists back to 1982, we focus on the data from 2007 to 2014.[6] The SLOOS is typically conducted four times per year and up to 60 commercial banks participate in each survey we cover. We limit our sample to a panel of banks that participate on a frequent basis (i.e. in at least 32 quarters during our sample period). Our sample represents 50% of total assets of all commercial banks.

While the main purpose of the SLOOS is to allow the Federal Reserve to monitor lending standards and demand by loan category within the banking sector, the SLOOS data have been used in several

[6] When producing correlations between loan growth and changes in lending standards as part of a robustness check, we use the data back to the earliest date for which we have the relevant SLOOS microdata (1991:Q1).

academic papers. Vojtech et al. (2016) document that responses to the SLOOS questions are correlated with actual outcomes in the mortgage market. Maddaloni and Peydró (2011) and Afansyeva and Guenter (2016) investigate how the aggregate SLOOS index reacts to interest rate changes. Bassett et al. (2014) shows that tightening movements in the aggregate SLOOS are associated with declines in output and credit supply.

We use two types of questions that are part of the survey. First, we use information on general lending standards. Questions about changes in standards follow a general pattern of

> Over the past three months, how have your bank's credit standards for approving applications for [loan category *k*] changed?

Second, we use the information on general loan demand. This question allows us to control for demand effects driving the tightening and easing of lending standards. The typical question is

> Apart from normal seasonal variation, how has demand for [loan category *k*] changed over the past three months?

Banks answer these questions on a scale ranging from 1 to 5. In the case of lending policies, the answers are 1 = eased considerably; 2 = eased somewhat; 3 = about unchanged; 4 = tightened somewhat; 5 = tightened considerably. For changes in loan demand: 1 = increased considerably, 2 = increased somewhat, 3 = about unchanged, 4 = decreased somewhat, 5 = decreased considerably.

Following Bassett et al. (2014), for our main specifications, we transform the original responses to categorical variables $I^S_{b,t}(k)$ defined as

$$I^S_{b,t}(k) = \begin{cases} -1 & \text{if bank } b \text{ reported easing standards in category } k \text{ in quarter } t \\ 0 & \text{if bank } b \text{ reported no change in standards in category } k \text{ in quarter } t \\ 1 & \text{if bank } b \text{ reported tightening standards in category } k \text{ in quarter } t \end{cases}$$

and $I^D_{b,t}(k)$ accordingly, where higher demand is indicated by -1, and decreased demand by 1. We match the SLOOS data with information on a bank's outstanding loan amounts in each category to construct a composite index of changes to a bank's overall lending standards and changes to a bank's overall perceived loan demand. As in Bassett et al. (2014), the composite indexes are calculated as weighted averages:

$$y_{b,t} = \sum_k \omega_{b,t-1}[k] \times I^S_{b,t}(k) \quad \text{and} \quad d_{b,t} = \sum_k \omega_{b,t-1}[k] \times I^D_{b,t}(k),$$

where $\omega_{b,t-1}[k]$ is bank b's fraction of category k loans relative to the overall loans portfolio.

[Figure 1 about here]

Figure 1 shows the aggregate lending standards and demand index from 2007 until 2014. Lending standards tightened substantially in response to the financial turmoil associated with the '07-'09 financial crisis. Banks overall reported tightened standards until the fourth quarter of 2009 and easing thereafter. Loan demand seems to be negatively correlated with lending standards during QE1 and QE3, but not QE2.

2.2 STBL

The Federal Reserve's Survey of Terms of Business Lending is a quarterly survey about the terms of business lending of a sample of about 400 banks and is conducted by the Federal Reserve. While the survey is conducted since 1977, we use only data from 2007-2014. Banks in the STBL represent around 60% of all assets of U.S. commercial banks (see Dell'Arricia et al. (2017)).

The survey collects information on commercial and industrial loans that are issued during the first business week of the middle month of every quarter. Other loan categories covered by the SLOOS are not covered by the STBL. Also note that the banks covered in the STBL are different than those in the SLOOS, and since bank participation in the STBL is voluntary, it fluctuates over time. While the SLOOS contains rather large banks, the STBL includes banks of all sizes. The intersection of the two data sets is not large enough to use the same sample of banks for our analysis.

The STBL is particularly suited for our analysis as it contains several important variables that allow us to analyze the risk characteristics of newly issued loans. Among other variables, bank report the face amount, the loan rate, loan issuance date, whether the loan is secured by collateral or not, the maturity as well as an internal risk rating. The internal risk rating is our key variable of interest. The loan risk rating can vary from 1 to 5, where 1 = minimal risk, 2 = low risk, 3 = moderate risk, 4 = acceptable risk and 5 =special mention or classified assets. Each bank uses a method to transform their own internal risk rating into the survey rating. Importantly, risk ratings are occasionally verified by the Federal Reserve to assure accuracy.

The STBL has also been used in a number of other academic studies, including the following ones on risk taking. Dell'Arricia et al. (2017) study the effect of conventional monetary policy on bank risk-taking. Falato and Scharfstein (2016) use the data to analyze the effect of the required return of the stock market on risk taking. And Black and Hazelwood (2013) analyze the effect of the Troubled Asset Relief Program's (TARP) capital purchase program on risk taking.

2.3 Call Reports

Finally, we complement the SLOOS and the STBL data with banks' balance sheet information. Our control variables mirror those used in the literature (precise definitions in the Appendix).

[Table 1 about here]

Table 1 shows descriptive statistics of all variables for bank that are participating in the SLOOS and in the STBL during the time period we consider. Compared to the overall universe of commercial banks in the US, our SLOOS sample consist of rather large banks. The STBL banks are more heterogeneous, contain additional banks that are smaller, and are therefore on average more similar to the overall universe of commercial banks.

2.4 Empirical Strategy

In order to identify the effect of QE on bank lending standards and bank risk-taking, we employ a difference-in-differences (DiD) design with a continuous treatment variable. We exploit the fact that there is considerable cross-sectional variation of holdings of mortgage-backed securities (MBS), measured as the ratio of MBS holdings over total securities, between banks that are otherwise very similar. The cross-sectional variation of the ratio of MBS holdings for a bank in the 4 quarters prior to the respective round of quantitative easing is depicted in Figure 2.[7]

[Figure 2 about here]

Importantly, we find that even though banks differ in their MBS holdings, they are similar on important other characteristics. Table 3 shows that balance sheet and income statement variables for all banks that are participating in the SLOOS are balanced for banks with high and low MBS shares.

[7] In the robustness section, we show that results do not depend on the particular window over which a bank's MBS share is calculated. Moreover, we also show that our results are robust to calculating the MBS holdings as a ratio of MBS holdings over total assets.

[Table 3 about here]

To further strengthen the causal interpretation of our estimates, we include bank fixed effects and the bank-specific controls in Table 3 in our main regression specification, which is as follows:

$$y_{b,t} = \alpha + \beta \left(\frac{MBS}{TotSec} \right)_b^{(j)} QE_t^{(j)} + \delta d_{b,t} + \theta X_{b,t} + \gamma_b + \tau_t + \epsilon_{b,t}. \tag{1}$$

Here, $y_{b,t}$ is the aggregated lending standard of bank b at time t, and $QE_t^{(j)}$ is an indicator variable equal to 1 after the introduction of the j-th round of quantitative easing with $j = 1, 2, 3$.[8] The fraction $\left(\frac{MBS}{TotSec}\right)_b^{(j)}$ is bank b's average ratio of MBS holdings over total securities over the four quarters prior to QE$^{(j)}$. In all regressions we use data from seven quarters, three quarters before and three quarters after the event. I.e., $t = -3, ..., 3$, where $t = 0$ is the starting date of a respective round of QE. Moreover, our regression includes bank-fixed effects, γ_b, and time-fixed effects, τ_t, to control for fixed differences between banks and for differences over time that affect all banks.[9]

We include bank-specific time-varying controls to control for remaining differences between banks. $X_{b,t}$ denotes controls from bank balance sheets discussed in Table 1 and Table 3. In addition, we control for bank-specific lending demand conditions, $d_{b,t}$, as reported by banks in the SLOOS survey. Controlling for loan demand at the bank level allows us to deal with the concern that banks with higher MBS holdings face systematically different lending demand than low MBS banks after QE.

The fact that different rounds of quantitative easing focused on different asset classes, makes the

[8]We create dummy variables for each round of QE:

- QE1, announced on November 25, 2008, was put into full action by March 2009. The SLOOS is a quarterly survey and in the main specification, we create a dummy equal to 1 for observations after 2009Q1 and thereafter, and zero otherwise. As a robustness check, we run the same specification with a dummy which is already equal to one for 2008Q4 and onwards and a a second specification in which the dummy is only 1 for 2009Q2 and onwards. As the STBL data contain information on actual issuance dates, we can use the issuance date directly, and we create a dummy equal to 1 for any loan issued after the event date, which we choose as November 25, 2008.
- The actual announcement of QE2 is hard to define. While there were several rumors throughout the summer of 2010, it was, however, only implemented starting from November 5, 2009. In the main specification, we create a dummy that is equal to one for 2009Q4 and thereafter. This tries to account for the fact that the communication over the summer of 2010 may have been imprecise and hence we choose as the event date when the actual program was in effect. As a robustness check, we run a regression with the dummy being equal to one starting in 2009Q3.
- QE3 was largely unanticipated and announced on September 13, 2012. We create a dummy variable equal to 1 for 2012Q4 and thereafter and zero otherwise. For the STBL data, we again use the issuance date directly and create a dummy equal to one for any loan issued after September 13, 2012.

[9]Therefore, only the interaction between the MBS share and the QE dummies is estimated while the main effects of both variables are absorbed by the fixed effects.

second round of QE a natural placebo test: i.e., while the Fed bought agency MBS as well as U.S. Treasuries in QE1 and QE3, it exclusively bought U.S. Treasuries in QE2. Hence, banks with larger MBS holdings should be affected during the first and third round of QE, but not in the second round.

An important concern with our identification strategy could be that those banks that held more MBS were those banks that were more affected by the financial crisis, as the 2007-2008 crisis centered around the housing market. If this is the case, one should expect a stronger effect on banks with larger MBS holdings during the recovery as those banks had the capacity to "catch up" with unaffected banks. Importantly, if this is driving our results, one should expect banks with high MBS shares to have lower lending standards throughout the entire sample period and not only right after a specific round of QE.

Another important concern with our identification strategy could be that banks strategically build up stocks of MBS in anticipation of government interventions. In order to address this potential endogeneity, Table 2 shows that a bank's MBS share is highly autocorrelated and can almost entirely be explained by past MBS holdings. This suggests that banks rarely deviate from their typical MBS holdings, a point that is also supported by Darmouni and Rodnyansky (2017) who document that, when sorted by MBS holdings, banks almost never transition between low and high cross-sectional MBS holdings rankings.

