Quantitative Easing and Bank Lending: Evidence from Japan

David Bowman

Fang Cai

Sally Davies

Steven Kamin

Federal Reserve Board

October 6, 2014

Background of Quantitative Easing Policy (QEP)

- Prolonged stagnation following burst of asset price bubble in early 1990s

  - declining consumer prices

  - weak banking system

- In March 2001, BOJ began implementing its QEP:

  - operating target changed from overnight call rate to financial institutions' current account balances at the BOJ;

  - commitment to maintain liquidity provision until the CPI (excluding perishables) registered stably at zero percent or an increase year on year;

  - increase in outright purchases of long-term JGBs.
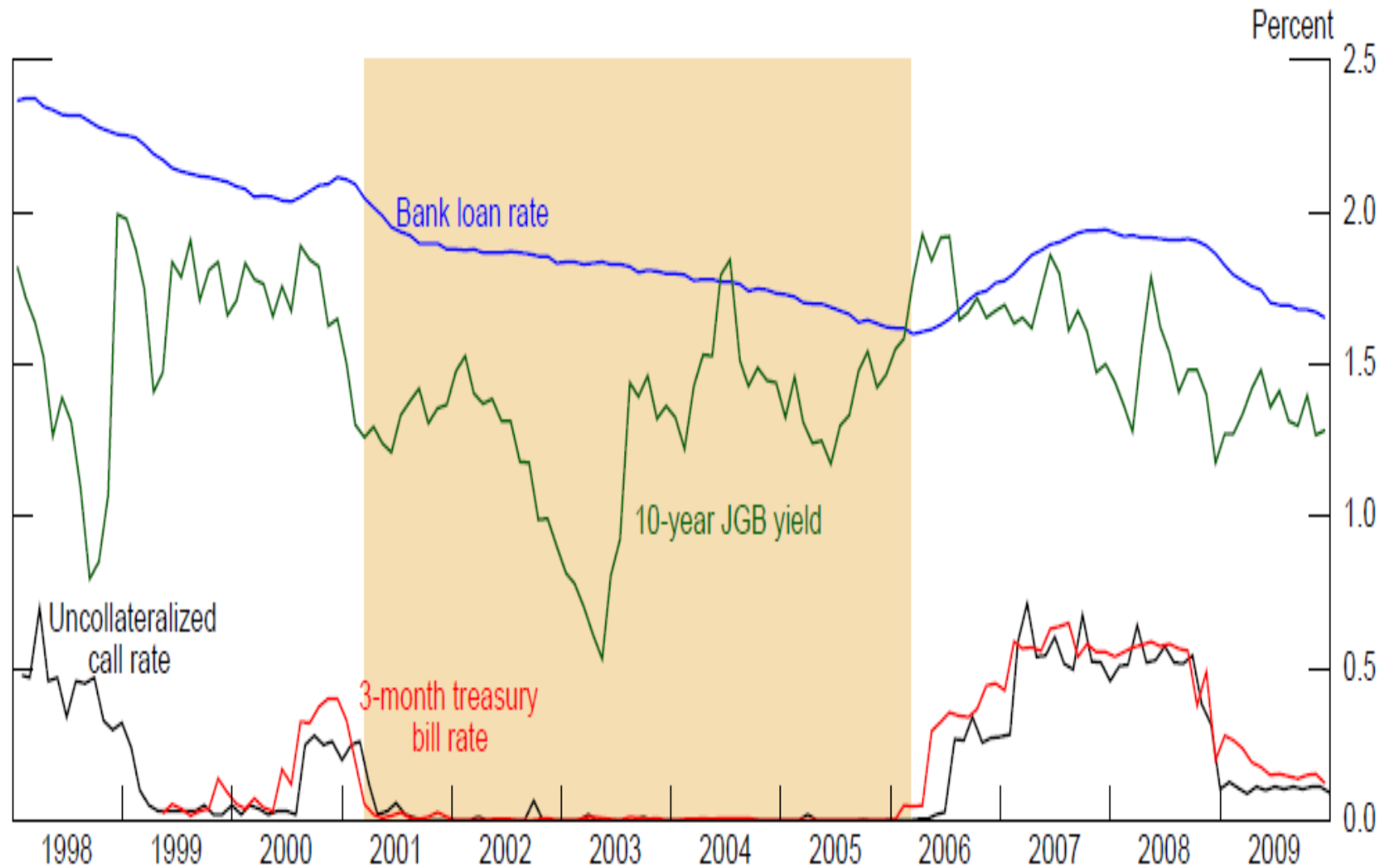
Current Account Balance and Required Reserves

Trillion yen

Percent of 2003 GDP

QEP

Target range

Current account balances*

Required reserves
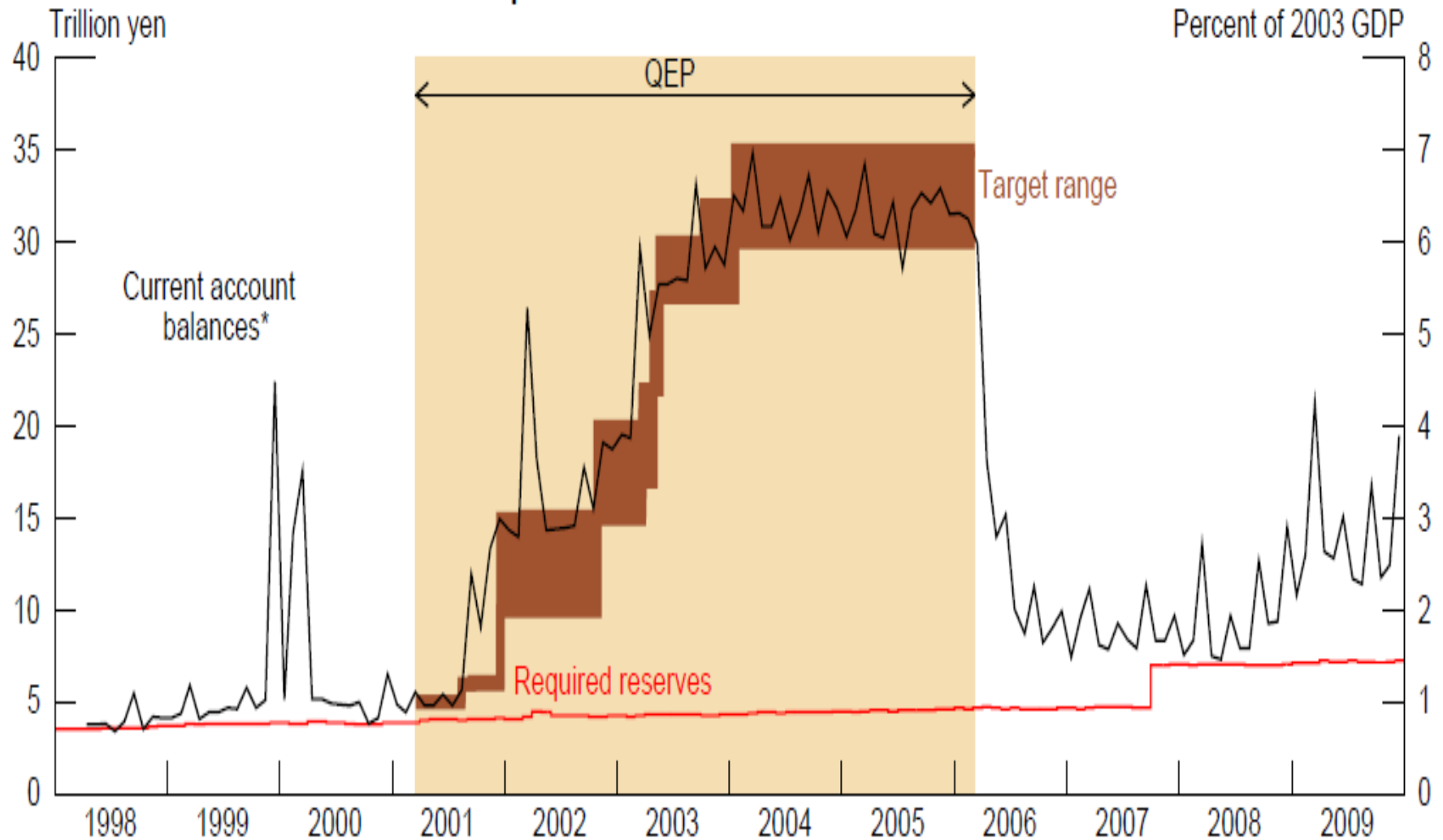
Source: Bank of Japan via Haver Analytics.

