Reversal of the BoJ's Balance Sheet Policy and Liquidity Dependence

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Abstract

This study empirically examines liquidity dependence in the Japanese banking system. Acharya and Rajan (2024) and Acharya et al. (2024) pointed out the phenomenon of liquidity dependence, which was observed during the U.S. quantitative easing and tightening policies and is regarded as a possible factor in the Silicon Valley Bank (SVB) bankruptcy in 2023. Since quantitative easing was introduced in March 2001, the Japanese economy has experienced a more than 20-year period of quantitative easing, longer than that encountered in the United States. Our macro and micro analysis employs more than 20 years of macroeconomic and bank-level accounting data and reveals that the same liquidity dependence phenomenon is observed in the Japanese economy. The Japanese economy deposit insurance system is superior to that in the United States, so an incident like the SVB bankruptcy is unlikely to occur in Japan. However, we suggest that the Japanese economy needs to prepare for the impending major quantitative tightening—the so-called exit from the long-term quantitative easing policy.

JEL: G01, G2, E5

Keywords: Bank of Japan, quantitative easing, quantitative tightening, deposits, financial stability, financial fragility, monetary policy

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1. Introduction

Developed market central banks that conduct quantitative easing have positioned the reduction in their balance sheets as merely adjustments with no policy intent. Therefore, they also state that the tightening effect of quantitative tightening (QT) is far weaker than the easing effect of QE. However, the history of central banks embarking on balance sheet reductions with such intentions shows that when they reduce their expanding balance sheets, the markets unwind portfolio rebalancing, causing bond prices to change. While this in itself is natural, several disruptive events occurred in the U.S. market and financial system as liquidity dried up. For example, after the Federal Reserve Board (Fed) started its QT in 2017, a repo rate spike occurred in September 2019. After the Fed restarted QT in 2022, Silicon-Valley Bank (SVB) and Signature Bank experienced massive outflows of non-insured deposits, reflecting their huge losses in security investments; both went bankrupt in March 2023.[3] Acharya et al. (2024) empirically showed that when the Fed expanded its balance sheet via quantitative easing, U.S. banks financed their reserve holdings with demand deposits and issued credit lines to corporations. Since these bank-issued claims on liquidity did not shrink even when the Fed halted its balance-sheet expansion and began reducing its balance sheet, banks became highly vulnerable to liquidity turbulence. In the case of SVB, when the bank announced in March 2023 that it had incurred significant losses on its bond investments due to the sharp rise in interest rates and its recapitalization program, start-ups with deposits in the bank withdrew their deposits rapidly and at a large scale, driving it into bankruptcy in just a few days. The concentration of large deposits in demandable deposits backfired.

Acharya and Rajan (2024) and Acharya et al. (2024) called the phenomenon in which QE leaves the banking system with demandable claims that are not simply reversed by QT, "liquidity dependence" because it necessitates even greater central bank balance sheet support in the future.[4] While standard analyses focus on changes in the asset side of banks and examine how these affect the real economy through price changes, they do not consider changes in banks' liability side. The key to inspecting a financial system's fragility is to look specifically at the liability side, particularly changes in liquidity. Acharya and Rajan (2024) and Acharya et al. (2024) assumed that the asymmetric bank behavior between QE and QT is due to their confidence in retaining access to liquidity

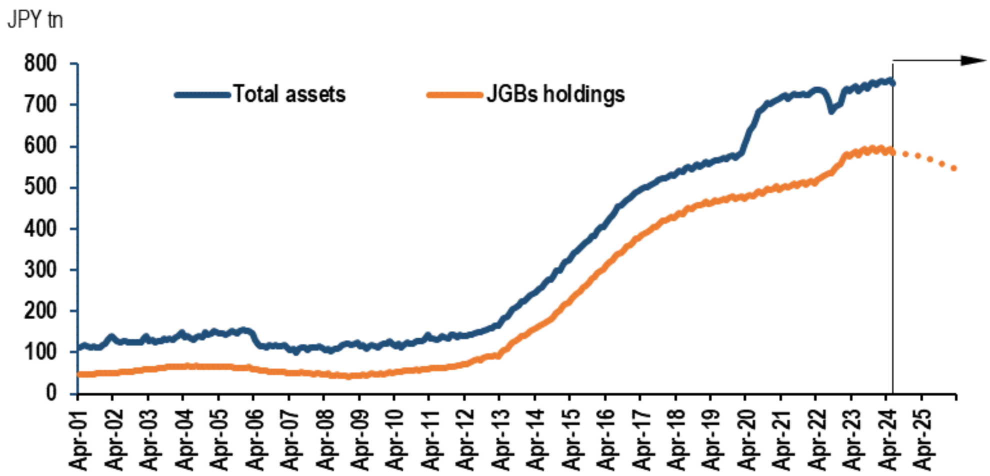
[3] Jiang et al. (2024) also examined monetary tightening and U.S. bank fragility in 2023. They provided a conceptual framework and an empirical methodology for analyzing all U.S. banks' exposure to rising interest rates and uninsured depositor runs, with implications for financial stability.

[4] While Acharya and Rajan (2024) theoretically examine this phenomenon, Acharya et al. (2024) do so empirically. The former do not emphasize the phrase "liquidity dependence" as much as the latter.

during QT if they substitute lost reserves with bonds that are eligible collateral for repo transactions.

In Japan, the Bank of Japan (BoJ) abolished its yield curve control (YCC) framework and negative interest rate policy in March 2024 after over 20 years of quantitative easing. The BoJ decided in August 2024 to begin reducing the amount of Japanese government bond (JGB) purchases from 6 trillion yen per month to around 3 trillion yen per month in January–March 2026, thereby gradually reducing the size of its balance sheet (Figure 1). Since the Japanese economy has just completed such a framework, experiencing the longest period and largest size (in terms of the BoJ's balance sheet-to-GDP ratio) of quantitative easing, this asymmetric bank behavior is worth addressing. In this study, we follow the U.S. Fed's terminology and refer to this phenomenon as a QT period. To examine the vulnerabilities of Japanese banks in the event of liquidity turbulence and how bank behavior impacts the effectiveness of monetary tightening during the QT period, we apply Acharya et al.'s (2024) method to analyze how the balance sheets of Japanese banks changed as the BoJ expanded and then shrunk its balance sheet.

Figure 1：Size of the BoJ's Balance Sheet



Note: The future size of JGB holdings is calculated based on the BoJ's plan to reduce its purchased amount of JGBs.