Finally, we run the same regression with banks' exposure to treasuries. In that case, the model becomes:

$$y_{b,t} = \alpha + \beta \left(\frac{TRE}{TotSec} \right)_b^{(j)} QE_t^{(j)} + \delta d_{b,t} + \theta X_{b,t} + \gamma_b + \tau_t + \epsilon_{b,t}. \tag{2}$$

Here, $\left(\frac{TRE}{TotSec}\right)_b^{(j)}$ is bank b's ratio of Treasury holdings over total securities in the four quarters prior to the j-th of QE, and all other variables are defined as above.

3 Results

3.1 SLOOS

We start with illustrative evidence in Figure 3. Each panel divides the banks into those with high and low MBS or U.S. Treasury (labeled as TRE) ratios (relative to the median) and computes the share of banks that ease or tighten their lending standards in each of the two groups around the different episodes of quantitative easing.

[Figure 3 about here]

Figure 3 illustrates our main findings that are supported by the more rigorous regressions below. The upper two panels focus on QE1. Being close to the financial crisis, the time period around QE1 is characterized by an overall tightening of lending standards (see Figure 1). In fact, before QE1, lending standards of banks with low and high MBS shares trended very similarly, no bank reported that it was easing lending standards and almost all banks reported a tightening of standards. After the introduction of QE1, though, some differences become apparent: Banks with a high MBS share are more likely to ease lending standards, and they are less likely to tighten them. This suggests that QE1 led to a less severe tightening of standards for banks with higher MBS exposure.

The middle two panels report the same outcome variable around QE2.[10] Lending standards for banks with high and low U.S. Treasury shares trended similarly before QE2, with no apparent change after the introduction of QE2.

Finally, the lower two panels show changes in lending standards around QE3, an episode that is characterized by banks that mostly eased their credit standards and by only a few banks that tightened them (see also Figure 1). Again, we observe that banks with high and low MBS shares had similar trends in lending standards before QE3. After the introduction of QE3, however, banks with high MBS shares were more likely to ease lending standards and less likely to tighten. Hence, a first glance at the evidence suggest that QE3 led to a less severe tightening of standards.

Next, we turn to the regression analysis, which supports the visual patterns in Figure 3. Table 4 estimates equation (1) for each episode of quantitative easing, with a time window of three quarters before and after the introduction of the respective program. Recall that the dependent variable in these regressions is the bank-specific lending standards index, and higher values of the index reflect tighter standards.

[Table 4 about here]

We make three observations about the results in Table 4. First, coefficient estimates are very similar, regardless of whether we include bank and time fixed-effects or not. This is reassuring and should not be surprising: As we discussed earlier (see section 2.4), the sample of banks is relatively homogenous

[10]With QE2 being focused on U.S. Treasuries, we use banks' treasury shares in this picture. We do not find any differences around QE2 if we use the MBS share instead.

and banks with high and low MBS shares display similar trends in lending standards before quantitative easing episodes.

Second, we find pronounced negative effects during QE1 and QE3, but small and insignificant effects during QE2. This is consistent with the focus of the different programs on MBS purchases (QE1, QE3) and U.S. Treasury purchases (QE2). We should not expect QE2 to affect banks with high and low MBS shares differently. Such a result is also consistent with the visual evidence in Figure 3.

Third, the effects during QE1 and QE3 are economically sizeable. In our QE1 sample, the difference in MBS share between a bank at the 75th percentile of the MBS share distribution and the 25th percentile of the MBS share distribution is around 0.3 (the standard deviation of the cross-sectional MBS share is also around 0.3). The estimate from column (3) of Table 4 implies that a bank at the 75th percentile (as compared to the 25th percentile) of the MBS distribution had a lending standards index that was lower by 0.07, which is about 20% of the standard deviation of the lending standards index. Around QE3, the interquartile difference of the MBS share is a bit larger (0.4), which, using the estimate from column (9) again implies that lending standards were lower by around 0.07 units for a bank at the 75th percentile of the MBS distribution than for a bank at the 25th percentile. Since the standard deviation of the lending standards index is lower around QE3, the estimate implies a move of about one third of the standard deviation of the lending standards index.

Interestingly, loan demand as perceived by loan officers is only significant during QE1 and QE3. Recall, that a lower demand variable $d_{b,t}$ implies higher perceived demand. Hence, during QE1 and QE3, there is a correlation between an expected increase in demand and less tight lending standards. An interpretation consistent with these findings is that QE1 and QE3 were expected to also affect other variables in the economy such as the general economic outlook, which in turn justified easing of lending standards. It is thus important to emphasize that, by nature of the empirical design, our results are robust to considering such additional effects.

Table 5 repeats the regressions using banks' U.S. Treasury shares before quantitative easing episodes as the treatment intensity (see equation (2)). Here, we do not find significant effects for any of the three episodes throughout all specifications. This finding can be interpreted as a further test of the "narrow channel:" If quantitative easing operated via a narrow channel, we should observe effects on lending standards only for banks that hold relatively more MBS while other secuitity holdings, including U.S. Treasuries, should be irrelevant. Table 5 suggests that this is indeed the case.

[Table 5 about here]

While regression results based on equation (1) report average differences in lending standards before and after quantitative easing episodes, Figure 4 attempts to provide a better picture of the timing of the effect around each episode. Here, we estimate the equation

$$y_{b,k} = \alpha + \sum_{k=-3}^{3} \beta_k^{(j)} \left(\frac{MBS}{TotSec}\right)_b^{(j)} \tau_k + \delta d_{b,k} + \theta X_{b,k} + \gamma_b + \tau_k + \epsilon_{b,k}, \tag{3}$$

where quarter k is measured relative to the introduction of the j-th episode of quantitative easing, and all variables are otherwise defined as above; that is, the model includes bank and period fixed effects and controls. The coefficients of interest, the $\beta_k^{(j)}$'s, indicate the effect of the MBS share on lending standards in period k, and we normalize $\beta_{-1}^{(j)}$ to zero.

[Figure 4 about here]

Figure 4 provides results. In all three panels, trends in lending standards are roughly independent of MBS exposure before the quantitative easing episodes start. Starting with the left panel, we see that QE1 had an almost immediate effect on lending standards of banks with higher MBS shares that persisted over the event window. Looking at the middle panel, QE2 had no such effect (as should be expected by now). The effect of QE3 (the right panel) on lending standards was more delayed. Although coefficient estimates turn negative right around the start of QE3, they only become significant a few quarters out.

3.2 STBL

While the results in the previous section were at the bank-level, we supplement our findings in this section with confidential loan-level data, which has a few key advantages. While the SLOOS surveys lending standards, the STBL measures actual lending. We can therefore investigate if banks act consistent with their intentions using the STBL data. The STBL also includes many small loans and therefore provides a more complete description of lending than would publicly available data on syndicated loans alone. Further, the sample of banks that participates in the STBL is bigger and more diverse than the sample of banks in the SLOOS, so we get a better picture of the entire lending landscape of the

United States. However, as we noted in Section 2.2, the data also come with two drawbacks. First, bank participation is voluntary and fluctuates over time. Second, the data only include commercial and industrial (C&I) lending, and therefore cover only one category of total bank lending.

Using the STBL data, we estimate the following model:

$$y_{i,b,t} = \alpha + \beta \left(\frac{MBS}{TotSec} \right)_b^{(j)} QE_t^{(j)} + \theta X_{b,t} + \zeta Z_{i,b,t} + \gamma_b + \tau_t + \epsilon_{i,b,t}. \tag{4}$$

In equation (4), $y_{i,b,t}$ describes the internal risk rating of loan i by bank b at time t, and $Z_{i,b,t}$ is a vector of loan-level controls, including the maturity-matched interest rate spread, loan size, maturity and whether it is secured or not. All other variables are the same as those in equation (1). In particular, we continue to control for bank and time fixed effects. We also include bank-level controls.[11]

Table 6 presents estimates of equation (4) for the three quantitative easing episodes and for two samples of loans. The first sample includes all loans that are part of the STBL data. For that sample, we find that banks with higher MBS shares took more risk in C&I lending after QE1 but not after QE2 or QE3. Arguably, the effect should be more pronounced for new loans that were made without a previous commitment (see Dell'Arricia et al. (2017)). For that sample of loans, we find somewhat larger and statistically significant effects for QE1 and QE3 and, again, no effect of QE2.

[Table 6 about here]

How large is this effect? Consider again a bank that has a 30 percentage point higher MBS share (the interquartile range of MBS shares across banks before QE1). After QE1 and QE3, that bank extends loans that are on average riskier by 0.05 units. As the standard deviation of risk ratings is about 0.85 in our sample, this corresponds to a move of roughly 6% of the risk rating's standard deviation.

To put the effect size in perspective, we can compare it to Dell'Arricia et al. (2017)'s estimate of the effect of conventional monetary policy on risk taking in the STBL. In their benchmark specification, they find that, on average over all banks, a one standard deviation decrease in interest rates increases loan risk ratings by 0.057 units. Therefore, our estimates imply that moving a bank from the 25th percentile of the MBS share distribution to the 75th percentile during QE1 or QE3 had about the same effect on loan risk ratings of newly issued loans as decreasing the interest rate by one standard deviation. In that

[11] Since the borrowing firm is not identified in the data, we cannot control for borrower fixed effects (as in Khwaja and Mian (2008)).

sense, unconventional monetary policy had similar effects to conventional monetary policy in normal times. That quantitative finding complements Gilchrist et al. (2015) who document that unconventional monetary policy lowered borrowing cost by about as much as conventional monetary policy.

We also run regression specifications that use banks' U.S. Treasury shares instead of their MBS shares. Table 7 provides results. Mirroring results from Section 3.1, we find fluctuating and insignificant coefficient estimates when we use the treasury share. This again lends support to a narrow transmission mechanism that operated via banks' MBS exposure.

4 Robustness

4.1 Controlling for Changes in Lending Volume

We start out by addressing potential concerns that results could be driven by a mere expansion of bank credit. If a bank expands its lending, it may mechanically move down the quality curve and make riskier loans. Risky borrowers that had been rationed before the expansion, receive access to loans which increases the overall riskiness of the bank's loan portfolio. Given that there's evidence that banks expanded lending volume after QE1 and QE3 (Darmouni and Rodnyansky (2017) this is a natural concern.

We address this concern by, first, providing evidence that our measures of lending standards are not highly correlated with changes in bank lending volume. We also show that our main results hold when we control for the change in lending directly.