*Includes banks and securities firms.

Interest Rates

Percent

2.5

Bank loan rate

2.0

10-year JGB yield

1.5

1.0

Uncollateralized
call rate

0.5

3-month treasury
bill rate

0.0

1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
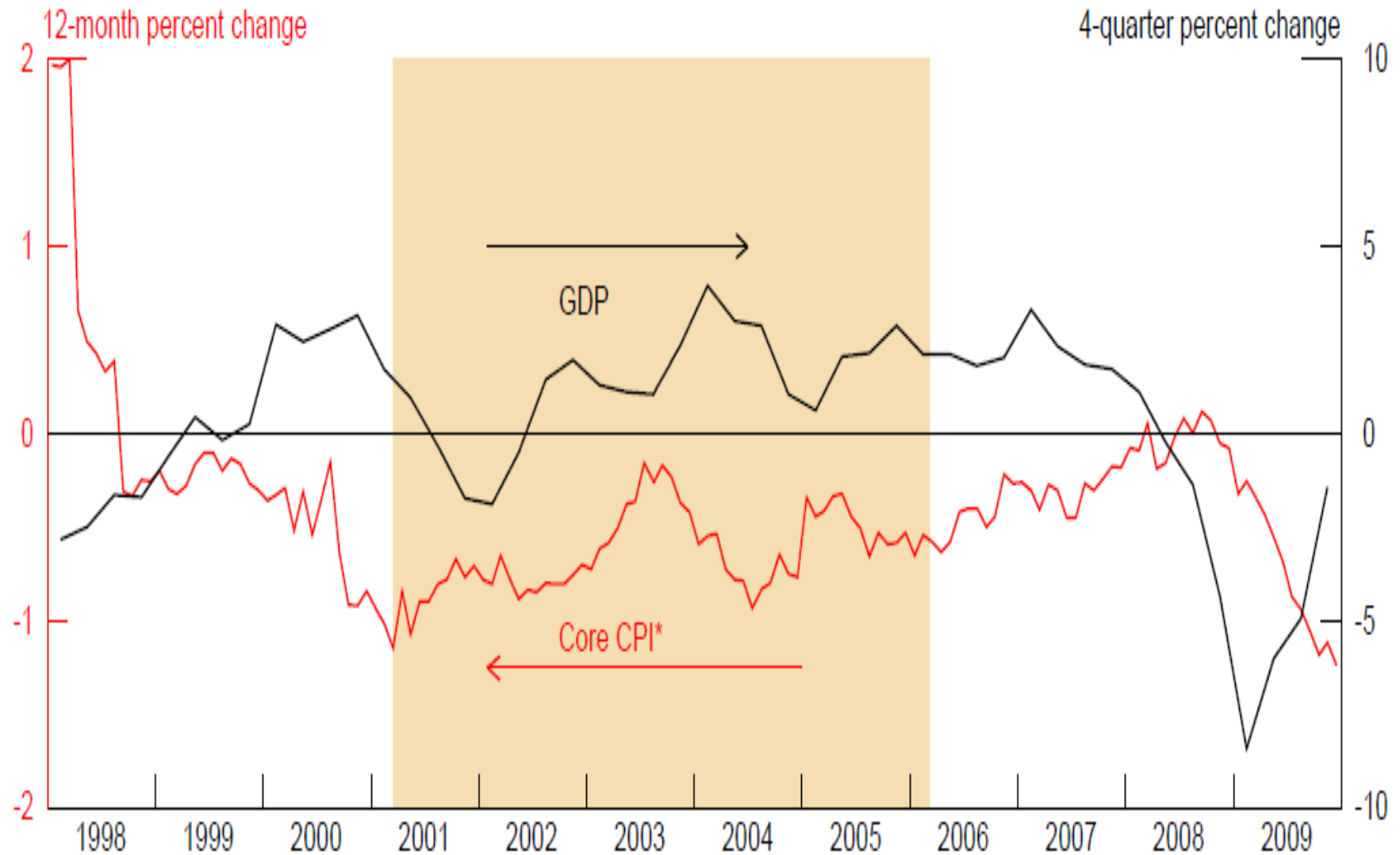
Sources: Association of Call & Discount Companies (Nihon Keizai Shinbun), Bank of Japan via Haver Analytics, and Bloomberg.

Was QEP Effective?

- General consensus: QEP didn't help the Japanese economy all that much, and especially didn't help lending

- That consensus was based on the broad macro trends:

  - macro conditions worsened in the first two years of QEP period before improving afterwards

  - core CPI declined for the entire QEP period

  - aggregate bank loans outstanding declined until 2005 although pace of decline moderated since 2002

  - banking sector weighed by NPLs

Macroeconomic Conditions

12-month percent change

4-quarter percent change

GDP

Core CPI*

Source: Haver Analytics.

*Excluding all food and energy.

Loans

4-quarter percent change (left axis)

Trillion yen (right axis)

