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

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This paper

Research Question:

- Did QE lead to lax lending standards and increased risk-taking by commercial banks?

Two main challenges

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   - Bank-level and loan-level survey data on standards and risk-taking
   - Exploit variation across banks' MBS holdings
   - QE1 and QE3 targeted MBS, while QE2 did not
   - Quasi-experimental setup

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2. **Desired vs. undesired risk**: hard to distinguish empirically

   - Cannot disentangle risk-taking from risk shifting
   - But: put risk-taking into historical context

Findings

1. QE1 and QE3 had a significant effect of bank lending standards and bank risk-taking for banks with more MBS on their books
   - Magnitude is comparable to effect of conventional monetary policy

   Robustness:
   - No effect on lending standards/risk-taking during QE2
   - No effect for banks with more Treasuries
   - Tapering of QE3 led to tightening of lending standards and decreased risk-taking

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2. Robustness:
   - No effect on lending standards/risk-taking during QE2
   - No effect for banks with more Treasuries
   - Tapering of QE3 led to tightening of lending standards and decreased risk-taking
3. Evidence is suggestive, *but by no means conclusive* that
   - QE1 was successful in supporting a distressed banking sector
   - QE3 led to an additional easing of standards, but did not induce a deterioration of loan quality

Literature

- Darmouni and Rodnyansky, 2017:
  - Banks with larger MBS holdings expand lending (quantity) more after QE1 and QE3
  - QE1 worked via a recapitalization channel, QE3 via a liquidity channel
- Several other papers on LSAPs:
  - US: Chakraborty, Goldstein, MacKinlay (2016), Di Maggio, Kermani, Palmer (2016), Kandrac and Schlusche (2017)
  - Europe: Acharya et al. (2016) et al., Carpinelli and Crosignani (2016), Crosignani et al. (2016)
- Papers on low interest environments:
  - Maggio and Kacperczyk (2017), Arammonte et al. (2015), Heider et al. (2016)
- Literature on effects of conventional monetary policy:
  - Dell'Ariccia, Laeven and Suarez (2016), Maddaloni and Peydro (2011), Jimenez and Ongena (2012), Jimenez et al (2014)

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The Federal Reserve's LSAPs

Details
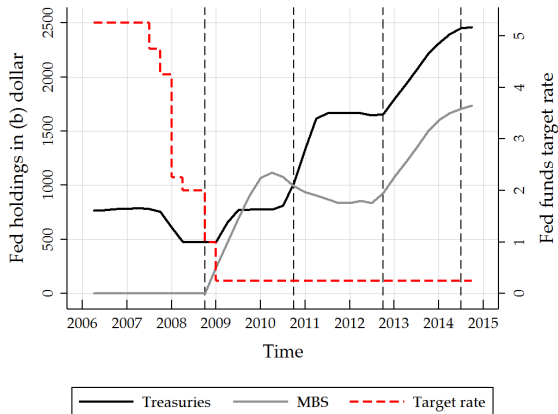
Data I: SLOOS

Federal Reserve's Senior Loan Officer Opinion Survey of Bank Lending (SLOOS)

- Queries banks about changes in lending standards and loan demand
- Five categories:
    - C&I loans, commercial real estate loans, residential real estate loans, home lines of equity, and consumer loans
- Use data from 2007 to 2014
- Survey is conducted four times per year and more than 60 commercial banks participate in each survey
- Surveyed represent a large fraction of the assets of the universe of commercial banks

Data I: SLOOS

Questions about changes in standards follow a general pattern of

Over the past three months, how have your bank's credit standards for approving loans of type k changed?