Source: BoJ, Macrobond

Specifically, when the demandable claims the BoJ supplies to banks become due as it moves from QE to QT, banks may experience liquidity stress. Therefore, we explore how the BoJ's balance sheet expansion affects banks' demandable deposits and demandable assets like credit lines. We also check whether banks move to reduce their liquid liabilities when the BoJ shifts from QE to QT when bank increases in demandable deposits during the QE period were very large. Banks may engage in asymmetric behavior in which they do not decrease their liquid liabilities by reducing demand deposits or raising time deposits in the QT period. Moreover, long-term interest rates may rapidly increase during the QT period, resulting in losses on banks' bond investments. If demandable deposits were substantially increased during the QE period and banks behave asymmetrically between the QE and QT periods, deposits may be easily withdrawn when banks incur losses on bond investments, consequently increasing liquidity risk. In addition, a change in banks' asset/liability maturity transformation behavior could also affect monetary tightening's spillover effects.

Awareness of the differences between the Japanese and U.S. financial systems is important when considering the impact of BoJ policies and how Japanese banks responded. In the U.S., if a Federal Deposit Insurance Corporation (FDIC) member bank fails, only up to USD 250,000 (approximately JPY 39 million) per account is protected.[5] In contrast, in Japan, deposits for settlement purposes, including current and non-interest-bearing ordinary deposits that meet the following three requirements, are fully protected: (1) they can provide settlement services, (2) the depositor can request reimbursement at any time, and (3) they do not earn interest. Interest bearing ordinary deposits, time deposits, installment savings, money trusts with contracts for compensating the principal, and financial bonds are protected up to 10 million yen in principal per depositor and their interests up to the date of bankruptcy per financial institution. More simply, the most significant difference is that corporate deposits in Japan are fully protected, whereas in the U.S., a large amount of corporate deposits are not protected. Thus, depositor corporations can potentially instantly withdraw those funds, which ultimately led to the collapse of SVB and Signature Bank. Another characteristics of Japanese banks is that they have diversified their yen funding sources by combining a variety of funding sources, especially small, sticky retail deposits. This suggests that the amount of deposits in Japanese banks is also diversified to include uncovered deposits to some extent (Figure 2). This may lead to stability during normal periods, but could lead to instability when households withdraw funds during a crisis period.

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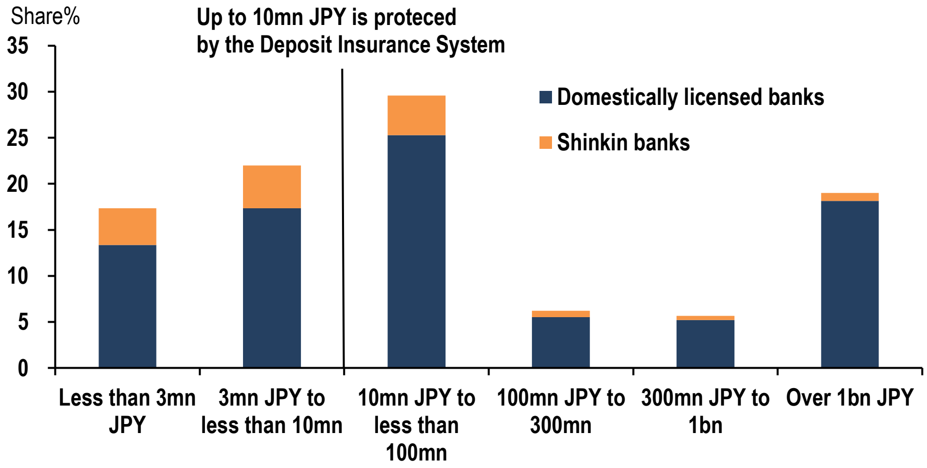
[5] Following the failures of SVB and Signature Bank, the FDIC published its report "Options for Deposit Insurance Reform" on May 1, 2023, The report considers reform of the deposit insurance system in response to the increased likelihood of a bank run due to the increase in uninsured deposits, as well as the increased speed of deposit withdrawals associated with technological advances. Further, the report proposes options for increased deposit insurance coverage: (i) maintaining the current deposit insurance framework and increasing the deposit insurance limit, (ii) introducing full protection, and (iii) applying preferential protection to certain deposits.

Figure 2：Distribution of Deposit Amounts per Account



Note: As of the end of September 2023. Shares of all deposits of domestically licensed banks and Shikin banks (amount basis), excluding financial institution deposits. Source: BoJ, JST

In this study, since the BoJ first initiated QE in March 2001, we regard the period from February 2002 to February 2024, just before the YCC framework and negative interest rate policy were removed (March 2024), as the QE estimation period, considering the constraints of accessing reliable data. The period between the BoJ's operating target change from the outstanding amount of current account balances at the BoJ (hereafter called "reserves") to uncollateralized overnight call rate balances until its resumption of QE (March 2006 to September 2010) is identified as the QT period. To inspect the debt side of banks, we consider the QE period as the period immediately prior to eliminating quantitative and qualitative monetary easing (QQE) with YCC. We do this because even though the BoJ converted from QQE to YCC in September 2016 (hereafter called "QQE with YCC"), it continued purchasing large amounts of JGBs; the period from QQE to YCC is often referred to as an unprecedented monetary easing. Except for SMEs (whose support operations ended in September 2022), following the BoJ's termination of its financial support operations in response to the COVID-19 pandemic at the end of March 2022, reserves began to decline. Thus, we consider the period from then until the YCC framework and negative interest rate policy were eliminated in March 2024 the QT period.

Using these periods, we examine how domestic banks increased or decreased demandable deposits, which are extremely liquid and can be withdrawn at any time, and time deposits, whose liquidity is fixed for a certain period of time. We make two key discoveries. First, the BoJ's QE created significant amounts of demandable deposits in

Japan's banking system, although the behavior of time deposits is unclear. Second, when the BoJ moved from QE to QT, the behavior of demandable deposits does not appear to have been asymmetric. However, their sensitivity to QT is quite low, and time deposits' behavior, which is sometimes symmetric and sometimes asymmetric, is quite uncertain. At the least, we cannot say that banks behaved in a way that would eliminate the liquidity mismatch between assets and liabilities. Overall, the same phenomenon as that seen in the U.S. financial system is also observed in Japan's financial system. The BoJ is not trying to move QT forward too rapidly. In fact, while the Fed stopped bond purchases just three months after it started raising interest rates in March 2022 and allowed maturing bonds to expire at or below the cut-off rate, the BoJ has only reduced its JGB purchases amount and has not gone as far as to stop buying. Thus, Japanese banks have plenty of liquidity. This raises the question: does this situation matter? The real problem does not occur in ordinary times but instead happens when there is a sudden need for large amounts of cash (Acharya et al. (2024) refer to this as a "dash for cash"). If liquidity is insufficient when this happens, Japanese banks not only will rush to secure reserves to avoid a bank run but will also concentrate the market's demand for funding. Consequently, interest rates will spike, and banks will be forced to conduct fire sales unless the BoJ can address them with appropriate market operations.