Let $\Delta\text{Lending}_{b,t}$ denote the change in the overall amount of loans held by bank b from t to $t+1$. Let L_t denote bank b's loans held, including C&I loans, residential real estate loans, and commercial real estate loans. We calculate the quarterly change as

$$\Delta\text{Lending}_{b,t} = \frac{L_{t+1} - L_t}{0.5(L_{t+1} + L_t)}.$$

While the change in the overall amount of loans held by a bank, $\Delta\text{Lending}_{b,t}$, is indeed correlated with the bank-specific lending standards index, the correlation is only around -0.05, see Table 8.[12] That is, tight lending standards are associated with less lending, and eased lending standards with additional lending. While the correlation is significant, which should be expected given the reasons outlined above,

[12]In our main sample, lagged bank-level total and C&I loan growth have even lower correlations with our bank-specific standards index.

its low level indicates that the SLOOS lending standards index contains information that goes beyond mere expansions and reductions in lending.

[Table 8 about here]

Further, Table 9 shows results for estimating our main specification using $\Delta\text{Lending}_{b,t}$ as an additional control. Given the low correlation between $\Delta\text{Lending}_{b,t}$ and the lending standards index, it is unsurprising that the main results are unchanged. The most important insight from this section is that loan growth does not necessarily imply more risk-taking by banks, a result that holds during our sample period but also holds more generally over the entire period over which the SLOOS is elicited.

[Table 9 about here]

4.2 Varying the Treatment Variable Specification

As a first alternative to our main specification, we calculate a bank's MBS exposure not as the ratio of MBS holdings over total securities of bank b, but as MBS relative to total assets, changing our specification into:

$$y_{b,t} = \alpha + \beta \left(\frac{MBS}{TotAssets} \right)_b^{(j)} QE_t^{(j)} + \delta d_{b,t} + \theta X_{b,t} + \gamma_b + \tau_t + \epsilon_{b,t}. \tag{5}$$

[Table 10 about here]

Equation (5), addresses the concern that it's not the overall holdings of MBS relative to securities that matter, but the overall fraction of MBS relative to the bank's balance sheet. Table 10 shows that our results are robust to this change. This is unsurprising as the ratio of MBS over securities and the ratio of MBS over total assets are highly correlated in our sample.

Moreover, we consider alternative definitions for banks' ratio of MBS over total securities. We do this to alleviate concerns that measuring the MBS share over the four quarters prior to a respective round of QE might not be exogenous or might not be sufficiently informative about a bank's MBS exposure directly before the QE events. First, we take the average over the entire sample, i.e., from 2007Q4 to

2014Q4. Second, we take the average ratio of MBS over securities in the quarters $t-6, ..., t-3$, where t is the event date. Third, we fix the MBS holdings at their value in the first quarter of 2008, prior to the start of LSAPs.

Table 12 show results for our main specifications. Results are robust to these alternative definitions of MBS exposure and change little overall, in line with our result on the stability of the MBS share over time in Table 2.

[Table 12 about here]

4.3 Event Dates

Since the SLOOS only provides quarterly data, the event date definition is necessarily somewhat imprecise. For instance, one may be worried that the effect of QE1 was already at work in 2008Q4 as QE1 was officially announced in November 2008. Or, given that the Fed was only officially purchasing MBS since March 2009, one may only expect an effect in 2009Q2. And, given that there were several rumors of additional actions by the Federal Reserve as well as signals by the Federal Reserve itself over the course of the summer 2010, one may consider that the effect of the policy had already been active before the implementation in November 2010.

Table 11 shows that QE1 remains significant for different event dates.For QE2, there is still no significant effect even when moving the event date.

[Table 11 about here]

4.4 Tapering

We investigate whether the tapering of QE3 had a significant effect on bank risk-taking with the reversed sign. The tapering was signaled over the course of 2013 and actually implemented in January 2014. We run the same specifications as above, however, now using the tapering as the event. As Table 13 shows, banks with higher MBS shares tended to tighten their standards more/ ease less after the tapering had been implemented.

[Table 13 about here]

The results carry over to the internal risk rating in the STBL data. Table 14 show sthat the tapering led to a decrease in the internal risk-rating on newly issued loans for those banks that were more exposed to the tapering. On the one hand, this finding can be seen as additional demonstration of the robustness of our findings. On the other hand, it also yields some insight on the mechanism underlying our finding, as it can be taken as evidence for QE3 operating via a liquidity channel, as discussed below.

[Table 14 about here]

5 Channel and mechanism

5.1 Lending categories

The aggregate lending index used above summarizes banks' lending standards in five different categories: C&I loans, commercial real estate loans, residential real estate loans, home equity lines of credit and consumer loans. The SLOOS data allow us to investigate these categories individually to assess which categories drove changes in overall lending standards. We estimate versions of Equation (1) in which we replace the aggregate lending standard on the left-hand side with category-specific lending standards, and we control for category-specific perceived credit demand instead of aggregate credit demand.

Tables 15 and 16 provide results for QE1 and QE3, respectively.[13] QE1 led to stronger reduction in lending standards across all categories (with the exception of consumer credit) for banks with a higher MBS share. Point estimates for QE3 are roughly in line with those for the QE1 episode. However, while the effect is stronger for C&I lending, it is weaker for residential real estate loans and not present for commercial real estate loans or home equity lines of credit. The overall pattern, hence, suggests a stronger reaction for banks with higher MBS shares in categories related to corporate lending and real estate.

5.2 Channel

In general, QE may affect the banks through an array of channels. For instance, by raising the prices of MBS, QE could generate a windfall gain for banks with MBS holdings, improving their capital position via a "net-worth channel".[14] An improved capital position in turn improves a bank's "risk capacity"

[13]Consistent with our results for the aggregate lending index, banks with low and high MBS shares did not adjust lending standards differentially in any domain after QE2 (results available on request).

[14]See the seminal paper by Bernanke and Gertler (1989), Kiyotaki and Moore (1997), and Brunnermeier and Sannikov (2014) on the net-worth channel.

and its ability to issue relatively more risky loans subsequently.

Alternatively, QE also affects the secondary market liquidity of MBS, making them relatively more liquid and facilitating banks' ability to re-balance their portfolios. We refer to this as a "liquidity channel", see Krishnamurthy and Vissing-Jorgensen (2011). QE works through both channels by essentially relieving a constraint faced by the bank. The extent to which relieving such constraints would relax loan quality is ex ante unclear.[15]

To examine the extent these channels affect bank risk taking, we first make use of the fact that the SLOOS surveys banks directly about the intentions of changes to lending standards in C&I loans. Loan officers are queried whether a tightening or easing of lending standards is driven by an improved capital position, and improved economic outlook, and improved liquidity position or an increase in risk appetite. For each "reason," the banks are asked two questions. If a bank had previously indicated that it was tightening its standards, it is asked a question whether any of the above reasons is driving the change and can provide three answers, 1 = "not important," 2 = "important," 3 = "very important." Likewise, a bank is asked the same if it has eased its standards. We aggregate the two questions into one variable for each question, where 1 = "tightening, very important," 2 = "tightening, important," 3 = "no change," 4 = "easing, important", and 5 = "easing, very important." We then use this variable as the dependent variable in a specification that is otherwise equivalent to Equation (1).

[Table 17 about here]

The results are reported in Table 17. The results indicate that increased risk appetite and an improved capital position played a role in changing lending standard during QE1, but not QE3. This indicates that QE1 is more likely to have affected banks' capital position and therewith their risk capacity. Hence, our finding suggests that the improved capital position allowed banks to take lower the lending standards on their newly issued loans, increasing the risk of their loan portfolio.

In contrast, banks neither report an improved capital position nor an improved liquidity position as the reason underlying their decision to ease standards during QE3. In the previous section, we provided evidence that the tapering of QE3 led to an additional tightening of standards. This is most consistent with QE3 operating via a liquidity channel: If QE3 was transitory and made banks' MBS holdings more

[15]For relieving either a net worth or liquidity constraint to affect loan quality, it must be the case that banks either want to take more risk were it not for their constraint, or that by relaxing their constraint they are induced to take more risk. Although we are able to present evidence that relaxing net worth and liquidity constraints affected bank risk taking, these two effects cannot be separated without a structural model.

liquid, instead of raising the values permanently, than one should observe less tight lending standards and less risk taking after QE3 was ended. Moreover, according to Darmouni and Rodnyansky (2017), the improved liquidity position of banks drove higher lending quantities during QE3. However, the SLOOS does not confirm this finding for banks' risk-taking decisions in our sample.

In order to test whether the above reported reasons are in line with actual changes in the banks' balance sheets, we run an additional specification to test whether banks' balance sheet variables react differentially to QE. To this end, we use the ratio of MBS available for sale over the total number of securities available for sale, realized gains and the liquidity ratio as dependent variables. Column (1) and column (3) suggest that banks with large MBS holdings are reducing their MBS holdings during the first and third round of QE. This indicates that banks make use of the fact that the Federal Reserve is purchasing MBS and re-balance their securities portfolios.

[Table 18 about here]

Moreover, column (4) documents a positive effect on realized and unrealized gains as a fraction of total securities for banks with larger MBS holdings during QE1. This confirms our evidence on the "net worth channel" discussed above. Also in line with the above, realized gains do not increase as a reaction to QE3. Finally, the liquidity ratio has a positive coefficient during QE1 as well as QE3, but the finding is not statistically significant.

Altogether, the evidence suggests that the increased risk-taking during QE1 can be attributed to an improved capital position of those banks that held more MBS. During QE3, in contrast, the picture that emerges is suggestive of a liquidity channel. From a financial stability perspective, the underlying channel is particularly important as additional risk-taking in light of an increased capital position is generally less concerning as additional risk-taking in the light of only an improved liquidity position. Hence, our results indicate that while loans became more risky during QE1, banks as institutions likely did not. The evidence for QE3 is less conclusive.

6 Conclusion

Our study documents a causal effect of the Federal Reserve's LSAPs on risk characteristics of newly issued bank loans. We find that the first and third round had a significant effect on bank lending standards, roughly similar in magnitude to a one percentage points decrease of the Fed fund target rate during normal times. We show that results are robust along a number of dimensions, including changes to the definition of the exposure variable, and assumptions about the timing of LSAPs.

Our findings contribute to the understanding of how unconventional monetary policy affects risk-taking behavior in the banking sector. This is an important finding, as it shows that QE did not only affect the availability of credit Darmouni and Rodnyansky (2017), but also led banks to issue relatively more risky loans with lower lending standards.