- Banks answer these questions by using a scale ranging from 1 to 5
- Following Bassett et al. (2014) we transform the original responses to create categorical variables $I_{bt}^S(k)$ defined as

$$I_{bt}^S(k) = \begin{cases} -1 & \text{if bank } b \text{ reported easing standards in category } k \text{ in } t \\ 0 & \text{if bank } b \text{ reported no change in standards in category } k \text{ in } t \\ 1 & \text{if bank } b \text{ reported tightening standards in category } k \text{ in } t \end{cases}$$
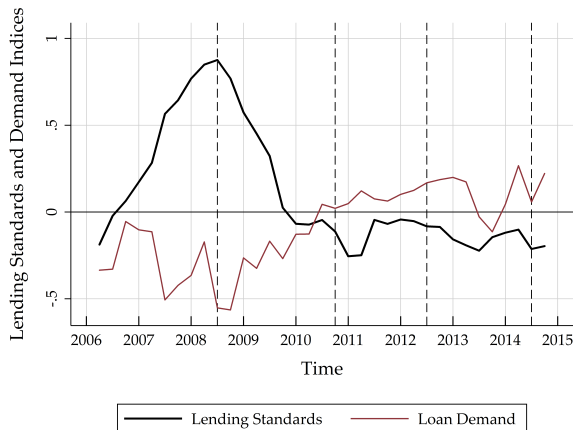
- Similar for perceived demand

Data I: SLOOS

Figure: Composite index of Bassett et al., which results from aggregating the category standards $I_{bt}^S(k)$ weighted by the overall fraction of the bank's activity in category k at time t.

Data II: STBL

Federal Reserve's Survey of Terms of Business Lending (STBL)

- Quarterly survey of a sample of about 400 banks
- Use data from 2007-2014
- Survey represents around 60% of all assets of U.S. commercial banks
- C&I loans issued during the first business week of the middle month of every quarter
- Contains important variables on risk characteristics of newly issued loans
  - face amount, loan rate, loan issuance date, secured or not, the maturity, and internal risk ratings
  - Risk rating can vary from 1 to 5, where 1 = minimal risk, and 5 = special mention or classified assets
- Remark: data contain credit lines, which we drop

Data III: Call Reports

Banks' balance sheet information from call reports

- Match SLOOS and STBL with bank balance sheet information
- Several standard control variables
- Remark 1: Banks in the SLOOS sample are rather large
- Remark 2: Banks in the STBL sample are representative of the overall universe of commercial bank

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Empirical strategy I

Identification challenge: need setting with differential effect of QE

- We exploit that there is cross-sectional variation in MBS holdings, measured as

$$\left(\frac{MBS}{TotSec} \right)_b$$

- ... for otherwise very similar banks

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- $\Rightarrow$ QE2 acts as a natural placebo

- Difference-in-difference methodology

- Applied by Darmouni and Rodyansky (2017)

  - supported by the fact that there is evidence that QE operated through a "narrow channel" (Krishnamurthy and Vissing-Jorgensen (2013))

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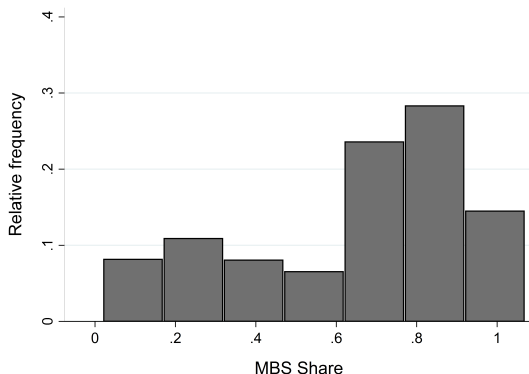
MBS holdings

Figure: Distribution the average ratio of MBS holdings over total securities, $\left(\frac{MBS}{TotSec}\right)_b^{(j)}$, over the entire sample.

MBS share persistent

Table: Dependent variable: MBS Share of bank b in period 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

Descriptives

Table: Descriptive Statistics for high and low MBS banks in the SLOOS sample

	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

This table shows the descriptive statistics for banks in the SLOOS sample which are split in to groups, "high MBS" (ratio of MBS over securities) and "low MBS", based on the median.