The rest of this paper proceeds as follows. Section 2 analyses aggregate time-series data by linking reserve amounts, types of deposits, and credit lines. Section 3 further analyses bank behavior using bank-level panel data. Section 4 concludes by describing the ratcheting-up of bank liquidity risk, the subsequent financial fragility, and certain monetary policy issues, offering some directions for future research.

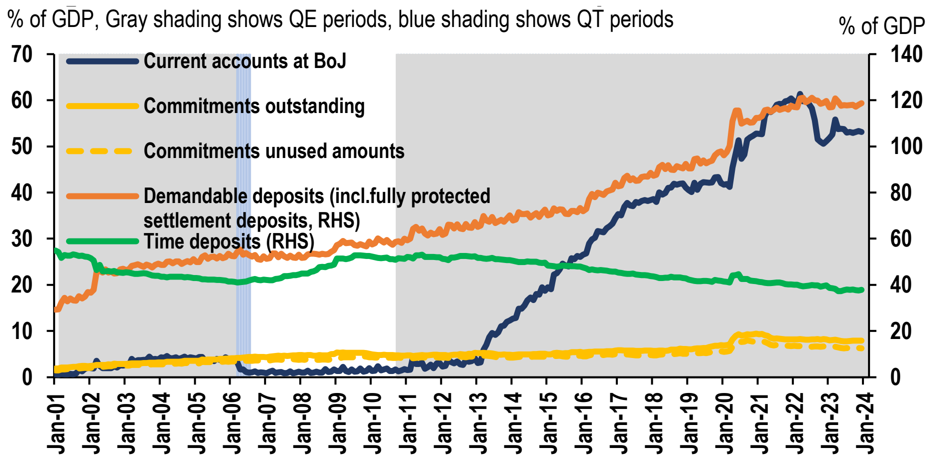
2. Aggregate time-series analysis

Before conducting the time-series analysis, we examine developments in domestic bank deposits and credit lines of Japanese banks during the QE period (Figure 3). Reserves increased throughout all QE periods; in particular, the pace of the increase accelerated when the BoJ launched QQE in 2013. Domestic banks' demandable deposits increased for almost the entire period, although their growth has accelerated since the BoJ implemented QQE. In contrast, time deposits appear to have continued to decline throughout the QE period. Credit lines are smaller than those of U.S. banks. Since credit lines are hardly used by firms, the contract and unused amounts have moved in similar ways. In any case, they appear to have increased moderately during the QE period.

Looking at the QT period, reserves decreased slightly in 2006 and remained flat until QE resumed; demandable deposits actually declined slightly when reserves declined but seem to resume growth thereafter. Time deposits appear to have increased throughout the QT period but declined after the suspension of operations in response to the COVID-19 pandemic. Credit lines seem to have at least stopped increasing.

Overall, demandable deposits generally increased during the QE period but did not decrease during the QT period. In addition, time deposits continued to decline during the QE period and conversely increased during the QT period. However, whether they increased or decreased after the suspension of operations in response to the COVID-19 pandemic is unclear. Conducting an empirical analysis is necessary to rigorously determine whether deposits increased or decreased during the QT period. In the following, we first conduct the aggregate the time series analysis using macro data.

Figure 3: Current Account Balances at the BoJ, Deposits, and Credit Lines



Note: This figure covers domestically licensed banks. As the BoJ's current accounts before 2005 do not include data for domestically licensed banks, those data are estimated using the shares of such banks in Jan. 2005. Source: BoJ, Cabinet Office

Specifically, following Acharya et al. (2024), we estimate the ordinary least square (OLS) regression using Eq. (1):

$$\Delta Y_t = \alpha \Delta X_t + \beta X_{t-12} + \varepsilon_t \tag{1}$$

where $\Delta Y_t = Y_t - Y_{t-12}$ is the change in Ln(*Deposits*) or Ln(*Credit lines*) or change in *Deposits* or *Credit lines*, to control for seasonality. $\Delta X_t = X_t - X_{t-12}$ is the change in Ln(*Reserves*) or change in *Reserves*. *Deposits* are then split into *Demandable deposits* and *Time deposits*, and the same analysis is performed for each. Furthermore, to allow for a lagged impact of *Reserves* production, we include a 12-month lag in Ln(*Reserves*) or *Reserves*. Newey-West's HAC estimator is applied to deal with variance heterogeneity and serial correlation.

The data used are domestic banks' reserves and monthly deposit and commitment lines data. The sample period is from January 2002, close to the initial period of QE, considering data reliability constraints, to February 2024, just before the removal of YCC framework and negative interest rate policy.

2.1. All periods

We estimate model (1) for all periods. Columns (1) to (4) of Table 1 show the correlation between the quarterly changes in the neutral logarithm of deposits/ demandable deposits/ time deposits, or credit lines (contract amount) and those of reserves. The results show that changes in reserves have a strong positive effect on changes in deposits and demandable deposits. However, changes in reserves and changes in time deposits are negatively correlated in some cases but not in others. Finally, changes in credit lines are not correlated with changes in reserves. Our point estimates indicate that a 10% increase in reserves is associated with a 0.17% increase in deposits and 0.6% increase in demandable deposits but is associated with a 0.3% decrease in time deposits. The correlations appear to be smaller than those Acharya et al. (2024) estimated for U.S. banks; the positive or negative signs of each deposit measure are the same; however, the sign of credit lines is not. Demandable and time deposits have opposite movements, as expected from Figure 1. This suggests that when the BoJ increased reserves, domestic banks not only increased deposits but also shifted from time to demandable deposits.

Columns (5) to (8) are not log-transformed but instead use arithmetic changes in *Deposits* and their breakdown, as well as changes in C*redit lines*, as dependent variables. The results are generally similar to the log-transformed results, with changes in deposits responding to changes in reserves in the same direction by about its 40% share, and changes in demandable deposits respond in the same direction by almost the same proportion of the shift. In contrast, the coefficient of changes in time deposits is negative but not statistically significant. Overall, as Acharya et al. (2024) measured, when the Fed increased the supply of reserves for U.S. banks, almost all of the increase was shifted to deposits. However, when the BoJ supplies reserves in Japan, about 40% flow into nonbanks as funds, which in turn flow back to the banks as demandable deposits. Since at least this portion has zero risk weight, domestic banks do not need to increase their capital or rebalance portfolios to meet liquidity regulations. We cannot determine from these macro data how much of demandable deposits is uninsured.