While the paper can speak to the causal effect of quantitative easing on bank lending standards and bank risk-taking, our data do not allow us to infer whether the additional risk-taking was desirable from the society's point of view, i.e. we cannot distinguish between desired risks - as in "risk-taking"- vs. undesired risks - as in "risk-shifting". Figure 5 shows that delinquencies relative to loan-loss reserves did not evolve differently for banks with high and low MBS holdings in our sample during both round of QE. If anything, they have been slightly lower for banks with high MBS holdings. This suggests that QE did not lead to an additional buildup of financial instability.

[Figure 5 about here]

Moreover, the historical context provided in Figure 1 suggests that QE1 induced less tightening during a phase in which banks were generally tightening their standards. Our findings suggest that banks increased risk in QE1 because of improved capital positions which should provide little concern with respect for financial stability. QE3, in contrast, induced additional easing of standards when the financial sector had been in a prolonged phase of recovery unrelated to improved capital positions. The additional risk-taking around QE3 could therefore provide somewhat more reason for concern about financial stability.

References

Adrian, T. and H. S. Shin (2010). Liquidity and leverage. *Journal of Financial Intermediation 19*(3), 418 – 437. Risk Transfer Mechanisms and Financial Stability.

Afansyeva, E. and J. Guenter (2016). Bank market power and the risk channel of monetary policy. Working paper.

Altunbas, Y., L. Gambacorta, and D. Marques-Ibanez (2010). Bank risk and monetary policy. *Journal of Financial Stability 6*(3), 121 – 129.

Aramonte, S., S. J. Lee, and V. Stebunovs (2015). Risk taking and low longer-term interest rates: Evidence from the u.s. syndicated loan market. FEDS WP 2015-068.

Bassett, W. F., M. B. Chosak, J. C. Driscoll, and E. Zakrasjek (2014). Changes in bank lending standards and the macroeconomy. *Journal of Monetary Economics 62*, 23 – 40.

Bernanke, B. and M. Gertler (1989). Agency costs, net worth, and business fluctuations. *The American Economic Review 79*(1), 14–31.

Bernanke, B. S. (2013, 5). The economic outlook. Before the Joint Economic Committee, U.S. Congress, Washington, D.C. May 22, 2013.

Black, L. K. and L. N. Hazelwood (2013). The effect of tarp on bank risk-taking. *Journal of Financial Stability 9*(4), 790 – 803.

Brunnermeier, M. K. and Y. Sannikov (2014, February). A macroeconomic model with a financial sector. *American Economic Review 104*(2), 379–421.

Bruno, V. and H. S. Shin (2013). Capital flows and the risk-taking channel of monetary policy. NBER WP No 18942.

Chakraborty, I., I. Goldstein, and A. MacKinlay (2016). Monetary stimulus and bank lending. Working paper.

Chodorow-Reich, G. (2014). Effects of unconventional monetary policy on financial institutions. *Brookings Papers on Economic Activity (Spring)*, 155–204.

Darmouni, O. and A. Rodnyansky (2017). The effects of quantitative easing on bank lending behavior. *Review of Financial Studies XX*(X), XX–XX. forthcoming.

Dell'Arricia, G., L. Laeven, and G. Suarez (2017). Bank leverage and monetary policy's risk taking channel: Evidence from the united states. *Journal of Finance XX*(X), XX–XX. forthcoming.

Di Maggio, M. and M. Kacperczyk (2017). The unintended consequences of the zero lower bound policy. *Journal of Financial Economics 123*(1), 59 – 80.

Di Maggio, M., A. Kermani, and C. Palmer (2016, September). How quantitative easing works: Evidence on the refinancing channel. Working Paper 22638, National Bureau of Economic Research.

Falato, A. and D. Scharfstein (2016). The stock market and bank risk-taking. NBER WP No. 22689.

Gilchrist, S., D. López-Salido, and E. Zakrajšek (2015, January). Monetary policy and real borrowing costs at the zero lower bound. *American Economic Journal: Macroeconomics 7*(1), 77–109.

Heider, F., F. Saidi, and G. Schepens (2016). Life below zero: Bank lending under negative policy rates. Working paper.

Ioannidou, V., S. Ongena, and J.-L. Peydró (2014). Monetary policy, risk-taking, and pricing: Evidence from a quasi-natural experiment. *Review of Finance 19*(1), 95.

Jimenez, G. and S. Ongena (2012). Credit supply and monetary policy: Identifying the bank balance-sheet channel with loan applications. *American Economic Review 102*(5), 2301–2326.

Jiménez, G., S. Ongena, J.-L. Peydró, and J. Saurina (2014). Hazardous times for monetary policy: What do twenty-three million bank loans say about the effects of monetary policy on credit risk-taking? *Econometrica 82*(2), 463–505.

Kandrac, J. and B. Schlusche (2016). Quantitative easing and bank risk taking: evidence from lending. Working paper.

Khwaja, A. I. and A. Mian (2008). Tracing the impact of bank liquidity shocks: Evidence from an emerging market. *American Economic Review 98*(4), 1413–42.

Kiyotaki, N. and J. Moore (1997). Credit cycles. *Journal of Political Economy 105*(2), 211–248.

Krishnamurthy, A. and A. Vissing-Jorgensen (2011). The effects of quantitative easing on interest rates: channels and implications for policy.

Krishnamurthy, A. and A. Vissing-Jorgensen (2013). The ins and outs of lsaps. Kansas City Federal Reserve Symposium on Global Dimensions of Unconventional Monetary Policy.

Maddaloni, A. and J.-L. Peydró (2011). Bank risk-taking, securitization, supervision, and low interest rates: Evidence from the euro-area and the u.s. lending standards. *The Review of Financial Studies 24*(6), 2121.

Rosengren, E. S. (2015, 11). Assessing the economy's progress. Presentation to the Newport Country Chamber of Commerce, Portsmouth, Rhode Island, November 9, 2015.

Vojtech, C. M., B. S. Kay, and J. C. Driscoll (2016). The real consequences of bank mortgage lending standards.

Williams, J. C. (2012). The role of monetary policy in bolstering economic growth. Presentation to Community Leaders Salt Lake City, Utah.

A Tables and figures

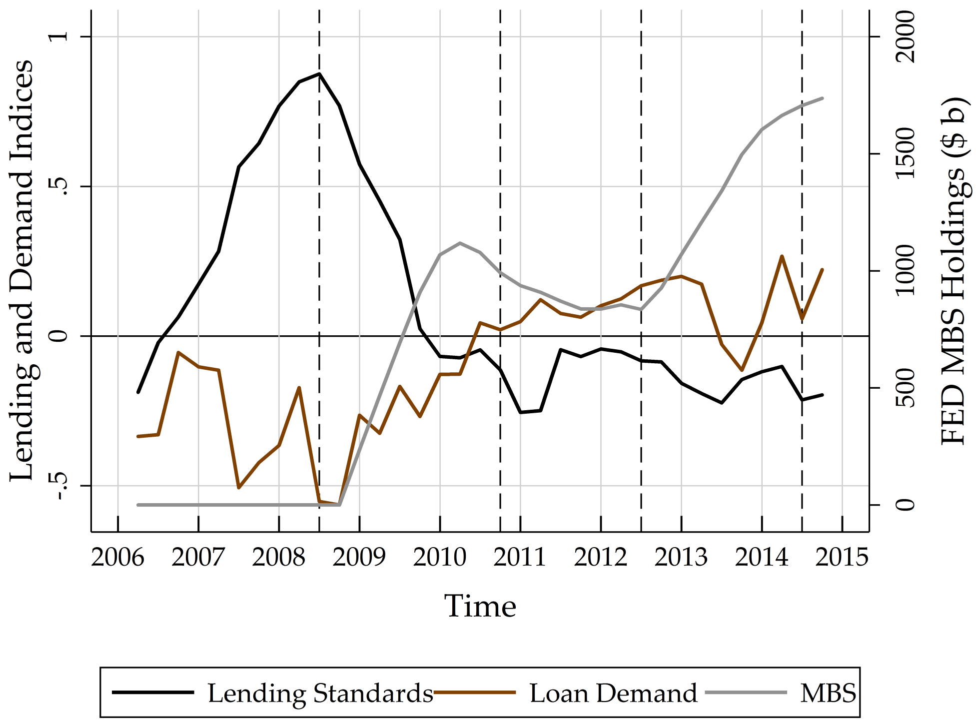
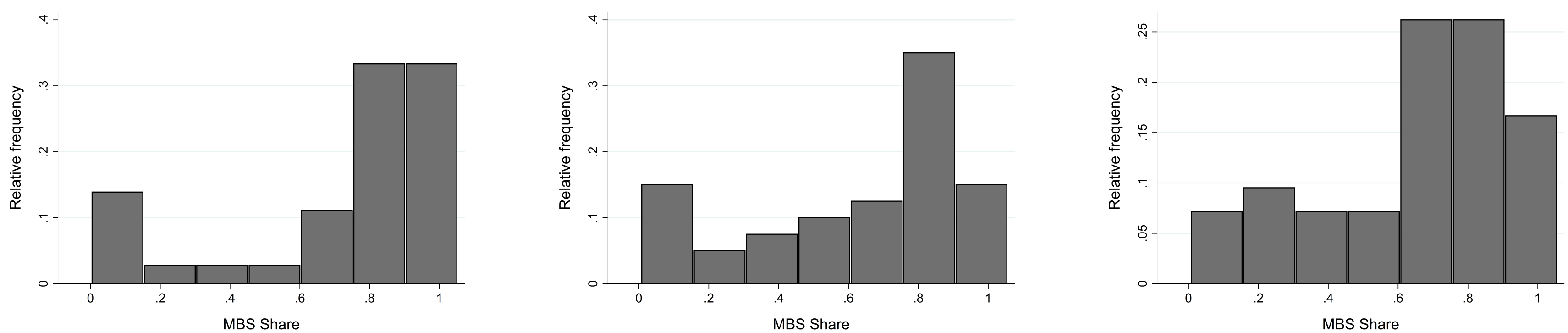
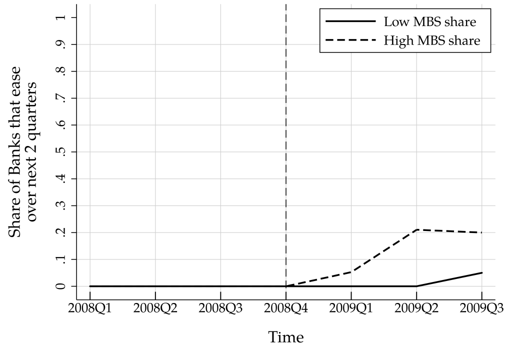