Amount outstanding

Growth
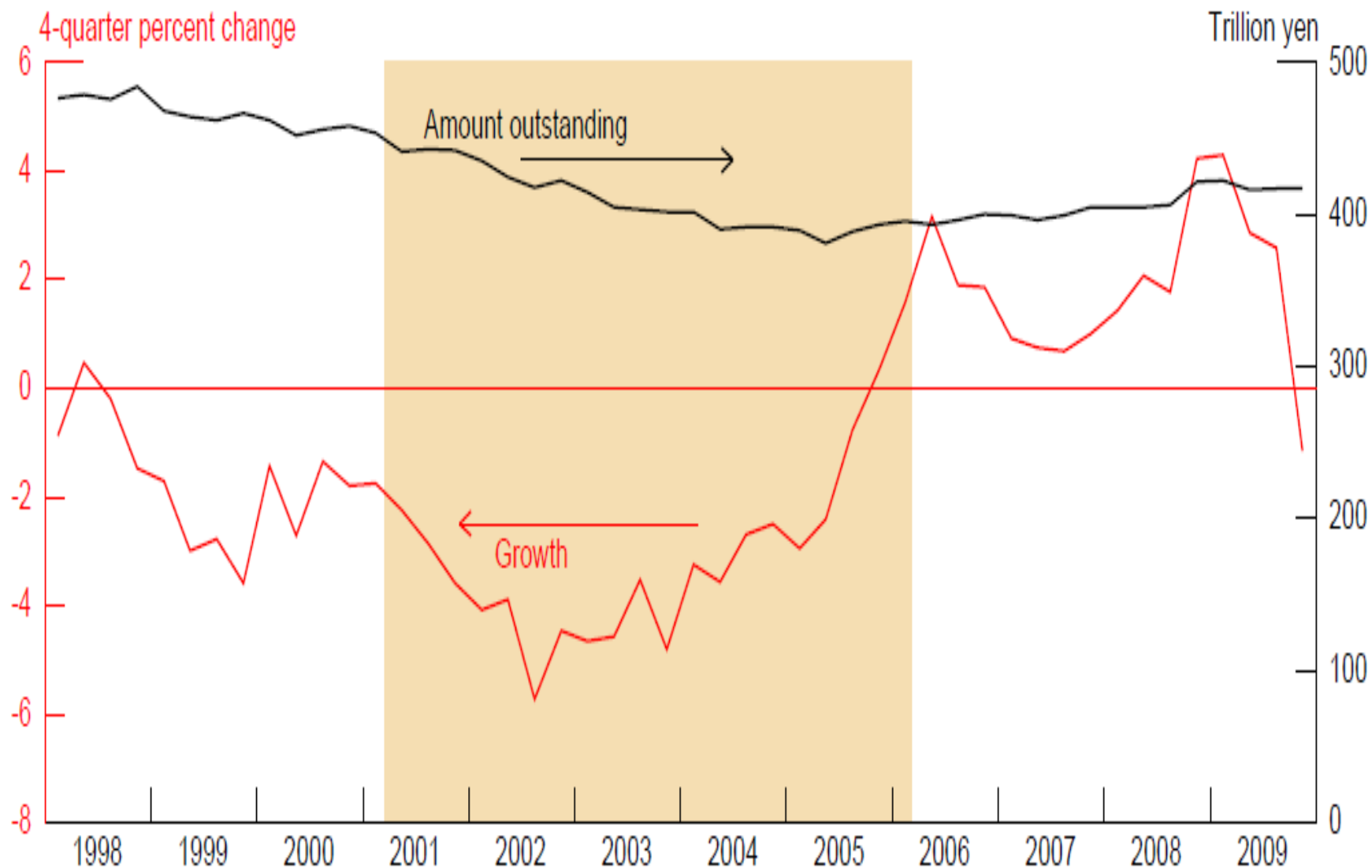
Source: Bank of Japan via Haver Analytics.

Banking Sector Weakness

Percent

NPLs/Loans

Equity/Assets

1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
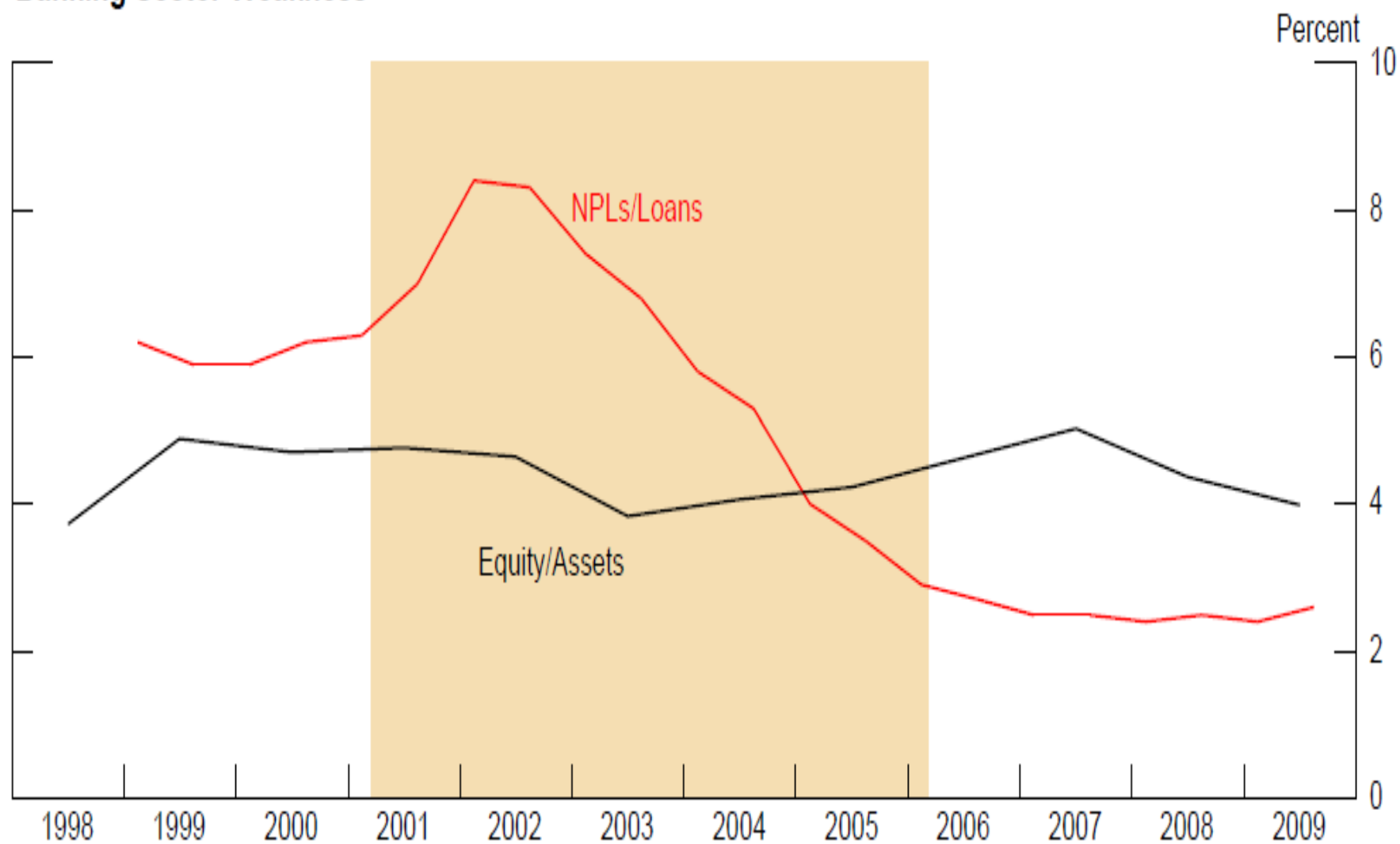
Limitations of Using Aggregate Data

- Difficult to separate decline in loan demand and decline in loan supply

- Can't observe counterfactual outcome : what if the current account balances had not gone up?

What We Do

- Look at individual bank data

  - Kashyap and Stein (2000)

  - Hosono (2006)

  - Kobayashi, Spiegel, and Yamori (2006)

- Assess the relationship between liquidity and bank lending during QEP at micro level

Main Questions

- What effect did BOJ's liquidity injection have on bank lending during QEP?