Table 1: Effects of reserves on aggregate deposits and credit lines (since the 2000s)

This table reports the results of OLS regressions of changes in deposits or credit lines on changes in reserves. The sample period is April 2001 to February 2024 for deposits, demandable deposits, and time deposits and January 2002 to February 2024 for credit lines. Demandable deposits consist of current, ordinary, savings, and notice deposits. Time deposits consist of time deposits and installment savings. t-statistics are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Newey-West's HAC estimator is applied.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ΔLn (Deposits)	ΔLn (Demandable deposits)	ΔLn (Time deposits)	ΔLn (Credit lines)	ΔDeposits	ΔDemandable deposits	ΔTime deposits	ΔCredit lines
ΔLn (Reserves)	0.0168***	0.0660***	-0.0303**	-0.0056				
	(7.2280)	(3.2356)	(-2.2491)	(-0.2714)				
Ln $(Reserves)_{t-12}$	0.0071***	0.0042	-0.0027	0.0007				
	(4.6871)	(0.9102)	(-0.7753)	(0.9373)				
ΔReserves					0.3707***	0.3959***	-0.0412	0.0146
					(5.0641)	(5.2635)	(-1.3728)	(0.7078)
$Reserves_{t-12}$					0.0765***	0.0721***	-0.0005	0.0026
					(5.5120)	(4.5827)	(-0.0503)	(0.6445)
Constant	-0.0637***	-0.0027	0.0289	0.0559	87542.2820***	112257.2400***	-24295.8540	11371.9185***
	(-3.4761)	(-0.0443)	(0.5956)	(0.5292)	(7.5060)	(4.1257)	(-0.9600)	(3.0736)
Number of Samples	275	275	275	266	275	275	275	266
Adj. R-sq	0.390	0.241	0.114	-0.006	0.624	0.455	0.001	0.019
Type of regression	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS

2.2. QQE period

Although we describe the BoJ's QE using a single phrase, the scale of the reserves expansion differs significantly between the initial QE and QQE period that began in 2013. The effects on bank behavior may differ because of this scale difference Therefore, to see how the portfolios of domestic banks have changed, we examine only the QQE period, when the scale of the BoJ's QE increased significantly.

First, we conduct the same estimations as (1) through (8) in Table 1 from the start of the QQE in April 2013 to February 2024, just before the QQE with YCC was abolished in March 2024. The results in Table 2 show that, as in Table 1, reserves positively affect changes in deposits and demandable deposits for both the logarithmic and arithmetic terms; however, the coefficients are larger in both cases. Changes in time deposits are no longer negatively correlated as in Table 1, and the coefficients are statistically non-significant. The coefficients of changes in credit lines are also statistically non-significant, as in Table 1. The characteristics of QQE are such that domestic banks shifted more of the increase in reserves to demandable deposits than they did in QE, but did not go as far as to reduce time deposits.

Table 2: Effects of reserves on aggregate deposits and credit lines (since QQE)

This table reports the results from OLS regressions of changes in deposits or credit lines on changes in reserves. The sample period is April 2013 to February 2024 for deposits, demandable deposits, time deposits, and credit lines. Demandable deposits consist of current, ordinary, savings, and notice deposits. Time deposits consist of time deposits and installment savings. t-statistics are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Newey-West's HAC estimator is applied.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ΔLn (Deposits)	ΔLn (Demandable deposits)	ΔLn (Time deposits)	ΔLn (Credit lines)	ΔDeposits	ΔDemandable deposits	ΔTime deposits	ΔCredit lines
ΔLn (Reserves)	0.0748 **	0.0940 **	0.0210	-0.1376				
	(2.2916)	(2.0586)	(1.2814)	(-0.7466)				
$Ln\ (Reserves)_{t-12}$	0.0297 **	0.0351 *	0.0030	-0.0424				
	(2.2810)	(1.9145)	(0.4366)	(-0.5364)				
ΔReserves					0.4200 ***	0.4641 ***	-0.0240	0.0193
					(3.1337)	(3.9343)	(-0.8688)	(0.4325)
$Reserves_{t-12}$					0.0937 ***	0.1046 ***	-0.0060	0.0029
					(3.3860)	(3.9013)	(-0.9453)	(0.2778)
Constant	-0.3989 **	-0.4539 *	-0.0616	0.6969	36509.0447	20635.8713	-14867.9623	9280.7789
	(-2.0832)	(-1.6808)	(-0.6067)	(0.6013)	(0.4964)	(0.3072)	(-0.8790)	(0.3581)
Number of Samples	131	131	131	131	131	131	131	131
Adj. R-sq	0.132	0.067	0.090	0.014	0.334	0.374	0.011	-0.005
Type of regression	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS

However, the absence of a negative correlation for time deposits may be due to the fact that QQE included a period when the supply of reserves was reduced. In fact, during the QQE period, when the COVID-19 pandemic occurred, the BoJ began strengthening monetary easing in March 2020. This included financial support operations, so that more liquidity was available to companies affected by COVID-19. These operations were terminated in March 2022 except for an extension of operations for SMEs until September 2022. Consequently, the amount of reserves supplied by the BoJ decreased beginning in March 2022. Thus, we use similar estimations to measure how domestic banks shifted their portfolios during the QQE period, treating the period only up to February 2022 as the QQE period.

Table 3 shows that the positive responses of changes in deposits and demandable deposits to a 10% increase in reserves are even greater, with deposits and demandable deposits increasing by 0.84% and 1.1%, respectively. About 60% of the increase in reserves went to increase deposits or demandable deposits. Changes in time deposits in arithmetic terms are positively but weakly affected by changes in reserves. The lack of significance for credit lines is consistent with the results of the previous analysis. Thus, no major trends changed when defining the QQE period narrowly or broadly, with the exception of the size of the coefficients.

Table 3: Effects of reserves on aggregate deposits and credit lines (when the BoJ's amount of JGB holdings increased under QQE)

This table reports the results from OLS regressions of changes in deposits or credit lines on changes in reserves. The sample period is April 2013 to March 2022 for deposits, demandable deposits, time deposits, and credit lines. Demandable deposits consist of current, ordinary, savings, and notice deposits. Time deposits consist of time deposits and installment savings. t-statistics are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Newey-West's HAC estimator is applied.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ΔLn (Deposits)	ΔLn (Demandable deposits)	ΔLn (Time deposits)	ΔLn (Credit lines)	ΔDeposits	ΔDemandable deposits	ΔTime deposits	ΔCredit lines
ΔLn (Reserves)	0.0838 **	0.1063 **	0.0200	-0.1231				
	(2.4272)	(2.2761)	(1.2318)	(-0.6212)				
Ln (Reserves)$_{t-12}$	0.0357 **	0.0468 **	-0.0024	-0.0223				
	(2.4938)	(2.3918)	(-0.3752)	(-0.2454)				
ΔReserves					0.6096 ***	0.5493 ***	0.0607 ***	0.0013
					(3.8827)	(3.5809)	(3.3141)	(0.0226)
Reserves$_{t-12}$					0.0928 ***	0.1177 ***	-0.0192 ***	0.0082
					(2.6759)	(3.4597)	(-4.7568)	(0.6285)
Constant	** -0.4838	** -0.6164	0.0108	0.4207	-29569.3242	-23670.2959	-30455.4409 ***	9854.9187
	(-2.3060)	(-2.1462)	(0.1126)	(0.3181)	(-0.3624)	(-0.3014)	(-2.9179)	(0.3228)
Number of Samples	108	108	108	108	108	108	108	108
Adj. R-sq	0.181	0.124	0.455	0.045	0.427	0.425	0.425	0.008
Type of regression	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS

2.3. QT period

This study's main concern is whether bank behavior is asymmetric when the BoJ moves from QE to QT. In other words, if domestic banks rapidly increase demandable deposits during the QE period and then do not reduce them to the same extent during the QT period, liquidity risk may increase. From this perspective, we estimate bank behavior during the QT period using macro-time-series data (Table 4).