Figure 1: *This graph depicts the lending standards index and the loan demand calculated by the method of Bassett et al. (2014), which can take a value between -1 and 1, where -1 represents an easing of bank lending standards and an increased perceived demand, and 1 represents a tightening of lending standards and a decreasing perceived demand (left y-axis). Moreover, it depicts the amount of MBS that the Federal Reserve bought as part of its LSAPs (right y-axis).*

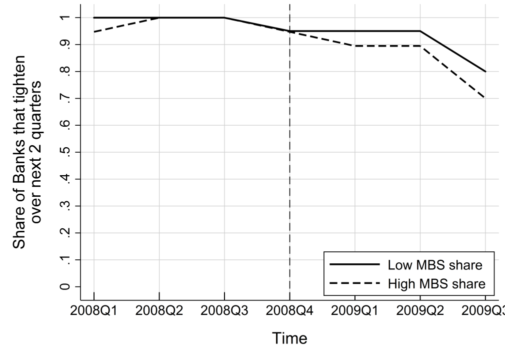


(a) *pre-QE1* **(b)** *pre-QE2* **(c)** *pre-QE3*

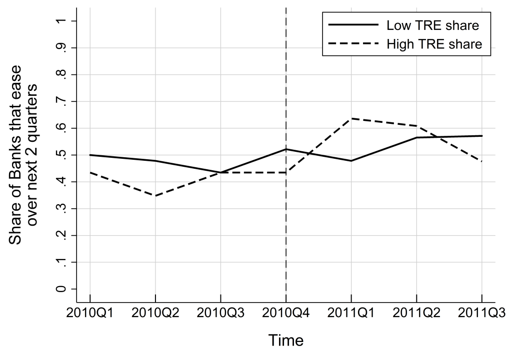
Figure 2: *The three histograms depict the distribution of the average ratio of MBS holdings over total securities,* $\left(\frac{MBS}{TotSec}\right)_b^{(j)}$, *in the four quarters prior to QE1, QE2, and QE3.*



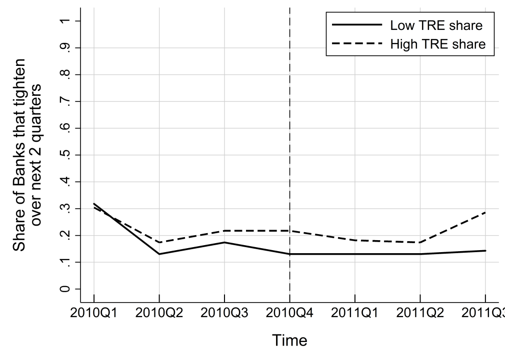
(a) *QE1, Easing*



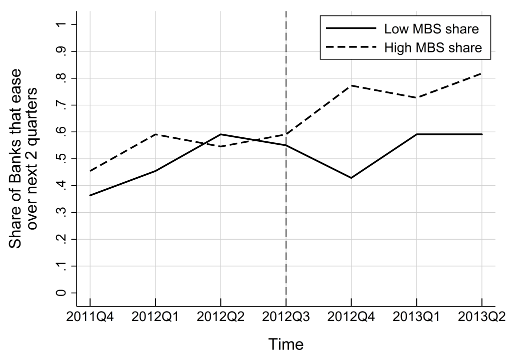
(b) *QE1, Tightening*



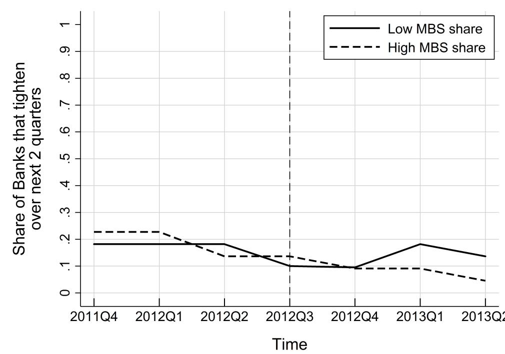
(c) *QE2, Easing*



(d) *QE2, Tightening*

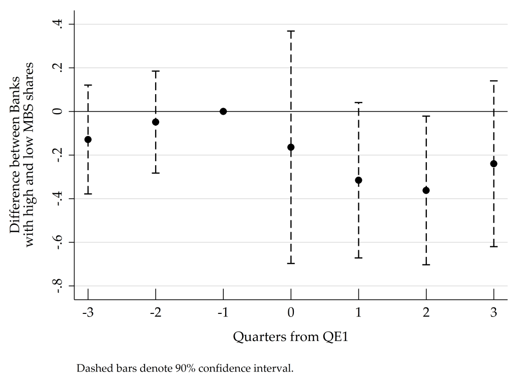


(e) *QE3, Easing*

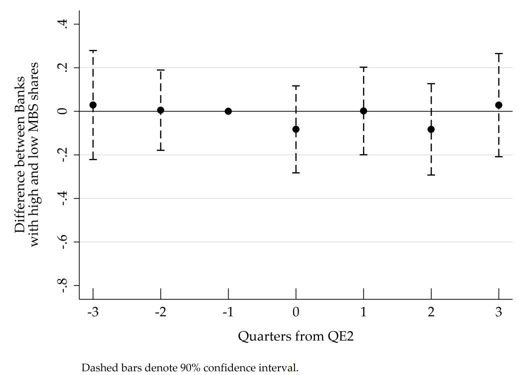


(f) *QE3, Tightening*

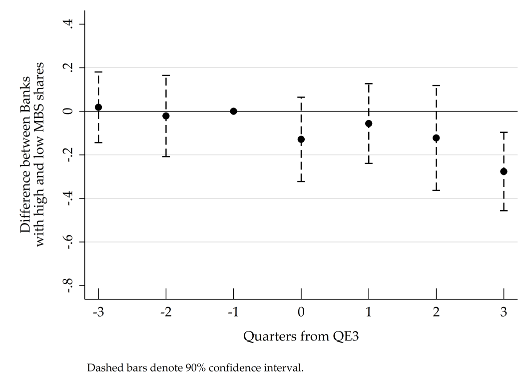
Figure 3: *This graph shows the average share of banks easing (tightening) their lending standards in the time window around a respective round of QE. We create a dummy variable at the bank level, $e_{b,t}$, that takes the value 1 if bank b reports easing its standards in the current or next quarter, i.e., if $I^S_{b,t} < 0$ or $I^S_{b,t+1} < 0$. We then take the average of $e_{b,t}$ at any point t. Likewise, for tightening, we create a dummy variable, $l_{b,t}$ equal to 1 if bank b reports tightening its standards in the current or next quarter, i.e., if $I^S_{b,t} > 0$ or $I^S_{b,t+1} > 0$. The three panels on the left plot the average $e_{b,t}$ at each t, i.e., the share of banks that ease in the current or next quarter, while plotted on the right panels is the average of $l_{b,t}$, i.e., the average number of banks tightening in the current or next quarter is .*



(a) *QE1*



(b) *QE2*



(c) *QE3*

Figure 4: *Coefficient plots from estimating:* $y_{b,k} = \alpha + \sum_{k=-3}^{3} \beta_k^{(j)} \left(\frac{MBS}{TotSec}\right)_b^{(j)} \tau_k + \delta d_{b,k} + \theta X_{b,k} + \gamma_b + \tau_k + \epsilon_{b,k}$*, where quarter k is measured relative to the introduction of the j-th episode of quantitative easing, and all variables are otherwise defined as above; that is, the model includes bank and period fixed effects and controls. The coefficients of interest, the* $\beta_k^{(j)}$*'s, indicate the effect of the MBS share on lending standards in period k, and we normalize* $\beta_{-1}^{(j)}$ *to zero.*

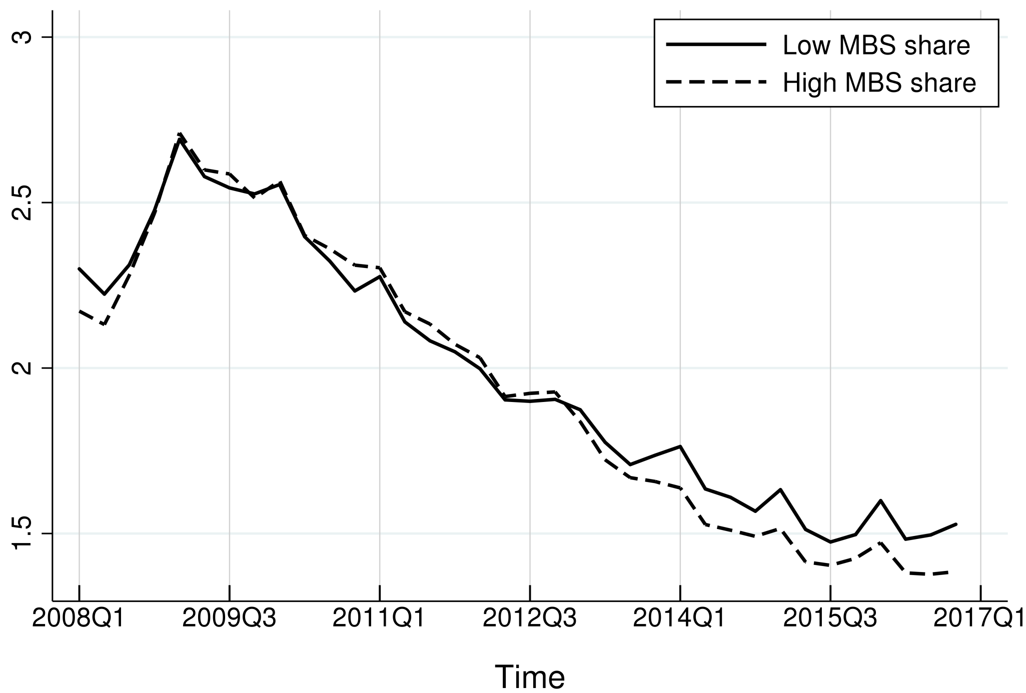


Figure 5: *The panel depicts the delinquency ratio defined as delinquencies over loan loss reserves, and divides the sample of all banks in the SLOOS and STBL into those with high and low MBS holdings in the four quarters prior to QE1, based on the median.*