- Did the effect vary across banks depending on bank characteristics?

- What was the effect of the rapid unwinding of current account balances after QEP was discontinued?

Possible Transmission Channels of QEP

- Clear commitment to maintain QEP until deflation is ended could have influenced policy expectations

- Outright purchase of JGBs could have helped lower long-term rates

- Liquidity effect: increase in bank liquidity could have stimulated loan supply

  - Bernanke and Blinder (1992)

Data

- Bank-level data: semi-annual balance sheet data for about 120 banks from Japanese Bankers' Association
- Sample period: March 2000 – March 2009
- Liquid assets: cash + deposits at the BOJ and at other banks + call loans to other banks
- Bank type:
  - city banks
  - regional banks
  - Tier II regional banks
  - Long-term credit banks, trust banks and other

Table A1. Total loans and bank assets in Japan by bank type
(Amounts outstanding in trillions of yen as of March 2001)

Bank Type	Total number	Loans and bills discounted	Total assets
City banks	8	207.84	378.70
Regional Banks	64	136.00	205.83
Tier II Regional Banks	56	45.96	62.90
Long-term credit banks, trust banks and other	10	65.30	126.57

Current Account Balances and Liquid Assets

Trillion yen

Liquid assets of
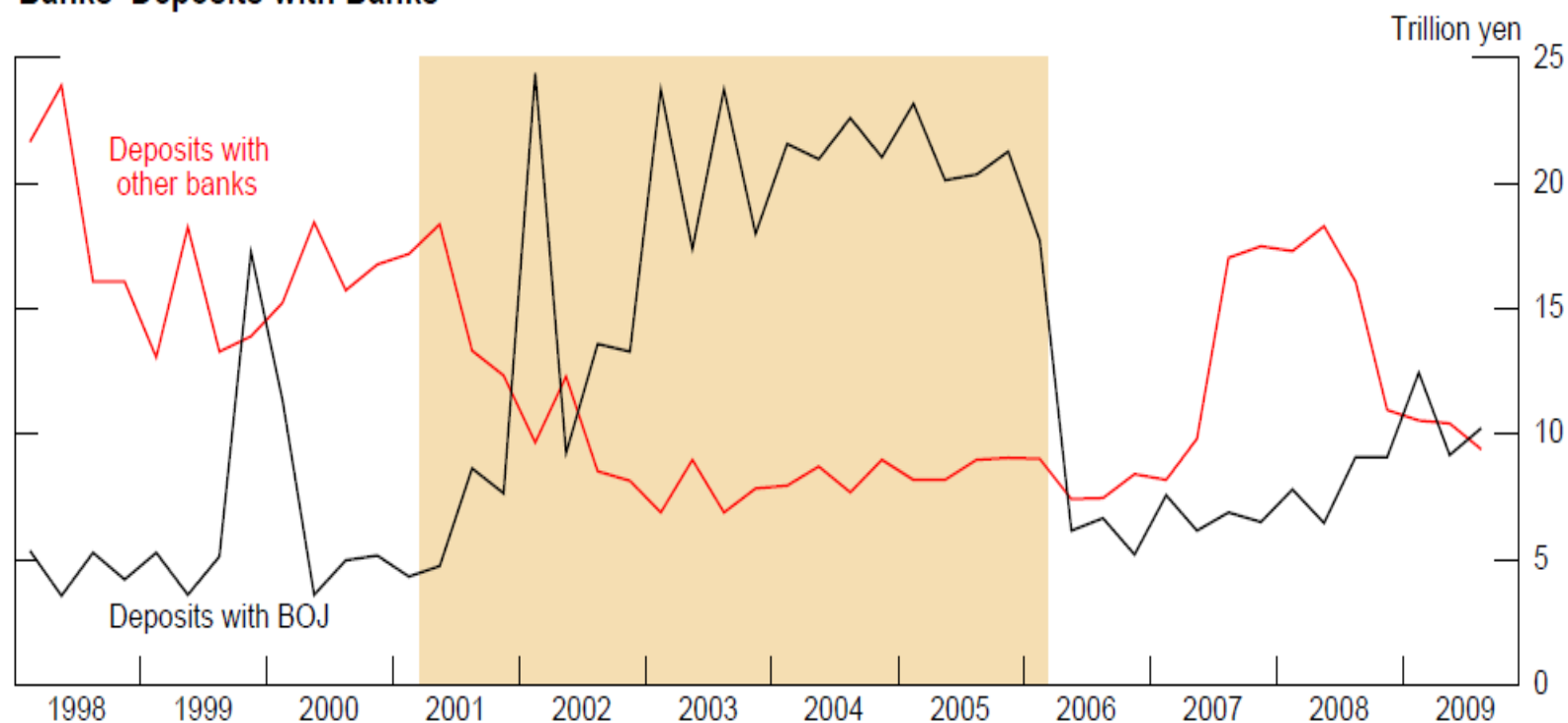domestic banks*

Current account balances
of domestic banks
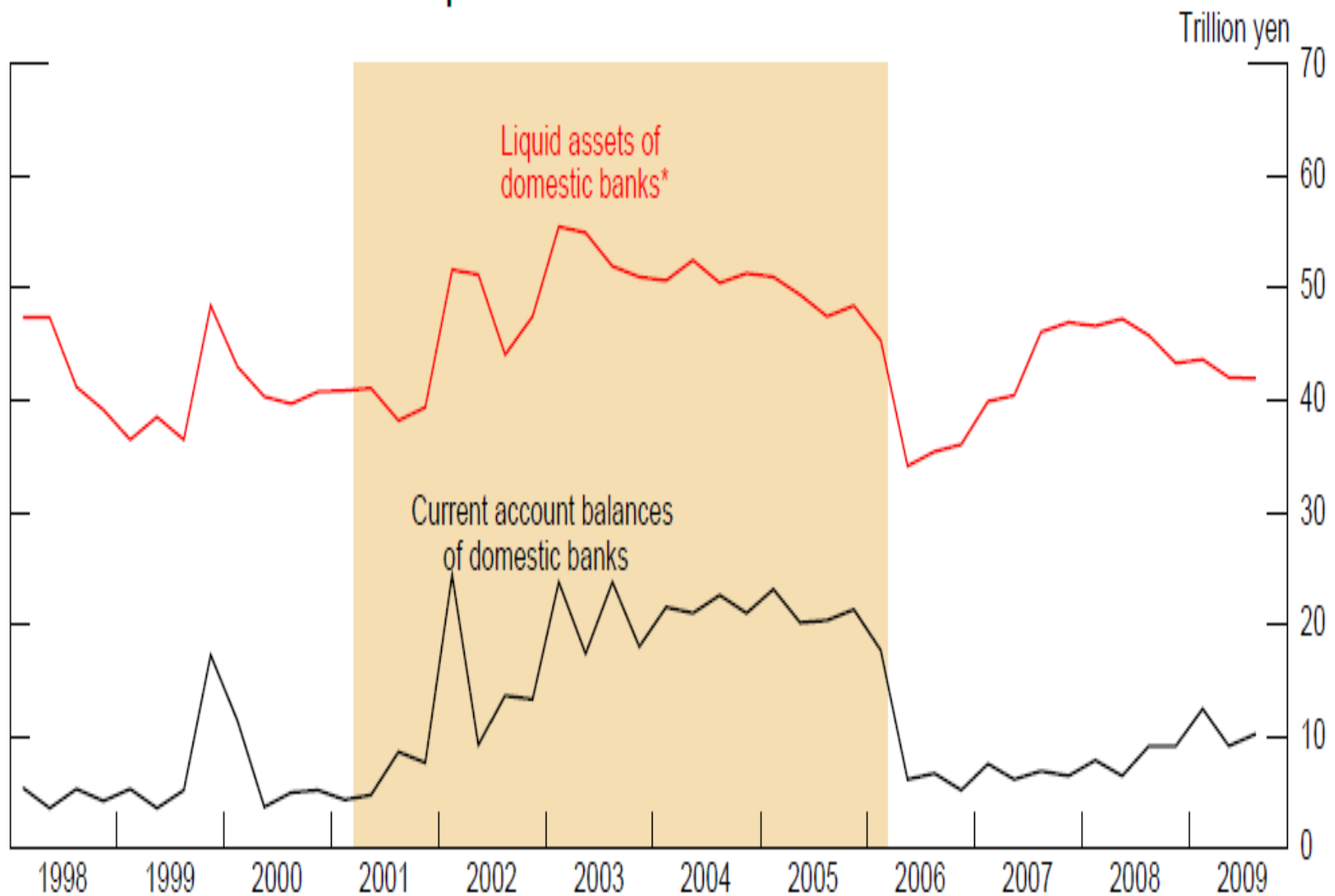
Source: Bank of Japan.