Easing and tightening of standards during QE1
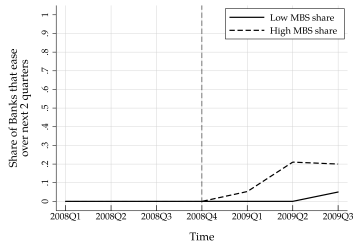
(a) QE1, Easing
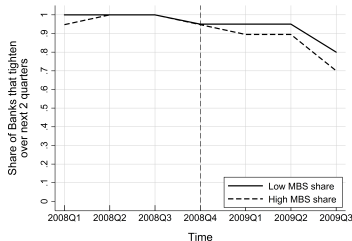
(b) QE1, Tightening

Figure: Dividing banks into those with high and low MBS-securities ratio (based on the Median), average share of banks that ease/tighten their standards in t and $t + 1$.

Easing and tightening of standards during QE2

(a) QE2, Easing

(b) QE2, Tightening

Figure: Dividing banks into those with high and low TRE-securities ratio (based on the Median), average share of banks that ease/tighten their standards in t and $t + 1$.

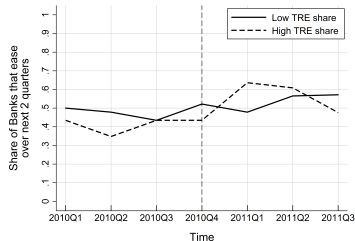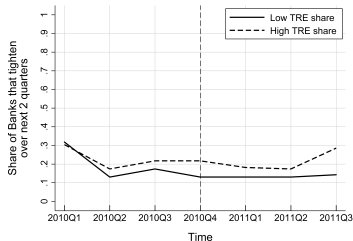# Easing and tightening of standards during QE3
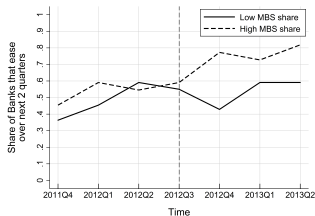
(a) QE3, Easing
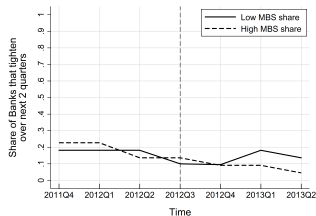
(b) QE3, Tightening

Figure: Dividing banks into those with high and low MBS-securities ratio (based on the Median), average share of banks that ease/tighten their standards in t and $t+1$.

Empirical strategy (ctd.)

Bank-level specification:

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

- $y_{b,t}$, bank lending standards
- $\left(\frac{MBS}{TotSec} \right)_b^{(j)}$, bank b's MBS portfolio share in the four quarter prior $QE^{(j)}$

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- $d_{b,t}$, perceived demand

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- $j = 1, 2, 3$
- $d_{b,t}$, perceived demand
- $X_{b,t}$, bank controls
- Event window of $+/-3$ quarters around each round of QE

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Results SLOOS, QE1

Table: Dependent variable: Lending standards

	QE1		
	(1)	(2)	(3)
$QE_{1,t}$ X $\left(\frac{MBS}{TotSec}\right)_{1,b}$	-0.280***	-0.213**	-0.227***
	(0.080)	(0.091)	(0.082)
Demand d_{it}	-0.053	-0.115**	-0.100*
	(0.042)	(0.049)	(0.050)
Constant	1.364**	-2.563	-1.467
	(0.668)	(3.554)	(3.658)
Bank FE	No	Yes	Yes
Time FE	No	No	Yes
Controls	Yes	Yes	Yes
R_a^2	0.487	0.578	0.586
No. Banks	36	36	36
N	250	250	250

Clustered standard errors in parentheses. Stars indicate significance at the 10%, 5% and 1% levels, respectively.