First, for the narrowly defined QT period from March 2006 to October 2010, we estimate the same measurements as those in columns (1)–(8) of Table 3. The results show that the coefficient of changes in demandable deposits is positive as before, but when using the log-transformed basis, the decrease in demandable deposits for a 10% decrease in reserves is about 1/3 of that in the QQE period. In contrast, using the arithmetic basis, the decrease in reserves is about two to three times the decrease in demandable deposits. Notably, the coefficients of changes in time deposits are also statistically significant, with time deposits increasing only 0.2% relative to a 10% decrease in reserves, or about 60%

of the decrease in reserves. This suggests that domestic banks make risk-averse portfolio choices in the QT period by reducing demandable deposits and increasing time deposits. Changes in credit lines are also statistically significant, with domestic banks increasing their credit lines when reserves decline. Although this appears to be myopic risk aversion behavior by banks, it likely indicates that firms' demands for credit line contracts increases when the financial environment tightens during the QT period.

Table 4: Effects of reserves on aggregate deposits and credit lines (from QT through the restart of QE)

This table reports the results from OLS regression of changes in deposits or credit lines on changes in reserves. The sample period is March 2006 to September 2010 for deposits, demandable deposits, time deposits, and credit lines. Demandable deposits consist of current, ordinary, savings, and notice deposits. Time deposits consist of time deposits and installment savings. t-statistics are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Newey-West's HAC estimator is applied.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ΔLn (Deposits)	ΔLn (Demandable deposits)	ΔLn (Time deposits)	ΔLn (Credit lines)	ΔDeposits	ΔDemandable deposits	ΔTime deposits	ΔCredit lines
ΔLn (Reserves)	0.0073 ***	0.0397 ***	-0.0207 **	-0.1000 **				
	(4.8001)	(5.4927)	(-2.2362)	(-2.4420)				
Ln (Reserves)$_{t-12}$	-0.0056 ***	0.0400 ***	-0.0493 ***	-0.0313				
	(-2.9955)	(5.7514)	(-5.6153)	(-0.7633)				
ΔReserves					0.4798 ***	1.3843 ***	-0.5828 **	-0.2548 **
					(5.9983)	(6.1521)	(-2.6224)	(-2.1225)
Reserves$_{t-12}$					-0.1731 *	1.3633 ***	-1.1988 ***	-0.1160
					(-1.9523)	(7.8098)	(-7.6804)	(-0.9800)
Constant	0.0843 ***	-0.4323 ***	0.5858 ***	0.3687	135890.0601 ***	-59862.8839 ***	179004.1438 ***	12261.9379
	(3.9400)	(-5.6777)	(6.0926)	(0.8172)	(14.3899)	(-4.3287)	(16.1542)	(1.5202)
Number of Samples	55	55	55	55	55	55	55	55
Adj. R-sq	0.763	0.299	0.546	0.389	0.806	0.281	0.562	0.343
Type of regression	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS

Since this is a very short QT period, the sample size may not be large enough for the estimation to be stable. However, reserves have been decreasing since the end of the COVID-19 pandemic in the second half of the QQE period, when the BoJ terminated its financial support operations, leaving only operations for SMEs at the end of March 2022. We may therefore be able to consider this a QT period and estimate by combining this period with the first QT period (Table 5).

Using this combination, although statistically significant, demandable deposits decrease by only 0.1% in response to a 10% decrease in reserves. In arithmetic terms, the decrease in demandable deposits is also statistically significant, but only by 10% of reserves. Furthermore, although the time deposit coefficients are statistically significant at the 10% level on a log-transformed basis, the signs of the coefficients are negative, opposite those in Table 3, suggesting asymmetric behavior (liquidity dependence). However, the coefficients are no longer statistically significant using the arithmetic basis. Changes in credit lines respond to the decrease in reserves in an increasing direction, as in the narrowly defined QT period.

Table 5: Effects of reserves on aggregate deposits and credit lines (from QT through the restart of QE and recent QE reduction)

This table reports the results from OLS regression of changes in deposits or credit lines on changes in reserves. The sample period is March 2006 to September 2010 and from April 2022 to February 2024 for deposits, demandable deposits, time deposits, and credit lines. Demandable deposits consist of current, ordinary, savings, and notice deposits. Time deposits consist of time deposits and installment savings. t-statistics are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Newey-West's HAC estimator is applied.

	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
	ΔLn (Deposits)		ΔLn (Demandable deposits)		ΔLn (Time deposits)		ΔLn (Credit lines)		ΔDeposits		ΔDemandable deposits		ΔTime deposits		ΔCredit lines	
ΔLn (Reserves)	0.0149	***	0.0125	**	0.0135	*	-0.0757	***								
	(13.6396)		(2.1018)		(1.6996)		(-5.2484)									
Ln (Reserves)$_{t-12}$	0.0032	***	0.0089	***	-0.0101	***	-0.0034									
	(8.1980)		(9.0886)		(-6.2275)		(-0.8501)									
ΔReserves									0.1193	**	0.1081	***	0.0490		-0.0329	*
									(2.1507)		(3.8394)		(0.9994)		(-1.8490)	
Reserves$_{t-12}$									0.0705	***	0.0878	***	-0.0251	***	-0.0014	
									(12.6695)		(21.5146)		(-4.2209)		(-0.7482)	
Constant	-0.0134	**	-0.0870	***	0.1506	***	0.0591		102981.3737	***	26980.5199		84441.4395	***	7440.5010	**
	(-2.6317)		(-5.9594)		(7.2070)		(1.0452)		(10.2973)		(2.1930)		(6.2883)		(2.0045)	
Number of Samples	78		78		78		78		78		78		78		78	
Adj. R-sq	0.818		0.537		0.538		0.389		0.856		0.875		0.362		0.088	
Type of regression	OLS		OLS		OLS		OLS		OLS		OLS		OLS		OLS	

Thus, bank behavior in response to the decline in reserves during the QT period is quite uncertain, if not asymmetric. This requires a more rigorous measurement using micro data and panel tests, as the OLS analysis of time series data is not conducive for inferences about the causal impact of reserves and may reflect a false correlation. Therefore, we turn to panel tests with cross-sectional micro bank data in Section 3.