*Cash, due from banks, and call loans.

Substitution in Bank Liquid Assets

Banks' Deposits with Banks*

Trillion yen

Deposits with other banks

Deposits with BOJ

Source: Haver Analytics.
*Domestic banks' deposits with domestic banks, including the BoJ.

Baseline Regression

- Dependent variable -- log loan growth $\Delta\log(Loan_{i,t})$
- Independent variables -- lagged values of
  - liquidity ratio: $LR_{i,t-1}$
  - bank size: $\log(TA_{i,t-1})$
  - equity ratio: $ER_{i,t-1}$
  - bad loan ratio: $BLR_{i,t-1}$
  - log deposit growth: $\Delta\log(Deposit_{i,t-1})$, $\Delta\log(Deposit_{i,t-2})$
  - log loan growth: $\Delta\log(Loan_{i,t-1})$, $\Delta\log(Loan_{i,t-2})$
  - QEP and non-QEP dummies
  - Semi-annual time dummies
  - bank type dummies

--- City Banks
--- Regional Banks
--- Regional Banks II
--- Trust Banks and Other
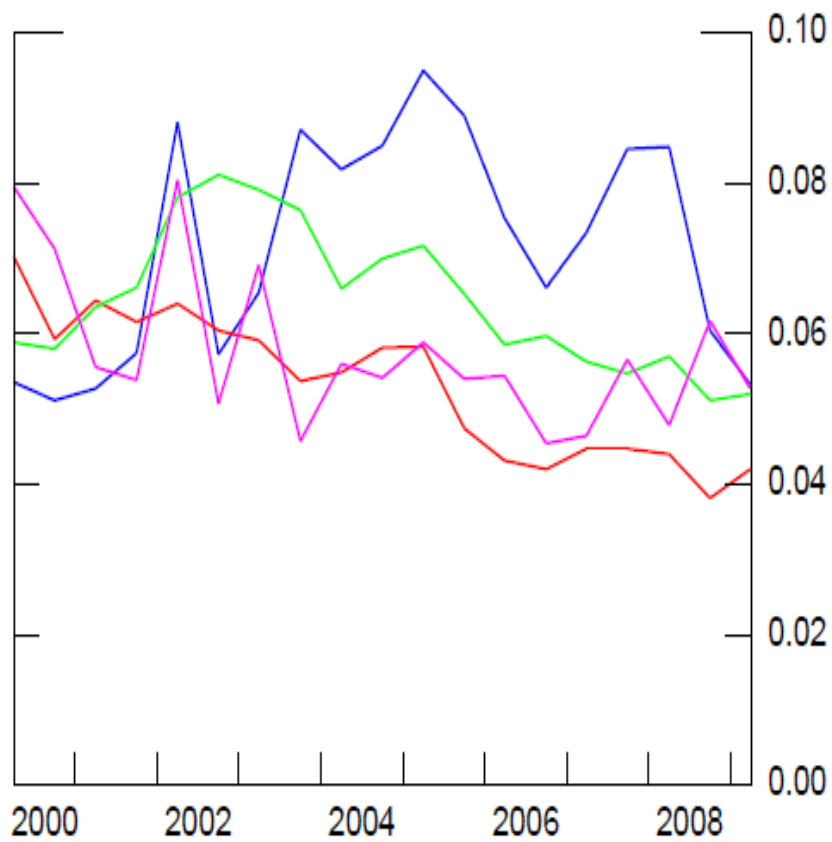
Median Total Assets
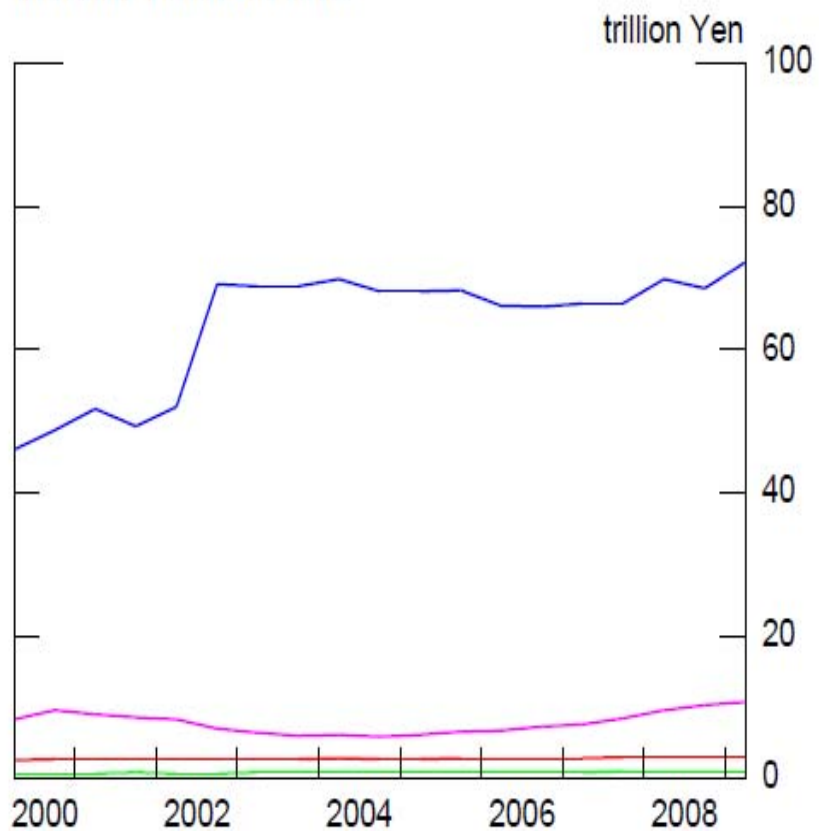
Median Equity Ratios
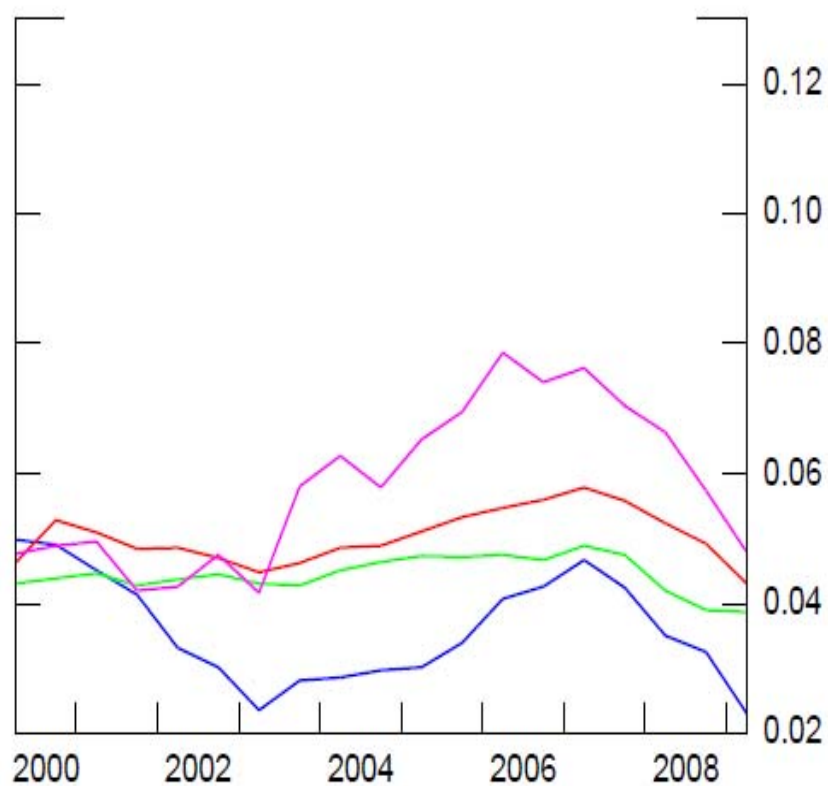
--- City Banks
--- Regional Banks
--- Regional Banks II
--- Trust Banks and Other