Results SLOOS, QE1
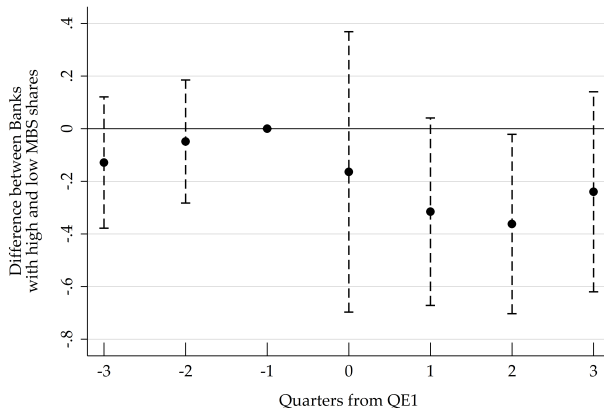
Dashed bars denote 90% confidence interval.

Figure: Coefficient plots for QE1, where we normalize β_{-1} to zero to assess pre-trends.

Results SLOOS, QE2

Table: Dependent variable: Lending standards

	QE2		
	(1)	(2)	(3)
$QE_{2,t} \times \left(\frac{MBS}{TotSec} \right)_{2,b}$	-0.009	-0.062	-0.089
	(0.059)	(0.070)	(0.070)
Demand d_{it}	-0.037	0.007	0.011
	(0.050)	(0.050)	(0.051)
Constant	0.892	2.558	2.583
	(0.609)	(2.234)	(2.561)
Bank FE	No	Yes	Yes
Time FE	No	No	Yes
Controls	Yes	Yes	Yes
R_a^2	0.182	0.045	0.101
No. Banks	44	44	44
N	304	304	304

Clustered standard errors in parentheses. Stars indicate significance at the 10%, 5% and 1% levels, respectively.

Results SLOOS, QE2

Dashed bars denote 90% confidence interval.

Figure: Coefficient plots for QE2, where we normalize β_{-1} to zero to assess pre-trends.

Results SLOOS, QE3

Table: Dependent variable: Lending standards

	QE3		
	(1)	(2)	(3)
$QE_{3,t} \times \left(\frac{MBS}{TotSec} \right)_{3,b}$	-0.186**	-0.144**	-0.171**
	(0.073)	(0.069)	(0.067)
Demand d_{it}	-0.099**	-0.093***	-0.108***
	(0.041)	(0.034)	(0.033)
Constant	-0.237	14.657***	11.740***
	(0.463)	(3.404)	(2.983)
Bank FE	No	Yes	Yes
Time FE	No	No	Yes
Controls	Yes	Yes	Yes
R_a^2	0.118	0.102	0.111
No. Banks	43	43	43
N	300	300	300

Clustered standard errors in parentheses. Stars indicate significance at the 10%, 5% and 1% levels, respectively.

Results SLOOS, QE3

Dashed bars denote 90% confidence interval.

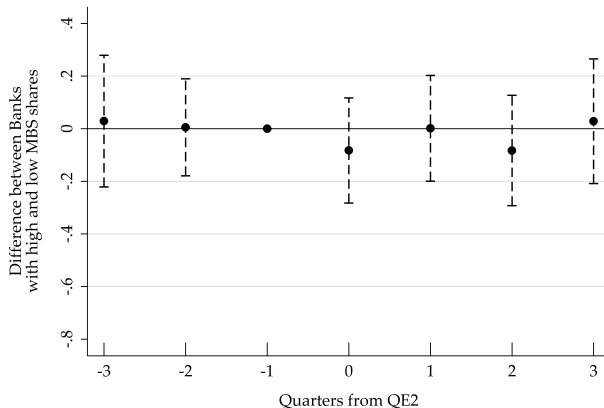Figure: Coefficient plots for QE3, where we normalize β_{-1} to zero to assess pre-trends.
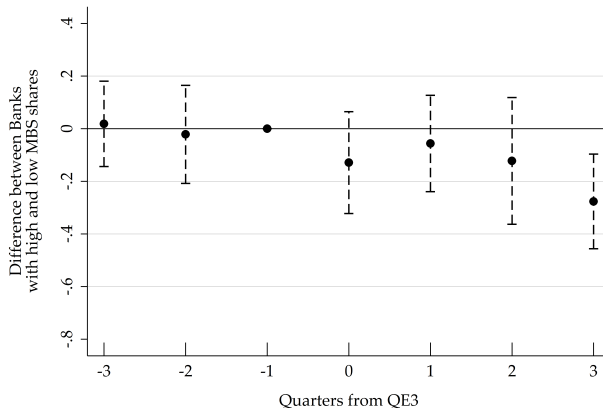
Results SLOOS, Treasuries