3. BoJ reserves and bank deposits: bank-level analyses

In this section, we conduct a micro-econometric analysis using bank accounting data from this century. A micro-analysis can consider confounding factors that cause biases that are difficult to remove in a macro-analysis. We cope with this difficulty by using two-stage least squares (2SLS) regressions.

While largely based on Acharya et al. (2024), this methodology differs from theirs in several respects due to differences in data availability for Japan and the United States. For example, while Acharya et al. (2024) used quarterly data, this study employs annual data. This is because, although a small portion of the data are available semi-annually, most of the variables used in the analysis are measured using annual data. The source of our bank accounting data (unconsolidated basis) is the Nikkei Economic Electronic Databank Systems' Financial QUEST (NEEDS FQ), and macroeconomic data are obtained from the BoJ. All data are as of the end of March of each year, which is the fiscal year end of all banks used in this empirical analysis.

We employ 2SLS analyses, instrumenting the change in bank-level reserves in the first stage to obtain the impact of an exogenous change in bank-level reserves on bank-level deposits to allay endogeneity concerns (Acharya et al. 2024).

The first and second stage estimations are shown in Eqs. (2) and (3):

The first stage

$$\Delta Ln(Reserves)_{it} = \alpha_1 z_{it}^{R1} + \alpha_2 z_{it}^{R2} + \alpha_3 Ln(Reserves)_{it-1} + \gamma X_{it-1} + \epsilon_{it}, \quad (2)$$

The second stage

$$\Delta Ln(Deposits)_{it} = \beta_1 \Delta Ln(\widehat{Reserves})_{it} + \beta_2 Ln(Reserves)_{it-1} + \delta X_{it-1} + \tau_t + u_{it}, \quad (3)$$

where $\Delta Ln(Reserves)_{it}$ is the annual growth rate of bank *i*'s reserve holdings in year *t*. "Cash and Due from Banks" in bank balance sheets are used to measure $Reserves$. Ideally, we should and would like to use "Deposit Paid to BoJ," but these data have not been recorded since fiscal year 2013 (March 2014). Although it is unclear why it has not been recorded since 2013, the change coincided with the period during which Governor Kuroda's QQE led to a rapid increase in reserves at the BoJ. During the period of so-called unconventional monetary policy beginning in March 2001,[6] "Cash and Due from Banks" primarily consists of "Deposit Paid to BoJ." Therefore, this treatment should not cause severe estimation biases.

$\Delta Ln(Deposits)_{it}$ is the annual growth rate of bank *i*'s deposits as liabilities in its balance sheet at year *t*. We use three different deposits as dependent variables: total deposits, demandable deposits (liquid deposits), and time deposits. Bank i's total deposits are the sum of its current, ordinary, savings, notice, time, installment savings, and other

[6] There are two different views regarding the start of unconventional monetary policy. One view is that it occurred in February 1999 (the start of the zero interest rate policy); the other is that it began in March 2001 (the start of the first quantitative easing policy). Significant increases in bank reserves begin with the latter.

deposits plus negotiable certificates of deposit. Demandable deposits are the sum of current, ordinary, savings, and notice deposits. Time deposits are the sum of time deposits and installment savings.

z_{it}^{R1} and z_{it}^{R2} are bank-level reserve instruments as shown in Eqs. (IV1) and (IV2):

$$z_{it}^{R1} = ln\left(\frac{Aggregate\ bank\ reserves_t}{Aggregate\ bank\ reserves_{t-1}}\right) \times \frac{1}{2}\sum_{k=0}^{1} Bank\ i'sshare\ of\ aggregate\ bank\ reserves_{t-k}, \qquad (IV1)$$

$$z_{it}^{R2} = ln\left(\frac{Monetary\ Base_t}{Monetary\ Base_{t-1}}\right) \times \frac{1}{2}\sum_{k=0}^{1} Bank\ i'sshare\ of\ aggregate\ bank\ reserves_{t-k}, \qquad (IV2)$$

where z_{it}^{R1} is computed as the product of two components, the most recent change in aggregate bank reserves and bank i's recent share of aggregate bank reserves. The second instrument, z_{it}^{R2}, replaces growth in aggregate reserves as the first component with growth in the monetary base. The first components of each variable are driven in large part by the BoJ's monetary policy stance, which can be considered as correlated with banks' reserves but not their deposits. The second component considers the difference among banks' propensity to use reserves.

X_{it} represents bank controls lagged by one year, including bank size (measured as *Ln*(Total Assets)), profitability (Ordinary Revenue/Total Assets), and capitalization (Net Assets /Total Assets). τ_t represents time fixed effects, and ϵ_{it} and u_{it} are the error terms.

Table 6 reports the variables' descriptive statistics. Our dataset comprises unbalanced panel data of 125 banks for 24 years. Due to missing values for *Time Deposits* and *Equity to Assets*, approximately 2,000 observations are used in the empirical analysis.

We focus on the estimation results of β_1 in QE and QT periods to examine whether liquidity dependence is observed in Japan. When liquidity dependence occurs, the coefficients of demandable deposits are expected to be positive during QE periods but not during QT periods, while the coefficients of time deposits are expected to be negative during QE periods but not during QT periods.

Table 6: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Dependent Variables					
$\Delta Ln(Total\ Deposits)_{it}$	2,695	0.028	0.080	-0.890	1.359
$\Delta Ln(Demandable\ Deposits)_{it}$	2,526	0.061	0.083	-0.515	0.937
$\Delta Ln(Time\ Deposits)_{it}$	2,007	-0.012	0.075	-1.006	0.849
Explanatory & Instrument Variables					
z_{it}^{R1}	2,587	14.642	104.110	-653.282	2463.408
z_{it}^{R2}	2,587	5.006	31.123	-173.542	587.304
$Ln(Reserves)_{it}$	2,813	11.920	1.641	8.254	18.325
$Ln(Total\ Asset)_{it}$	2,814	14.780	1.242	9.845	19.518
ROA_{it}	2,814	0.020	0.011	0.000	0.182
$Equity\ to\ Asset_{it}$	2,063	0.051	0.024	0.004	0.640

3.1. All periods

Table 7 shows the estimation results of the second stage of 2SLS using our full sample of 24 years from March 2001 to March 2024. This sample period almost matches that used in Table 1, where we report the OLS regression results using macroeconomic data.[7]

The table shows that, throughout the sample period, the change in demandable deposits is positively affected by changes in reserves, while there is no significant effect on total and time deposits. The results for demandable deposits are consistent with those of the macro-econometric analysis in Table 1, suggesting that when the BoJ increased (decreased) reserves, Japanese banks increased (decreased) demandable deposits.