Median Liquidity Ratios

Median Bad Loan Ratios
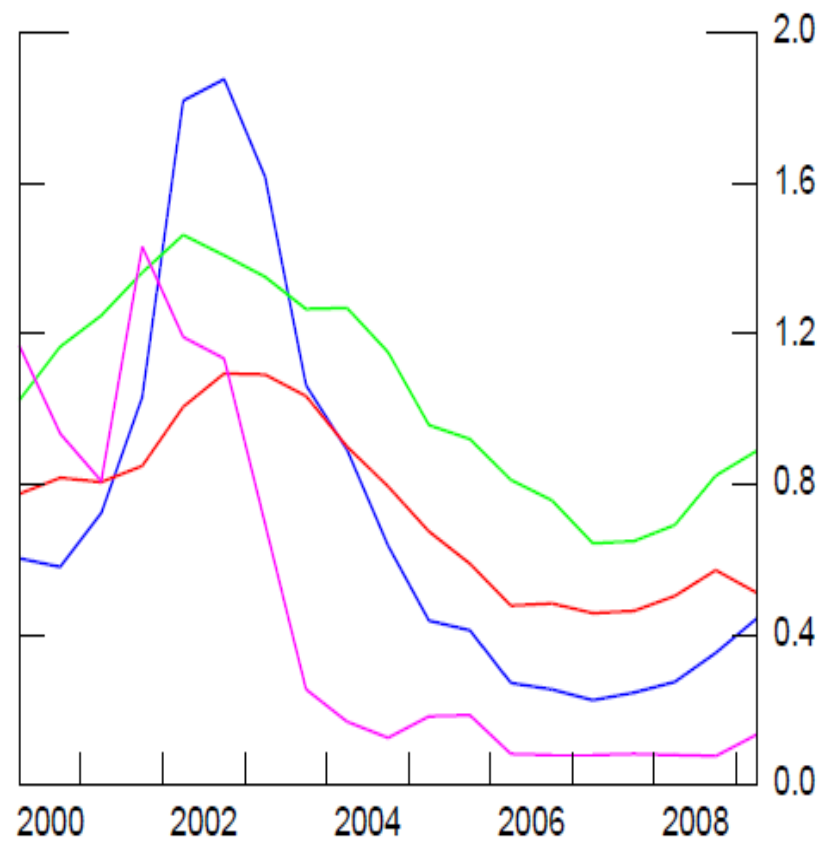
--- City Banks
--- Regional Banks
--- Regional Banks II
--- Trust Banks and Other

Median Loan Growth
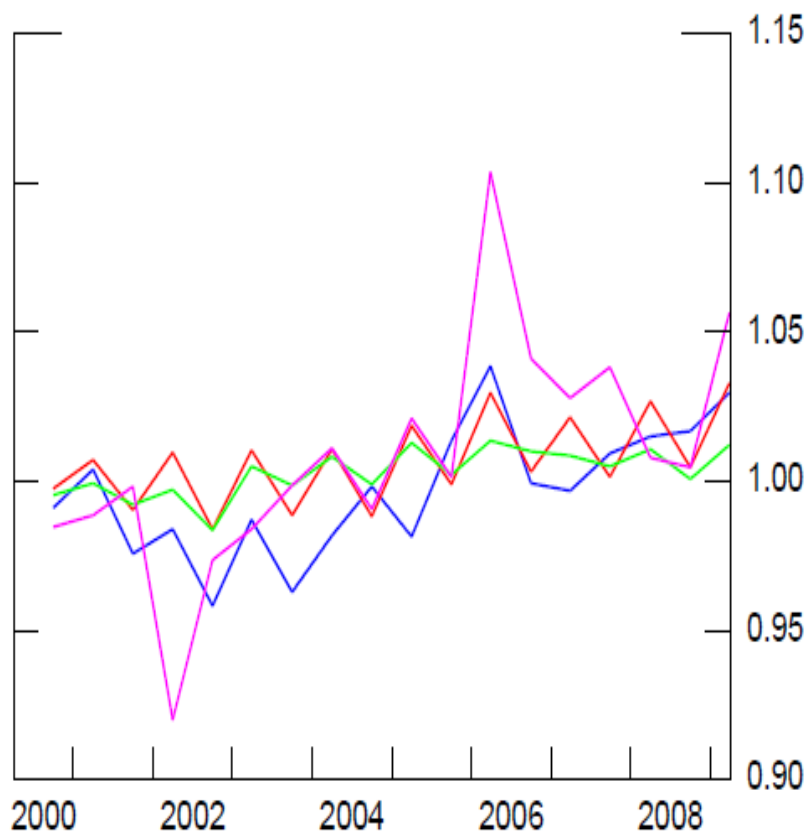
Median Deposit Growth
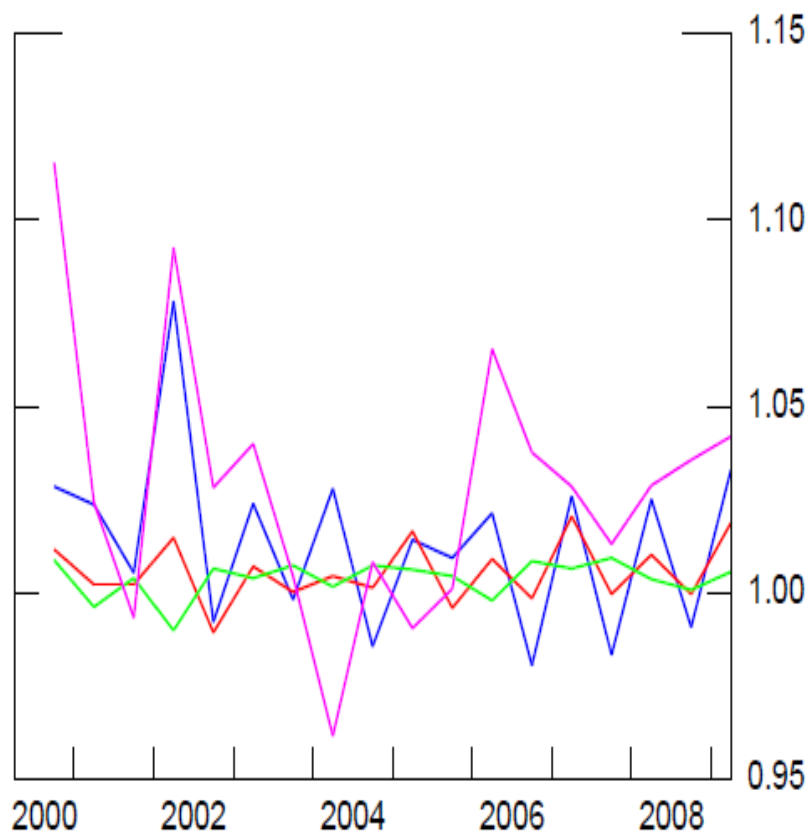
Table 1. Loan growth and liquidity during QEP