Table 1: *Summary Statistics for bank-level control variables*

	Mean	Std	10th Perc	25th Perc	Median	75th Perc	90th Perc	N
	SLOOS banks							
log(assets)	17.74	1.50	16.05	16.49	17.80	18.66	19.56	1836
Leverage Ratio	0.11	0.03	0.08	0.10	0.11	0.13	0.15	1836
Profitability	0.00	0.01	0.00	0.00	0.00	0.01	0.01	1836
Liquidity Ratio	0.02	0.01	0.01	0.01	0.01	0.02	0.03	1836
Deposit Ratio	0.75	0.08	0.64	0.71	0.76	0.81	0.85	1836
Overhead Ratio	0.65	0.19	0.52	0.58	0.64	0.71	0.78	1836
Net interest margin	0.02	0.01	0.01	0.01	0.02	0.03	0.03	1836
Real Estate Ratio	0.55	0.17	0.30	0.44	0.56	0.69	0.75	1836
Loans to Assets	0.59	0.16	0.38	0.51	0.64	0.71	0.75	1836
C&I Loan Ratio	0.23	0.10	0.13	0.17	0.21	0.28	0.37	1836
Tier 1 Ratio	0.12	0.03	0.09	0.10	0.12	0.13	0.15	1836
	STBL banks							
	Mean	Std	10th Perc	25th Perc	Median	75th Perc	90th Perc	N
log(assets)	14.51	2.12	12.09	13.13	14.20	15.57	17.82	8076
Leverage Ratio	0.11	0.03	0.08	0.09	0.10	0.12	0.14	8076
Profitability	0.00	0.01	0.00	0.00	0.00	0.01	0.01	8076
Liquidity Ratio	0.01	0.01	0.00	0.01	0.01	0.02	0.03	8076
Deposit Ratio	0.81	0.08	0.71	0.77	0.82	0.86	0.89	8076
Overhead Ratio	0.68	0.41	0.51	0.59	0.66	0.74	0.82	8076
Net interest margin	0.02	0.01	0.01	0.01	0.02	0.03	0.04	8076
Real Estate Ratio	0.67	0.18	0.42	0.57	0.70	0.80	0.86	8076
Loans to Assets	0.64	0.15	0.44	0.57	0.66	0.74	0.79	8076
C&I Loan Ratio	0.19	0.11	0.08	0.11	0.17	0.24	0.33	8076
Tier 1 Ratio	0.14	0.06	0.10	0.11	0.12	0.15	0.18	8076

This table reports the distribution of variables used as controls in all our regressions for the SLOOS and STBL banks.

Table 2: *Evidence on autocorrelation of banks' MBS holdings*

Dependent variable:			$\left(\frac{MBS}{TotSec}\right)_{b,t}$		
	(1)	(2)	(3)	(4)	(5)
$\left(\frac{MBS}{TotSec}\right)_{b,t-1}$	0.913***				1.008***
	(0.021)				(0.075)
$\left(\frac{MBS}{TotSec}\right)_{b,t-2}$		0.817***			-0.055
		(0.042)			(0.079)
$\left(\frac{MBS}{TotSec}\right)_{b,t-3}$			0.742***		-0.011
			(0.054)		(0.051)
$\left(\frac{MBS}{TotSec}\right)_{b,t-4}$				0.655***	-0.021
				(0.070)	(0.038)
Constant	0.069***	0.141***	0.184***	0.248***	0.060***
	(0.021)	(0.037)	(0.048)	(0.062)	(0.017)
Bank FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
R^2_a	0.870	0.730	0.608	0.481	0.872
No. Banks	46	46	46	46	46
N	1475	1427	1378	1337	1298

This table presents bank-level coefficient estimates, relating bank b's ratio of MBS over total securities, $\left(\frac{MBS}{TotSec}\right)_{b,t}$, at date t to the same ratio in period $t-1$, $t-2$, $t-3$, $t-4$, while using controls, bank and time fixed-effects. Standard errors are clustered at the bank level and displayed in parentheses. Stars indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 3: *Comparison of banks with high and low MBS shares*

	SLOOS banks					
	Low MBS Share		High MBS Share		Difference	
	Mean	Std	Mean	Std	Diff	t-stat
log(assets)	17.184	1.336	18.144	1.490	0.808	1.844
Leverage Ratio	0.112	0.028	0.115	0.033	0.007	0.849
Profitability	0.005	0.006	0.004	0.009	-0.002	-1.991
Liquidity Ratio	0.017	0.014	0.013	0.008	-0.004	-1.540
Deposit Ratio	0.757	0.093	0.743	0.077	-0.020	-1.056
Overhead Ratio	0.639	0.200	0.655	0.186	0.036	1.181
Net interest margin	0.020	0.011	0.020	0.010	0.000	0.326
Real Estate Ratio	0.566	0.181	0.532	0.164	-0.003	-0.056
Loans to Assets	0.593	0.162	0.596	0.154	0.025	0.617
C&I Loan Ratio	0.233	0.094	0.234	0.102	-0.008	-0.319
Tier 1 Ratio	0.121	0.021	0.116	0.030	-0.003	-0.485
	STBL banks					
	Low MBS Share		High MBS Share		Difference	
	Mean	Std	Mean	Std	Diff	t-stat
log(assets)	13.594	1.635	15.262	2.172	1.504	6.410
Leverage Ratio	0.109	0.032	0.108	0.029	-0.001	-0.285
Profitability	0.005	0.009	0.004	0.008	-0.000	-0.598
Liquidity Ratio	0.017	0.015	0.013	0.010	-0.003	-2.691
Deposit Ratio	0.825	0.078	0.791	0.074	-0.031	-3.762
Overhead Ratio	0.690	0.570	0.668	0.200	-0.021	-1.144
Net interest margin	0.022	0.011	0.022	0.011	-0.000	-0.202
Real Estate Ratio	0.681	0.171	0.653	0.179	-0.022	-1.037
Loans to Assets	0.637	0.153	0.638	0.141	0.005	0.323
C&I Loan Ratio	0.171	0.099	0.204	0.111	0.034	2.769
Tier 1 Ratio	0.147	0.071	0.130	0.047	-0.015	-2.561

This table compares SLOOS and STBL banks with "high MBS" (ratio of MBS over securities) and "low MBS". Banks are split into groups based on the median of their average MBS share in the four quarters prior to the first round of QE.

Table 4: *Effect of QE1, QE2, and QE3 on lending standards: Bank-level results and MBS exposure*

Dependent variable:	Bank-specific standards index								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\text{QE}^{(1)} \times \left(\frac{MBS}{TotSec}\right)_b^{(1)}$	-0.242***	-0.208**	-0.211**						
	(0.087)	(0.082)	(0.081)						
$\text{QE}^{(2)} \times \left(\frac{MBS}{TotSec}\right)_b^{(2)}$				-0.016	-0.033	-0.039			
				(0.056)	(0.065)	(0.066)			
$\text{QE}^{(3)} \times \left(\frac{MBS}{TotSec}\right)_b^{(3)}$							-0.138*	-0.134**	-0.139**
							(0.074)	(0.066)	(0.067)
Demand $d_{b,t}$	-0.109*	-0.138***	-0.129**	-0.053	0.003	0.010	-0.118***	-0.108***	-0.115***
	(0.058)	(0.045)	(0.049)	(0.042)	(0.043)	(0.045)	(0.042)	(0.038)	(0.035)
Bank FE	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Time FE	No	No	Yes	No	No	Yes	No	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R_a^2	0.447	0.680	0.688	0.230	0.514	0.537	0.137	0.391	0.409
No. Banks	42	42	42	49	49	49	47	47	47
N	284	284	284	339	339	339	326	326	326

This table presents bank-level coefficient estimates, relating a bank's lending standards to a bank's exposure to a respective round of QE, measured by the average ratio of MBS over total securities in the four quarters prior to the respective event. The specification of column (3), (6), and (9) is given by:

$$y_{b,t} = \alpha + \beta \left(\frac{MBS}{TotSec}\right)_b^{(j)} QE_t^{(j)} + \delta d_{b,t} + \theta X_{b,t} + \gamma_b + \tau_t + \epsilon_{b,t},$$

where $j = 1, 2, 3$ and $t = -3, ..., 3$, where $t = 0$ is the starting date of a respective round of QE. Standard errors are clustered at the bank level and displayed in parentheses. Stars indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 5: *Effect of QE1, QE2, and QE3 on lending standards: Bank-level results and Treasury exposure*

Dependent variable:	Bank-specific standards index								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$QE^{(1)} \times \left(\frac{TRE}{TotSec}\right)_b^{(1)}$	0.378	0.071	0.076						
	(0.258)	(0.182)	(0.177)						
$QE^{(2)} \times \left(\frac{TRE}{TotSec}\right)_b^{(2)}$				0.040	0.091	0.099			
				(0.133)	(0.154)	(0.150)			
$QE^{(3)} \times \left(\frac{TRE}{TotSec}\right)_b^{(3)}$							-0.037	-0.056	-0.082
							(0.241)	(0.204)	(0.228)
Demand $d_{b,t}$	-0.095*	-0.164***	-0.155***	-0.071	0.003	0.012	-0.111***	-0.097**	-0.106***
	(0.052)	(0.042)	(0.045)	(0.046)	(0.042)	(0.043)	(0.041)	(0.037)	(0.033)
Bank FE	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Time FE	No	No	Yes	No	No	Yes	No	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R_a^2	0.442	0.666	0.672	0.178	0.507	0.530	0.110	0.371	0.391
No. Banks	50	50	50	51	51	51	49	49	49
N	336	336	336	351	351	351	340	340	340

This table presents bank-level coefficient estimates, relating a bank's lending standards to a bank's exposure to a respective round of QE, measured by the average ratio of Treasuries over total securities in the four quarters prior to the respective event. The specification of column (3), (6), and (9) is given by:

$$y_{b,t} = \alpha + \beta \left(\frac{TRE}{TotSec}\right)_b^{(j)} QE_t^{(j)} + \delta d_{b,t} + \theta X_{b,t} + \gamma_b + \tau_t + \epsilon_{b,t},$$

where $j = 1, 2, 3$ and $t = -3, ..., 3$,where $t = 0$ is the starting date of a respective round of QE. Standard errors are clustered at the bank level and displayed in parentheses. Stars indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 6: *Effect of QE1, QE2, and QE3 on risk rating: Loan-level results and MBS exposure*

Dependent variable:	Loan-specific internal risk rating					
	All	Non-committed	All	Non-committed	All	Non-committed
$\text{QE}^{(1)} \times \left(\frac{MBS}{TotSec}\right)_b^{(1)}$	0.153*	0.195*				
	(0.081)	(0.099)				
$\text{QE}^{(2)} \times \left(\frac{MBS}{TotSec}\right)_b^{(2)}$			-0.092	-0.012		
			(0.063)	(0.076)		
$\text{QE}^{(3)} \times \left(\frac{MBS}{TotSec}\right)_b^{(3)}$					-0.005	0.156*
					(0.064)	(0.088)
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Loan Controls	Yes	Yes	Yes	Yes	Yes	Yes
R_a^2	0.349	0.422	0.311	0.315	0.260	0.251
No Banks	257	240	267	248	256	239
No obs	131894	42256	252617	93226	259499	94116

This table presents loan-level coefficient estimates, relating a loan's internal risk rating to the loan-issuing bank's exposure to a respective round of QE, measured by the average ratio of MBS over total securities in the four quarters prior to the respective event. The specification is given by:

$$y_{i,b,t} = \alpha + \beta \left(\frac{MBS}{TotSec}\right)_b^{(j)} QE_t^{(j)} + \theta X_{b,t} + \zeta Z_{i,b,t} + \gamma_b + \tau_t + \epsilon_{i,b,t}$$

where $j = 1, 2, 3$ and $t = -3, ..., 3$, where $t = 0$ is the starting date of a respective round of QE. Standard errors are clustered at the bank level and displayed in parentheses. Stars indicate significance at the 10%, 5%, and 1% levels, respectively..