Table 7: Results of Second Stage (2SLS): Mar. 2001- 2024

This table reports the results of the second stage from the 2SLS regression of changes in deposits on changes in reserves. The sample period is March 2001 to March 2024 for total, demandable, and time deposits. Demandable deposits consist of current, ordinary, savings, and notice deposits. Time deposits consist of time deposits and installment savings. t-statistics are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

[7] The sample periods for Tables 7, 8, 9, 10, and 11 match those of Tables 1, 2, 3, 4, and 5 in Section 2, respectively.

	$\Delta Ln(Total\ Deposits)_{it}$	$\Delta Ln(Demandable\ Deposits)_{it}$	$\Delta Ln(Time\ Deposits)_{it}$
$Instr\ \Delta Ln(Reserves)_{it}$	0.267	0.090 ***	0.021
	(1.420)	(4.240)	(1.590)
$Ln(Reserves)_{i\,t-1}$	0.101	0.044 ***	0.012
	(1.560)	(4.440)	(1.200)
$Ln(Total\ Asset)_{i\,t-1}$	-0.309 *	-0.214 ***	-0.126 **
	(-1.770)	(-5.530)	(-1.990)
$ROA_{i\,t-1}$	2.755	-4.845 ***	1.751
	(0.860)	(-3.020)	(1.210)
$Equity\ to\ Asset_{i\,t-1}$	-2.116	-1.367 ***	-0.751 *
	(-1.400)	(-3.950)	(-1.790)
$Constant$	3.440 *	2.839 ***	1.699 **
	(1.860)	(5.360)	(1.970)
R-sq(within)	0.000	0.128	0.139
Number of obs	1,820	1,710	1,273
Number of banks	125	117	99

3.2. QQE periods

Table 8 presents the estimation results of the second stage of 2SLS using the QQE period beginning in April 2013, from the end of March 2014 to March 2024. We find that reserves have no significant effects on deposits. These results are not consistent with those of Table 2, which analyses the QQE period using macro-economic data.

However, as discussed in subsection 2.2., when the COVID-19 pandemic occurred in 2020, during the QQE period, the BoJ began strengthening monetary easing in March 2020. The actions included financial support operations, so that more liquidity was available to companies affected by the COVID-19 pandemic. These were terminated in March 2022; consequently, the amount of reserves supplied by the BoJ decreased following March 2022. Thus, we use similar estimations to measure how Japanese banks shifted their portfolios during the QQE period, treating the period only up to February 2022 as the QQE' period.

Table 8: Results of Second Stage (2SLS): QQE (Mar. 2014–Mar. 2024)

This table reports the results of the second stage of the 2SLS regression of changes in deposits on changes in reserves. The sample period is March 2014 to March 2024 for total, demandable, and time deposits. Demandable deposits consist of current, ordinary, savings, and notice deposits. Time deposits consist of time deposits and installment savings. t-statistics are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	$\Delta Ln(Total\ Deposits)_{it}$	$\Delta Ln(Demandable\ Deposits)_{it}$	$\Delta Ln(Time\ Deposits)_{it}$
$Instr\ \Delta Ln(Reserves)_{it}$	0.600	0.148	0.008
	(1.200)	(1.330)	(0.160)
$Ln(Reserves)_{i\,t-1}$	0.321	0.087	-0.004
	(1.210)	(1.390)	(-0.130)
$Ln(Total\ Asset)_{i\,t-1}$	-0.612 *	-0.224 **	-0.054 **
	(-1.460)	(-2.350)	(-1.240)
$ROA_{i\,t-1}$	10.241	0.648	1.007
	(0.770)	(0.140)	(0.250)
$Equity\ to\ Asset_{it-1}$	-1.927	-0.939	-2.010 ***
	(-1.420)	(-1.360)	(-3.310)
$Constant$	5.010 *	2.343 ***	0.906 *
	(1.740)	(3.650)	(1.800)
R-sq(within)	0.000	0.000	0.139
Number of obs	1,126	1,051	738
Number of banks	119	111	84

Table 9 presents the estimation results of the second stage of 2SLS using the QQE period from March 2014 to March 2021. While the change in demandable deposits is positively and significantly affected by changes in reserves, the effects on total and time deposits are not significant. Thus, the QQE policy increased the amounts of demandable deposits. This result for demandable deposits is consistent with that of the macro-econometric analysis in Table 3, suggesting that when the BoJ increased (decreased) reserves, Japanese banks increased (decreased) demandable deposits. In other words, the Japanese economy also experienced a maturity-shortening of deposits at the bank level during QE periods.

Table 9: Results of Second Stage (2SLS): QQE' (Mar. 2014-Mar. 2021)

This table reports the results of the second stage of the 2SLS regression of changes in deposits on changes in reserves. The sample period is March 2014 to March 2021 for total, demandable, and time deposits. Demandable deposits consist of current, ordinary, savings, and notice deposits. Time deposits consist of time deposits and installment savings. t-statistics are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	$\Delta Ln(Total\ Deposits)_{it}$	$\Delta Ln(Demandable\ Deposits)_{it}$	$\Delta Ln(Time\ Deposits)_{it}$
$Instr\ \Delta Ln(Reserves)_{it}$	0.447	0.086 **	-0.036
	(1.290)	(2.050)	(-0.870)
$Ln(Reserves)_{i\,t-1}$	0.286	0.053 *	-0.034
	(1.290)	(1.790)	(-1.160)
$Ln(Total\ Asset)_{i\,t-1}$	-0.933	-0.147 **	-0.073 **
	(-1.550)	(-2.100)	(-1.310)
$ROA_{i\,t-1}$	7.556	-6.590 *	-4.022
	(0.520)	(-1.710)	(-0.840)
$Equity\ to\ Asset_{it-1}$	-0.699	-2.108 ***	-1.445 ***
	(-0.430)	(-3.140)	(-2.900)
$Constant$	10.243 *	1.814 ***	1.611 ***
	(1.700)	(2.590)	(2.820)
R-sq(within)	0.000	0.000	0.000
Number of obs	908	860	607
Number of banks	116	111	84

3.3. QT periods

Table 10 reports the results of estimating the second stage of 2SLS using the QT period from March 2006 to March 2010. In contrast to the results in Table 9, while the change in time deposits is positively and significantly affected by changes in reserves, it is not significant for total and demandable deposits. This result for time deposits is inconsistent with that of the macro-economic analysis in Table 4 but consistent with that reported in Table 5. This suggests that when the BoJ decreased reserves, Japanese banks decreased time deposits. The maturity-shortening shown in subsection 3.2. does not reverse when the central bank stops injecting or reduces aggregate reserves. Banks may not have behaved in a way that would eliminate the liquidity mismatch between assets and liabilities that they faced during QT periods.