Run same specification with treasury holdings

Table: Dependent variable: Lending standards

	QE1	QE2	QE3
	(1)	(2)	(3)
$QE_{j,t} \times \left(\frac{TRE}{TotSec} \right)_{j,b}$	-0.052	0.284	0.111
	(0.118)	(0.169)	(0.276)
Demand d_{it}	-0.135***	0.013	-0.097***
	(0.049)	(0.049)	(0.030)
Constant	1.179	2.495	10.372**
	(3.285)	(2.910)	(4.399)
Bank FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Controls	Yes	Yes	Yes
R_a^2	0.572	0.093	0.100
No. Banks	43	46	45
N	298	316	314

Clustered standard errors in parentheses. Stars indicate signif-

STBL Results

- Loan-level data to confirm results
- Merit I: Loan risk rating potentially less soft than survey lending standards
- Merit II: Data contains broader set of banks
- Drawback: More diverse set of banks that differ on more dimensions
$\Rightarrow$ Control for these dimensions in regressions

Table: Descriptive Statistics for high and low MBS banks in the STBL sample

	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 shows the descriptive statistics for banks in the STBL sample which are split in to groups, "high MBS" (ratio of MBS over securities) and "low MBS", based on the median.

Empirical strategy, STBL

Loan-level specification:

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

- $y_{i,b,t}$, internal risk rating
- $Z_{i,b,t}$, loan-level controls
- everything else is as before

Results STBL

Table: Dependent variable: loan risk rating, STBL

	QE 1	QE 2	QE 3
$QE_{j,t} \times \left(\frac{MBS}{TotSec} \right)_{j,b}$	0.187**	0.001	0.164*
	(0.094)	(0.025)	(0.087)
Constant	7.744**	4.025	3.063
	(3.220)	(6.114)	(5.608)
Bank FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes
Loan Controls	Yes	Yes	Yes
R_a^2	0.419	0.313	0.250
No Banks	240	248	239
No obs	42256	93226	94116

Clustered standard errors in parentheses. Stars indicate significance at the 10%, 5% and 1% levels, respectively.

Results STBL, Treasuries

Table: Dependent variable: loan risk rating, STBL

	QE 1	QE 2	QE 3
$QE_{j,t} \times \left(\frac{TRE}{TotSec} \right)_{j,b}$	0.208	0.087	-0.189
	(0.175)	(0.084)	(0.205)
Constant	4.648**	1.720	-1.397
	(2.095)	(5.166)	(6.668)
Bank FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes
Loan Controls	Yes	Yes	Yes
R_a^2	0.358	0.298	0.238
No Banks	267	255	242
No obs	56198	96976	99131

Clustered standard errors in parentheses. Stars indicate significance at the 10%, 5% and 1% levels, respectively.