	OLS
$LR_{i,t-1}$	0.11***
$\log(TA_{i,t-1})$	-0.00*
$ER_{i,t-1}$	-0.06
$BLR_{i,t-1}$	-0.01***
$\Delta\log(Deposit_{i,t-1})$	0.15***
$\Delta\log(Deposit_{i,t-2})$	0.04*
$\Delta\log(Loan_{i,t-1})$	-0.02
$\Delta\log(Loan_{i,t-2})$	0.02
Observations	1199
R-square	0.24

Table 2. Loan growth and liquidity over time

The results are from a variation of panel regression (1) for the full period. A bank's log loan growth ($\Delta\log(Loan_{i,t})$) is regressed on its lagged liquidity ratio($LR_{i,t-1}$), lagged values of bank size ($\log(TA_{i,t-1})$), equity ratio ($ER_{i,t-1}$), bad loan ratio ($BLR_{i,t-1}$), two lags of banks' loan growth and deposit growth ($\Delta\log(Deposit_{i,t-1})$, $\Delta\log(Deposit_{i,t-2})$), as well as interaction terms between $LR_{i,t-1}$ and either dummies for the QEP and non-QEP periods ($D_{\_QEP}$ and $D_{\_NONQEP}$) or semi-annual time dummies (mar02, sep02, etc.) during the QEP period. We also include bank type dummies (not shown). See Appendix 2 for variable definitions. ***, **, * denote significance at 1, 5, and 10 percent significance levels respectively.

	w/ QEP Interaction Terms	w/ Semi-Annual Interaction Terms
$D_{\_QEP}*LR_{i,t-1}$	0.13***	---
$D_{\_NONQEP}*LR_{i,t-1}$	-0.03	---
$LR_{i,t-1}$	---	-0.02
mar02*$LR_{i,t-1}$	---	0.17*
sep02*$LR_{i,t-1}$	---	0.23**
mar03*$LR_{i,t-1}$	---	0.19*
sep03*$LR_{i,t-1}$	---	0.42***
mar04*$LR_{i,t-1}$	---	0.19**
sep04*$LR_{i,t-1}$	---	0.21***
mar05*$LR_{i,t-1}$	---	0.01
sep05*$LR_{i,t-1}$	---	0.04
mar06*$LR_{i,t-1}$	---	-0.08
$\log(TA_{i,t-1})$	0.00	0.00
$ER_{i,t-1}$	0.03	0.03
$BLR_{i,t-1}$	-0.01***	-0.01***
$\Delta\log(Deposit_{i,t-1})$	0.16***	0.15***
$\Delta\log(Deposit_{i,t-2})$	0.02	0.01
$\Delta\log(Loan_{i,t-1})$	0.01	0.01
$\Delta\log(Loan_{i,t-2})$	0.05***	0.06***
Observations	1950	1950
R-square	0.24	0.25

Cross-Sectional Differences

- Baseline regression with interaction terms

  - Liquidity ratio interacted with size, equity ratio and bad loan ratio

- Baseline regression with sample split into terciles

  - By size
  - By equity ratio
  - By bad loan ratio

- Baseline regression with interaction terms with CAB policy variable

  - Percentage change in CAB interacted with size, equity ratio, liquidity ratio, and bad loan ratio

Table 3. Loan Growth and liquidity with interaction terms

The results are from the panel regression (2) for the QEP period (March 2001 to March 2006). A bank's log loan growth ($\Delta\log(Loan_{i,t})$) is regressed on its lagged liquidity ratio($LR_{i,t-1}$), lagged values of bank size ($\log(TA_{i,t-1})$), equity ratio ($ER_{i,t-1}$), bad loan ratio ($BLR_{i,t-1}$), two lags of banks' loan growth and deposit growth ($\Delta\log(Deposit_{i,t-1})$, $\Delta\log(Deposit_{i,t-2})$), as well as the interaction terms between bank characteristics ($\log(TA_{i,t-1})$, $ER_{i,t-1}$, and $BLR_{i,t-1}$) and $LR_{i,t-1}$. We also include semiannual time dummies and bank type dummies (not shown). See Appendix 2 for variable definitions. ***, **, * denote significance at 1, 5, and 10 percent significance levels respectively.

$LR_{i,t-1}$	0.93**
$LR_{i,t-1}*\log(TA_{i,t-1})$	-0.04
$LR_{i,t-1}*ER_{i,t-1}$	-6.79***
$LR_{i,t-1}*BLR_{i,t-1}$	-0.01
$\log(TA_{i,t-1})$	0.00
$ER_{i,t-1}$	0.33**
$BLR_{i,t-1}$	-0.01**
$\Delta\log(Deposit_{i,t-1})$	0.17***
$\Delta\log(Deposit_{i,t-2})$	0.03
$\Delta\log(Loan_{i,t-1})$	-0.04
$\Delta\log(Loan_{i,t-2})$	0.03
Observations	1199
R-square	0.25

Table 4. Baseline regression with sample split for the QEP period

The panel regression (1) for the QEP period (March 2001 to March 2006) is modified with the sample split into terciles based on bank size, equity ratio and bad loan ratio, respectively. A bank's log loan growth ($\Delta\log(Loan_{i,t})$) is regressed on its lagged liquidity ratio($LR_{i,t-1}$), controlling for lagged values of other bank characteristics as well as two lags of banks' loan growth and deposit growth ($\Delta\log(Deposit_{i,t-1})$, $\Delta\log(Deposit_{i,t-2})$). We also include semiannual time dummies (not shown), to control for macroeconomic developments that might affect loan demand across time as well as bank type dummies (coefficients not shown). See Appendix 2 for variable definitions. ***, **, * denote significance at 1, 5, and 10 percent significance levels respectively.