Table 10: Results of Second Stage (2SLS): QT (Mar. 2006-Mar. 2010)

This table reports the results of estimating the second stage from the 2SLS regression of changes in deposits on changes in reserves. The sample period is March 2006 to March 2010 for total, demandable, and time deposits. Demandable deposits consist of current, ordinary, savings, and notice deposits. Time deposits consist of time deposits and installment savings. t-statistics are reported in parentheses. ***, **, and * indicate significance at the 1%, 5% and, 10% levels, respectively.

	$\Delta Ln(Total\ Deposits)_{it}$	$\Delta Ln(Demandable\ Deposits)_{it}$	$\Delta Ln(Time\ Deposits)_{it}$
$Instr\ \Delta Ln(Reserves)_{it}$	0.089	0.068	0.130 **
	(1.410)	(1.170)	(2.020)
$Ln(Reserves)_{i\,t-1}$	0.094	0.087	0.109 *
	(1.480)	(1.410)	(1.720)
$Ln(Total\ Asset)_{i\,t-1}$	-0.846 ***	-0.741 ***	-0.897 ***
	(-7.640)	(-3.860)	(-7.380)
$ROA_{i\,t-1}$	0.955	-3.138	-8.028 *
	(0.450)	(-1.320)	(-1.960)
$Equity\ to\ Asset_{it-1}$	-0.566	-3.476 ***	0.669
	(-0.920)	(-5.200)	(0.890)
$Constant$	11.332 ***	10.085 ***	11.975 ***
	(8.170)	(3.740)	(6.270)
R-sq(within)	0.420	0.399	0.000
Number of obs	353	334	282
Number of banks	119	113	97

When we include March 2023–2024 in the QT' sample period, the estimation results change. Table 11 shows the second stage results of the 2SLS estimation using the QT' period: March 2006 to March 2010 and March 2023 to March 2024. While the effect of reserves on total deposits is significantly positive, reserves have no significant effects on demandable and time deposits. The shrinking of reserves during the QT' period decreased total deposits, but whether this decrease is caused by the decrease in demandable or time deposits cannot be clearly determined from the results. Although the negative and positive coefficients of demandable and time deposits in Table 11 are not significant, we might infer that the decrease in time deposits caused the decrease in total deposits. If this inference is correct, it implies that the Japanese economy experienced liquidity dependence during the QT' period, thus increasing the liquidity mismatch between the asset and liability sides in the Japanese banking sector. In other words, although liquidity in the asset side was decreased by the QT policy, liquidity in the liability side increased.

Table 11: Results of Second Stage (2SLS): QT' (Mar. 2006-2010 & Mar. 2023-2024)

This table reports the results of the second stage of the 2SLS regression of changes in deposits on changes in reserves. The sample period is from March 2006 to March 2010, and from March 2023 to March 2024 for total, demandable, and time deposits. Demandable deposits consist of current, ordinary, savings, and notice deposits. Time deposits consist of time deposits and installment savings. t-statistics are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	$\Delta Ln(Total\ Deposits)_{it}$	$\Delta Ln(Demandable\ Deposits)_{it}$	$\Delta Ln(Time\ Deposits)_{it}$
$Instr\ \Delta Ln(Reserves)_{it}$	0.137 **	-0.030	0.134
	(2.140)	(-1.000)	(0.880)
$Ln(Reserves)_{i\,t-1}$	0.073 **	0.016	0.060
	(2.410)	(0.620)	(0.680)
$Ln(Total\ Asset)_{i\,t-1}$	-0.204 **	-0.133	-0.276
	(-2.010)	(-1.100)	(-0.960)
$ROA_{i\,t-1}$	-0.164	-3.876 **	-1.947
	(-0.180)	(-2.030)	(-0.650)
$Equity\ to\ Asset_{it-1}$	0.452	-1.991 ***	-0.141
	(0.780)	(-4.460)	(-0.230)
$Constant$	2.176 *	1.963	3.407
	(1.820)	(1.260)	(1.040)
R-sq(within)	0.000	0.127	0.000
Number of obs	462	428	346
Number of banks	125	117	97

Overall, the results in this section suggest that, as in the U.S. economy, the Japanese economy experienced liquidity dependence. Maturity-shortening of deposits at the bank level occurred during QE periods; however, this does not reverse during QT periods. A micro-analysis that considers confounding factors, which are difficult to remove in a macro-analysis, reveals the existence of the liquidity dependence phenomenon in Japan.

4. Conclusion and Further Research

This study empirically examines liquidity dependence in the Japanese banking system. Acharya and Rajan (2024) and Acharya et al. (2024) pointed out the liquidity dependence phenomenon that was observed during the quantitative easing and tightening policies in the United States and is regarded as a possible factor in the SVB bankruptcy in 2023. Since quantitative easing was introduced in March 2001, the Japanese economy has experienced a longer period of quantitative easing than that in the United States, lasting more than 20 years. Our macro and micro analyses, which use more than 20 years of macroeconomic and bank-level accounting data, revealed the existence of the same phenomenon in the Japanese economy.

Our findings have implications for both financial and monetary stability. On the financial stability side, the main takeaway from our findings is that the BoJ's QE may have incentivized an accumulation of liquidity risk in some banks, albeit to a lesser extent than that in U.S. banks, while the impending QT could not significantly alleviate the accumulation. Interestingly, the central bank's reserve provision could induce bank movements that would make the financial system potentially more vulnerable to liquidity risk. The Japanese economy has a deposit insurance system that is superior to the U.S. system, so an incident like the SVB bankruptcy is unlikely to occur in Japan. However, we suggest that the Japanese economy needs to prepare for the impending major quantitative tightening, the so-called exit from the long-term quantitative easing policy. If the sticky retail deposits become more flexible or large shocks affect banks that hold large amounts of flexible retail deposits, a bankruptcy might happen when bank solvency is in question. What conditions could trigger such situations and what types of banks would be vulnerable appear to be fertile areas for future analyses.

On the monetary policy side, one of the channels through which QE is intended to work is "portfolio rebalancing" under the preferred habitat theory (Vayanos and Vila 2021). However, our evidence shows that although the BoJ compressed long-term yields, banks are shortening the maturity of their liabilities by increasing demandable deposits. This limits the maturity-lengthening effect of QE on bank assets (loans), weakening some portion of the portfolio rebalancing channel. It may be necessary to revisit the desirable scale, scope, and duration of the next QE, giving due consideration to the financial stability issue and weakening effect of monetary policy, which also appear to be areas for future research. After eliminating the YCC framework and negative interest rate policy, the BoJ is heading toward a significant QT process. The symmetric but smaller or asymmetric behaviors in transforming the maturity of their liabilities suggests that QT's maturity-shortening effect on their assets might be maintained. This would, ceteris paribus, at least not weaken the tightening effect of QT, contrary to QE's easing effect.

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