Economic significance

Effects have about the same economic magnitude for QE1 and QE3

- Increase MBS ratio by one standard deviation

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  equivalent to moving a bank from the 25th percentile to the 75th
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Economic significance

Effects have about the same economic magnitude for QE1 and QE3

- Increase MBS ratio by one standard deviation

  .. equivalent to moving a bank from the 25th percentile to the 75th percentile of the MBS distribution

  - SLOOS: lending index is 0.07 units lower after QE1 and QE3
    20% of the index' standard deviation in QE1 and 30% in QE3

    - STBL: risk rating of newly issued loans is .05 units higher
      Roughly 8% of the standard deviation for both QE1 and QE3

Economic significance

Effects have about the same economic magnitude for QE1 and QE3

- Increase MBS ratio by one standard deviation

  .. equivalent to moving a bank from the 25th percentile to the 75th percentile of the MBS distribution

  - SLOOS: lending index is 0.07 units lower after QE1 and QE3
    20% of the index' standard deviation in QE1 and 30% in QE3
  - STBL: risk rating of newly issued loans is .05 units higher
    Roughly 6% of the standard deviation for both, QE1 and QE3

The latter is comparable to estimates of conventional monetary policy on risk taking by Dell Arricia et al.

One standard deviation decrease in interest rates increase loan risk ratings by .057 units

Economic significance

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Effect of unconventional monetary policy in same ballpark as effect of conventional monetary policy in normal times

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$\Rightarrow$ Effect of unconventional monetary policy in same ballpark as effect of conventional monetary policy in normal times

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Tapering

- Tapering should have effect in opposite direction if same channel at play

Results SLOOS, Tapering

Table: Dependent variable: Lending standards

	Tapering		
	(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

Clustered standard errors in parentheses. Stars indicate significance at the 10%, 5% and 1% levels, respectively.

Results STBL, Tapering

	Tapering	
	All	Non-committed
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^2_a	0.266	0.259
No Banks	244	232
No obs	286077	95856

Clustered standard errors in parentheses. Stars indicate significance at the 10%, 5% and 1% levels, respectively.

Robustness

We conduct a large number of robustness checks:

- Different exposure measures:
  - MBS holdings over total securities in 2008Q1
  - Average MBS holdings over total securities over entire sample period
  - Average MBS holdings over securities from $t - 6$ to $t - 3$ if QE in t
- Different event dates
  - QE1: weaker effects if QE1 in 2008Q4 or 2009Q3
  - No effect for QE2 in 2010Q3
- Lending categories
  - Change in lending standards operates mostly through C&I loans as well as residential real estate loans
    - RRE loans more important in QE1
    - C&I loans more important in QE3

Last slide

Contribution

- Estimate effect of QE1 and QE3 on bank lending standards and bank risk taking
- Magnitude is comparable to interest rate change in normal times
- QE2 as well as Treasury purchases did not affect bank lending standards
- Does not seem likely that QE induced excessive risk taking by banks

Caveats

- Treasury purchases may as well work through other channels
- QE may have induced excessive risk taking by other institutions through other channels
- We cannot speak to the overall effectiveness of QE and whether other measures may have been more effective/efficient

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The Federal Reserve's LSAPs

- **QE1:** $1.25 trillion in MBS, $ 175 billion in Federal Agency debt, and $300 billion in U.S. Treasuries
    - Announced on November 25, 2008, December 1, 2008 as well as March 18, 2009
    - Target rate lowered to its effective lower bound on December 16, 2008
    - The purchases ended on March 31, 2010
- **QE2:** Purchase of $600 billion in long-term U.S. Treasuries between November 3, 2010 through June 30, 2011.
    - Announcement on August 10 as well as Jackson Hole Symposium on August 29, 2010
    - FOMC statement September 21, 2010

The Federal Reserve's LSAPs II

- "Operation Twist": sale of short-term U.S. Treasuries and the purchase of long-term Treasuries
- **QE3:** Purchase of $40 billion in agency MBS per month, another $45 billion in U.S. Treasuries
  - Announced on September 13, 2012; flow-based, open ended and largely unanticipated
  - **Tapering:** purchase amounts reduced to $35 billion in agency MBS and $40 billion in U.S. Treasuries in December, 2013
  - The program formally ended October 29, 2014.

Balance sheet of the Fed from about $800 billion prior to the financial crisis to over $4 trillion by Fall 2014.