	Top Third Assets	Bottom Third Assets	Top Third Equity Ratio	Bottom Third Equity Ratio	Top Third Bad Loan Ratio	Bottom Third Bad Loan Ratio
$LR_{i,t-1}$	0.14**	0.13**	0.09	0.13**	0.11*	0.06
$\log(TA_{i,t-1})$			0.00	0.00	0.00	0.00
$ER_{i,t-1}$	-0.23**	0.16			-0.06	0.39***
$BLR_{i,t-1}$	-0.01***	-0.00***	-0.02***	-0.00***		
$\Delta\log(Deposit_{i,t-1})$	0.10**	0.25***	0.12***	0.16***	0.08**	-0.02
$\Delta\log(Deposit_{i,t-2})$	0.06	0.16***	0.14***	-0.02	0.00	0.09
$\Delta\log(Loan_{i,t-1})$	0.01	-0.14***	0.03	-0.05	0.07	-0.02
$\Delta\log(Loan_{i,t-2})$	-0.01	-0.03	0.19***	0.07	0.04	0.00
Observations	397	411	385	423	494	354
R-square	0.28	0.37	0.43	0.18	0.20	0.34

Table 5. Loan Growth and liquidity with interaction terms with CAB policy variable

The results are obtained by adding a CAB target variable to the regression (2) for the QEP period (March 2001 to March 2006). A bank's log loan growth ($\Delta\log(Loan_{i,t})$) is regressed on its lagged liquidity ratio($LR_{i,t-1}$), lagged values of bank size ($\log(TA_{i,t-1})$), equity ratio ($ER_{i,t-1}$), bad loan ratio ($BLR_{i,t-1}$), two lags of banks' loan growth and deposit growth ($\Delta\log(Deposit_{i,t-1})$, $\Delta\log(Deposit_{i,t-2})$), as well as the interaction terms between bank characteristics ($LR_{i,t-1}$, $\log(TA_{i,t-1})$, $ER_{i,t-1}$, and $BLR_{i,t-1}$) and a policy variable, defined as either the percentage change of the CAB target ($CABCHG_{t-1}$) or the level of the CAB target (CAB_{t-1}). We also include semiannual time dummies and bank type dummies (not shown). See Appendix 2 for variable definitions. ***, **, * denote significance at 1, 5, and 10 percent significance levels respectively.

	w/ percentage change in CAB target as policy variable
$LR_{i,t-1}$	0.07*
$LR_{i,t-1}*CABCHG_{t-1}$	0.09
$\log(TA_{i,t-1})*CABCHG_{t-1}$	-0.00**
$ER_{i,t-1}*CABCHG_{t-1}$	0.01
$BLR_{i,t-1}*CABCHG_{t-1}$	0.01***
$\log(TA_{i,t-1})$	0.00
$ER_{i,t-1}$	-0.07
$BLR_{i,t-1}$	-0.01***
$\Delta log(Deposit_{i,t-1})$	0.14***
$\Delta log(Deposit_{i,t-2})$	0.10***
$\Delta log(Loan_{i,t-1})$	-0.03
$\Delta log(Loan_{i,t-2})$	0.12***
Observations	1078
R-squared	0.26

Robustness Check

- Endogeneity: System GMM

- Individual bank fixed effects

- Alternative variable definitions
    - bad loans less loan-loss reserves
    - adjusted loan growth to control for write-offs

Table 1. Loan growth and liquidity (QEP period)

The results are from the panel regression (1) for the QEP period (March 2001 to March 2006). A bank's log loan growth ($\Delta Loan_{i,t}$) is regressed on its lagged liquidity ratio($LR_{i,t-1}$), controlling for lagged values of bank size ($\log(TA_{i,t-1})$), equity ratio ($ER_{i,t-1}$), bad loan ratio ($BLR_{i,t-1}$) as well as two lags of banks' loan growth and deposit growth ($\Delta\log(Deposit_{i,t-1})$, $\Delta\log(Deposit_{i,t-2})$). We also include semiannual time dummies and bank type dummies (not shown). See Appendix 2 for variable definitions. System GMM is estimated following Arellano and Bover (1995) and Blundell and Bond (1998). Lags 1 and 2 of loan growth variable and liquidity ratio are used as instruments. Hansen test is the *p*-value of the *J*-statistic for over-identifying restrictions (distributed chi-square). Statistical significance of estimates is calculated using Windmeijer (2005) corrected standard errors. ***, **, * denote significance at 1, 5, and 10 percent significance levels respectively.

	OLS	GMM
$LR_{i,t-1}$	0.11***	0.33***
$\log(TA_{i,t-1})$	-0.00*	-0.01
$ER_{i,t-1}$	-0.06	0.13
$BLR_{i,t-1}$	-0.01***	-0.01
$\Delta\log(Deposit_{i,t-1})$	0.15***	0.28**
$\Delta\log(Deposit_{i,t-2})$	0.04*	0.04
$\Delta\log(Loan_{i,t-1})$	-0.02	-0.08
$\Delta\log(Loan_{i,t-2})$	0.02	0.04
Observations	1199	1199
R-square	0.24	---
Hansen test	---	0.19
2nd-order serial correl.	---	0.30

Table 6. Baseline Regression with Individual Bank Dummies

The results are from a variation of panel regression (1) for the QEP period (March 2001 to March 2006). A bank's log loan growth ($\Delta\log(Loan_{i,t})$) is regressed on its lagged liquidity ratio($LR_{i,t-1}$), controlling for lagged values of bank size ($\log(TA_{i,t-1})$), equity ratio ($ER_{i,t-1}$), bad loan ratio ($BLR_{i,t-1}$) as well as two lags of banks' loan growth and deposit growth ($\Delta\log(Deposit_{i,t-1})$, $\Delta\log(Deposit_{i,t-2})$). We also include individual bank dummies and semiannual time dummies (not shown). See Appendix 2 for variable definitions. ***, **, * denote significance at 1, 5, and 10 percent significance levels respectively.

$LR_{i,t-1}$	0.21***
$\log(TA_{i,t-1})$	0.00
$ER_{i,t-1}$	-0.08***
$BLR_{i,t-1}$	0.16
$\Delta\log(Deposit_{i,t-1})$	0.00
$\Delta\log(Deposit_{i,t-2})$	0.15***
$\Delta\log(Loan_{i,t-1})$	0.08***
$\Delta\log(Loan_{i,t-2})$	-0.13***
Observations	1199
R-square	0.40

Conclusion

- A significant positive effect of liquidity on bank lending during QEP

- However, the overall effect likely to be quite small

- Effect of central bank liquidity injection was muted by substitution of central bank liquidity for interbank liquidity

- Some evidence of weak banks benefiting more from QEP

- Rapid unwinding of liquidity infusions had little impact once bank health was restored