Table 7: *Effect of QE1, QE2, and QE3 on risk rating: Loan-level results and Treasury exposure*

Dependent variable:	Loan-specific internal risk rating					
	All	Non-committed	All	Non-committed	All	Non-committed
$QE^{(1)} \times \left(\frac{TRE}{TotSec}\right)_b^{(1)}$	-0.072	0.224				
	(0.120)	(0.162)				
$QE^{(2)} \times \left(\frac{TRE}{TotSec}\right)_b^{(2)}$			0.141	0.097		
			(0.098)	(0.088)		
$QE^{(3)} \times \left(\frac{TRE}{TotSec}\right)_b^{(3)}$					-0.089	-0.196
					(0.117)	(0.230)
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Loan Controls	Yes	Yes	Yes	Yes	Yes	Yes
R_a^2	0.267	0.357	0.303	0.298	0.254	0.237
No Banks	284	267	274	255	259	242
No obs	203810	56198	261592	96976	276439	99131

This table presents loan-level coefficient estimates, relating a loan's internal risk rating to the loan-issuing bank's exposure to a respective round of QE, measured by the average ratio of Treausries over total securities in the four quarters prior to the respective event. The specification of column (3), (6), and (9) is given by:

$$y_{i,b,t} = \alpha + \beta \left(\frac{TRE}{TotSec}\right)_b^{(j)} QE_t^{(j)} + \theta X_{b,t} + \zeta Z_{i,b,t} + \gamma_b + \tau_t + \epsilon_{i,b,t}$$

where $j = 1, 2, 3$ and $t = -3, ..., 3$, where $t = 0$ is the starting date of a respective round of QE. Standard errors are clustered at the bank level and displayed in parentheses. Stars indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 8: *Correlations of standards and risk ratings with loan growth*

	SLOOS banks: correlation with bank-specific standards index		
	Total loan growth	C&I loan growth	N
2007:Q3-2014:Q4	-0.05**	-0.08***	1665
1991:Q1-2007:Q2	-0.07***	-0.08***	3601
1997:Q1-2007:Q2	-0.09***	-0.10***	2240
1991:Q1-2014:Q4	-0.07***	-0.09***	5383
1997:Q1-2014:Q4	-0.07***	-0.10***	4022

Quarterly loan growth for total loans and C&I loans is computed using the formula

$$\Delta \mathrm{L}_{b,t} = \frac{L_{b,t+1} - L_{b,t}}{0.5(L_{b,t+1} + L_{b,t})},$$

where L denotes loan size. Both growth measures are winsorized at the 1% level. Lax lending standards are correlated with higher lending volume, and tighter lending standards are correlated with lower lending volume. Stars indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 9: *Robustness: controlling for changes in the amount of loans held*

Dependent variable:	Bank-specific standards index								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$QE^{(1)} \times \left(\frac{MBS}{TotSec}\right)_b^{(1)}$	-0.257***	-0.219**	-0.216**						
	(0.087)	(0.086)	(0.085)						
$QE^{(2)} \times \left(\frac{MBS}{TotSec}\right)_b^{(2)}$				-0.027	-0.027	-0.036			
				(0.059)	(0.064)	(0.066)			
$QE^{(3)} \times \left(\frac{MBS}{TotSec}\right)_b^{(3)}$							-0.144*	-0.120*	-0.124*
							(0.073)	(0.062)	(0.064)
$\Delta Lending_{b,t}$	-0.733**	-0.271	-0.219	-0.061	0.125	0.099	-0.515*	-0.740**	-0.620*
	(0.313)	(0.281)	(0.286)	(0.204)	(0.217)	(0.222)	(0.260)	(0.347)	(0.365)
Demand $d_{b,t}$	-0.103*	-0.132***	-0.126**	-0.053	0.006	0.012	-0.120***	-0.110***	-0.115***
	(0.056)	(0.047)	(0.050)	(0.043)	(0.044)	(0.045)	(0.043)	(0.039)	(0.035)
Bank FE	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Time FE	No	No	Yes	No	No	Yes	No	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R_a^2	0.485	0.682	0.689	0.230	0.515	0.538	0.149	0.403	0.418
No. Banks	42	42	42	49	49	49	47	47	47
N	282	282	282	333	333	333	324	324	324

This table presents bank-level coefficient estimates, relating a bank's lending standards to a bank's exposure to a respective round of QE, measured by the average ratio of MBS over total securities in the four quarters prior to the respective event. The specification of column (3), (6), and (9) is given by:

$$y_{b,t} = \alpha + \beta \left(\frac{MBS}{TotSec}\right)_b^{(j)} QE_t^{(j)} + \delta d_{b,t} + \theta X_{b,t} + \gamma_b + \tau_t + \epsilon_{b,t},$$

where $j = 1, 2, 3$ and $t = -3, ..., 3$, where $t = 0$ is the starting date of a respective round of QE. Standard errors are clustered at the bank level and displayed in parentheses. Stars indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 10: *Robustness: Different denominator of the treatment variable*

Dependent variable:	Bank-specific standards index								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\mathrm{QE}^{(1)} \times \left(\frac{MBS}{TotAssets}\right)_b^{(1)}$	-1.000***	-0.667*	-0.671*						
	(0.295)	(0.354)	(0.357)						
$\mathrm{QE}^{(2)} \times \left(\frac{MBS}{TotAssets}\right)_b^{(2)}$				-0.130	-0.112	-0.202			
				(0.231)	(0.268)	(0.285)			
$\mathrm{QE}^{(3)} \times \left(\frac{MBS}{TotAssets}\right)_b^{(3)}$							-0.298*	-0.255*	-0.283*
							(0.170)	(0.141)	(0.146)
Demand $d_{b,t}$	-0.114**	-0.163***	-0.152***	-0.086	-0.061	-0.046	-0.112***	-0.096**	-0.107***
	(0.052)	(0.040)	(0.044)	(0.056)	(0.061)	(0.060)	(0.039)	(0.036)	(0.033)
Bank FE	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Time FE	No	No	Yes	No	No	Yes	No	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R_a^2	0.465	0.683	0.688	0.227	0.452	0.487	0.128	0.375	0.390
No. Banks	48	48	48	52	52	52	50	50	50
N	325	325	325	358	358	358	347	347	347

This table presents bank-level coefficient estimates, relating a bank's lending standards to a bank's exposure to a respective round of QE, measured by the average ratio of MBS over total assets in the four quarters prior to the respective event. The specification is given by:

$$y_{b,t} = \alpha + \beta \left(\frac{MBS}{TotAssets}\right)_b^{(j)} QE_t^{(j)} + \delta d_{b,t} + \theta X_{b,t} + \gamma_b + \tau_t + \epsilon_{b,t},$$

where $j = 1,2,3$ and $t = -3,...,3$, where $t = 0$ is the starting date of a respective round of QE. Standard errors are clustered at the bank level and displayed in parentheses. Stars indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 11: *Robustness: Varying the timing of QE1 and QE2*

Dependent variable:	Bank-specific standards index								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\text{QE1}_t^{early} \times \left(\frac{MBS}{TotSec}\right)_b^{(1)}$	-0.257*	-0.251	-0.218						
	(0.136)	(0.155)	(0.160)						
$\text{QE1}_t^{late} \times \left(\frac{MBS}{TotSec}\right)_b^{(1)}$				-0.225**	-0.152*	-0.149*			
				(0.102)	(0.085)	(0.082)			
$\text{QE2}_t^{early} \times \left(\frac{MBS}{TotSec}\right)_b^{(2)}$							-0.053	-0.023	-0.054
							(0.085)	(0.091)	(0.094)
Demand $d_{b,t}$	-0.083*	-0.149**	-0.140**	-0.122**	-0.107**	-0.086*	-0.072	-0.033	-0.015
	(0.045)	(0.057)	(0.054)	(0.048)	(0.051)	(0.049)	(0.055)	(0.061)	(0.064)
Bank FE	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Time FE	No	No	Yes	No	No	Yes	No	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R_a^2	0.328	0.558	0.623	0.499	0.695	0.723	0.247	0.533	0.556
No. Banks	37	37	37	40	40	40	44	44	44
N	256	256	256	273	273	273	304	304	304

This table presents bank-level coefficient estimates, relating bank b's lending standards to bank b's exposure to a respective round of QE, measured by the average ratio of MBS over total assets in the four quarters prior to the respective event. In column (1)-(3), QE1 is assumed to be in 2008Q4, in column (4)-(6), it is assumed to take place in 2009Q2. In column (7)-(9), QE2 is assumed to take place in 2010Q3. The specification is given by Equation (1) :

$$y_{b,t} = \alpha + \beta \left(\frac{MBS}{TotSec}\right)_b^{(j)} QE_t^{(j)} + \delta d_{b,t} + \theta X_{b,t} + \gamma_b + \tau_t + \epsilon_{b,t},$$

where $j = 1, 2, 3$ and $t = -3, ..., 3$, where $t = 0$ is the starting date of a respective round of QE. Standard errors are clustered at the bank level and displayed in parentheses. Stars indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 12: *Robustness: Varying the calculation of the treatment variable*

Dependent variable:	Bank-specific standards index								
	QE1	QE2	QE3	QE1	QE2	QE3	QE1	QE2	QE3
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\text{QE}_t^{(j)} \times \left(\frac{MBS}{TotSec}\right)_b^{(j),overall}$	-0.297***	0.040	-0.152**						
	(0.102)	(0.084)	(0.064)						
$\text{QE}_{j,t} \times \left(\frac{MBS}{TotSec}\right)_b^{(j),t-6,..,t-2}$				-0.302***	0.022	-0.167**			
				(0.102)	(0.087)	(0.066)			
$\text{QE}_{j,t} \times \left(\frac{MBS}{TotSec}\right)_b^{(j),2008Q1}$							-0.253***	-0.028	-0.150**
							(0.090)	(0.082)	(0.066)
Demand $d_{b,t}$									
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R_a^2	0.673	0.507	0.415	0.672	0.507	0.416	0.684	0.543	0.437
No. Banks	43	42	45	43	42	45	35	40	42
N	298	294	315	298	294	315	243	280	294

This table presents bank-level coefficient estimates, relating bank b's lending standards to bank b's exposure to a respective round of QE, measured in three different ways. In column (1)-(3) it is measured as the average MBS over securities ratio over the entire sample, i.e., from 2007Q4 to 2014Q4. In column (4)-(6), it is measured as the average fraction of MBS of all securities in the quarters $t-6,...,t-2$, where t is the event date. Finally, in column (7)-(9), it is measured as the MBS holding in the first quarter of 2008. The specification of column (3), (6), and (9) is given by:

$$y_{b,t} = \alpha + \beta \left(\frac{MBS}{TotSec}\right)_b^{(j)} QE_t^{(j)} + \delta d_{b,t} + \theta X_{b,t} + \gamma_b + \tau_t + \epsilon_{b,t},$$

where $j = 1,2,3$ and $t = -3,...,3$, where $t = 0$ is the starting date of a respective round of QE. Standard errors are clustered at the bank level and displayed in parentheses. Stars indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 13: *Bank-level evidence on the Tapering of QE3*

Dependent variable:	Bank-specific standards index		
	(1)	(2)	(3)
$\text{Tapering}_t \times \left(\frac{MBS}{TotSec}\right)_b^{(3)}$	0.116	0.155*	0.159*
	(0.092)	(0.079)	(0.079)
Demand $d_{b,t}$	-0.119***	-0.076*	-0.075*
	(0.040)	(0.040)	(0.041)
Bank FE	No	Yes	Yes
Time FE	No	No	Yes
Controls	Yes	Yes	Yes
R_a^2	0.126	0.349	0.352
No. Banks	48	48	48
N	332	332	332

This table presents bank-level coefficient estimates, relating bank b's lending standards to bank b's exposure to a respective round of QE. The specification of column (3) is given by:

$$y_{b,t} = \alpha + \beta \left(\frac{MBS}{TotSec}\right)_b^{(3)} Tapering_t + \delta d_{b,t} + \theta X_{b,t} + \gamma_b + \tau_t + \epsilon_{b,t},$$

where $t = -3, ..., 3$, where $t = 0$ is 2014Q1. Standard errors are clustered at the bank level and displayed in parentheses. Stars indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 14: *Loan-level evidence on the Tapering of QE3*

Dependent variable:	Loan-specific internal risk rating	
	All	Non-committed
$\text{Tapering}_t \times \left(\frac{MBS}{TotSec}\right)_b^{(3)}$	-0.001	-0.158**
	(0.048)	(0.073)
Constant	-2.680	-6.728
	(2.697)	(5.953)
Bank FE	Yes	Yes
Time FE	Yes	Yes
Bank Controls	Yes	Yes
Loan Controls	Yes	Yes
R_a^2	0.266	0.259
No Banks	244	232
No obs	286077	95856

This table presents loan-level coefficient estimates, relating a loans internal risk rating to the bank's exposure during the Tapering of QE3. The specification is as in Equation (4)

$$y_{i,b,t} = \alpha + \beta \left(\frac{MBS}{TotSec}\right)_b^{(3)} Tapering_t + \theta X_{b,t} + \zeta Z_{i,b,t} + \gamma_b + \tau_t + \epsilon_{i,b,t}$$

where $t = -3, ..., 3$, where $t = 0$ is 2014Q1. Standard errors are clustered at the bank level and displayed in parentheses. Stars indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 15: *Lending standards by categories during QE1*

Dependent variable:	C&I loans	CRE loans	RRE loans	HELOC	Cons loans
	(1)	(2)	(3)	(4)	(5)
QE1$_t \times \left(\frac{MBS}{TotSec}\right)_b^{(j)}$	-0.340*	-0.238*	-0.367*	-0.340**	0.041
	(0.189)	(0.123)	(0.207)	(0.157)	(0.195)
C&I demand$_{b,t}$	-0.140***				
	(0.039)				
Housing demand$_{b,t}$		-0.008	-0.016		
		(0.040)	(0.057)		
HELOC demand$_{b,t}$				-0.034	
				(0.044)	
Consumer credit demand$_{b,t}$					-0.151***
					(0.052)
Bank FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
R^2_a	0.567	0.544	0.503	0.475	0.480
No. Banks	39	37	37	38	38
N	264	253	253	259	256

This table presents bank-level coefficient estimates, relating bank b's category specific lending standards (bank lending standards for C&I loans, CRE loans, RRE loans, HELOCs, and consumer loans) to bank b's exposure during QE1, measured by the average ratio of MBS over total securities in the four quarters prior to the respective event. The specification is as in Equation (1):

$$y_{b,t} = \alpha + \beta \left(\frac{MBS}{TotSec}\right)_b^{(j)} QE_t^{(j)} + \theta X_{b,t} + \gamma_b + \tau_t + \epsilon_{b,t}$$

where $j = 1,2,3$ and $t = -3, ..., 3$, where $t = 0$ is the starting date of a respective round of QE. Standard errors are clustered at the bank level and displayed in parentheses. Stars indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 16: *Lending standards by categories during QE3*

Dependent variable:	C&I loans	CRE loans	RRE loans	HELOC	Cons loans
	(1)	(2)	(3)	(4)	(5)
$\text{QE3}_t \times \left(\frac{MBS}{TotSec}\right)_b^{(j)}$	-0.261**	-0.115	-0.340*	-0.183	-0.010
	(0.127)	(0.129)	(0.179)	(0.120)	(0.106)
C&I demand$_{b,t}$	-0.036				
	(0.036)				
Housing demand$_{b,t}$		-0.017	-0.100**		
		(0.046)	(0.044)		
HELOC demand$_{b,t}$				-0.062*	
				(0.032)	
Consumer credit demand$_{b,t}$					-0.047*
					(0.026)
Bank FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
R_a^2	0.450	0.375	0.318	0.261	0.273
No. Banks	43	43	43	43	42
N	300	293	293	299	292

This table presents bank-level coefficient estimates, relating bank b's category specific lending standards (bank lending standards for C&I loans, CRE loans, RRE loans, HELOCs, and consumer loans) to bank b's exposure during QE3, measured by the average ratio of MBS over total securities in the four quarters prior to the respective event. The specification is as in Equation (1):

$$y_{b,t} = \alpha + \beta \left(\frac{MBS}{TotSec}\right)_b^{(j)} QE_t^{(j)} + \theta X_{b,t} + \gamma_b + \tau_t + \epsilon_{b,t}$$

where $j = 1, 2, 3$ and $t = -3, ..., 3$, where $t = 0$ is the starting date of a respective round of QE. Standard errors are clustered at the bank level and displayed in parentheses. Stars indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 17: *Underlying reasons for changes in C&I lending standards during all three rounds of QE.*

Dependent variable	Risk appetite			Improved capital position			Improved liquidity position		
	QE1 (1)	QE2 (2)	QE3 (3)	QE1 (4)	QE2 (5)	QE3 (6)	QE1 (7)	QE2 (8)	QE3 (9)
$\text{QE}_t^{(j)} \times \left(\frac{MBS}{TotSec}\right)_t^{(j)}$	0.603**	-0.191	0.053	0.326*	0.172	-0.029	-0.111	-0.299	-0.055
	(0.258)	(0.336)	(0.253)	(0.192)	(0.182)	(0.106)	(0.273)	(0.345)	(0.099)
Demand $d_{b,t}$	0.057	-0.103	-0.030	0.091	0.118	-0.138	0.070	0.300**	-0.136
	(0.129)	(0.094)	(0.123)	(0.080)	(0.095)	(0.085)	(0.111)	(0.141)	(0.115)
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R_a^2	0.156	0.177	0.157	0.105	0.056	0.075	0.241	0.110	0.026
No. Banks	33	32	33	33	32	34	33	33	33
N	169	165	140	173	169	148	171	168	145

This table presents bank-level coefficient estimates, relating bank b's surveyed reasons for changing bank lending standards (changes in risk appetite, an improved capital position as well as an improved liquidity position) to bank b's exposure to a respective round of QE, measured by the average ratio of MBS over total securities in the four quarters prior to the respective event. The specification is as in Equation (1):

$$y_{b,t} = \alpha + \beta \left(\frac{MBS}{TotSec}\right)_b^{(j)} QE_t^{(j)} + \theta X_{b,t} + \gamma_b + \tau_t + \epsilon_{b,t}$$

where $j = 1, 2, 3$ and $t = -3, ..., 3$, where $t = 0$ is the starting date of a respective round of QE. Standard errors are clustered at the bank level and displayed in parentheses. Stars indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 18: *Three different balance-sheet measures during all three rounds of QE*

Dependent variable	$\frac{\text{MBS (AFS)}}{\text{Total Securities}}$			$\frac{\text{RGains+URGains}}{\text{Total Securities}}$			Liquidity Ratio		
	QE1 (1)	QE2 (2)	QE3 (3)	QE1 (4)	QE2 (5)	QE3 (6)	QE1 (7)	QE2 (8)	QE3 (9)
$\text{QE}_b^{(j)} \times \left(\frac{MBS}{TotSec}\right)_b^{(j)}$	-0.169***	-0.053	-0.086**	0.022*	-0.005	-0.010	0.003	-0.002	0.002
	(0.037)	(0.032)	(0.042)	(0.011)	(0.004)	(0.007)	(0.003)	(0.001)	(0.002)
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R_a^2	0.186	0.100	0.142	0.140	0.291	0.291	0.206	0.340	0.285
No. Banks	72	80	81	73	80	81	73	80	81
N	504	560	567	505	560	567	509	560	567

This table presents bank-level coefficient estimates, relating three different variables (bank b's holdings of MBS available for sale over securities, bank b's ratio of realized and unrealized gains to total securities, and bank b's liquidity ratio) to the bank's exposure to a respective round of QE, measured by the average ratio of MBS over total securities in the four quarters prior to the respective event. The specification is as in Equation (1):

$$y_{b,t} = \alpha + \beta \left(\frac{MBS}{TotSec}\right)_b^{(j)} QE_t^{(j)} + \theta X_{b,t} + \gamma_b + \tau_t + \epsilon_{b,t}$$

where $j = 1, 2, 3$ and $t = -3, ..., 3$, where $t = 0$ is the starting date of a respective round of QE. Standard errors are clustered at the bank level and displayed in parentheses. Stars indicate significance at the 10%, 5%, and 1% levels, respectively.