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Taxation and Bank Liquidity Creation

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Taxation and Bank Liquidity Creation

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Abstract

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Keywords: Bank liquidity creation; Bank Capital; Taxes; Risk; Japanese Banks

JEL Codes: G21, G28

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1. Introduction

Bank liquidity creation has powerful effects on the real economy and financial system.[1] Prior research suggests that bank liquidity creation is driven by many factors, but somewhat surprisingly the role of taxes has only been indirectly examined.[2] In this paper, we utilize a quasi-natural experiment to test the effect of taxes on bank liquidity creation using the so-called Tokyo bank tax, which targeted the gross profit of large commercial banks with business operations in the Tokyo prefecture.

It is unknown *ex ante* whether taxes on bank profits lead to increased or decreased bank liquidity creation. By increasing the cost of equity, taxes make raising capital through retained earnings and other methods more difficult and incentivize debt over equity finance. As such, taxes have implications for bank capital. The *Risk Absorption Hypothesis* posits that capital is vital for liquidity creation, enabling banks to take on risks associated with creating liquidity (Allen and Santomero, 1997; Bhattacharya and Thakor, 1993). Conversely, the *Financial Fragility-Crowding Out Hypothesis* posits that capital inhibits liquidity creation as less fragility disincentivizes banks from monitoring risky borrowers – necessary to raise deposit funds to extend loans (Diamond and Rajan, 2000, 2001), and may also crowd out deposits (Gorton and Winton, 2017).

Prior research linking bank capital and liquidity creation yields mixed evidence on these hypotheses, even within the same study and/or same banking system. Berger and Bouwman (2009) find that bank capital negatively impacts liquidity creation for smaller banks (consistent with financial fragility-crowding out), but also has positive effects for larger banks in the US (supporting risk absorption). Evans and Haq (2022) also find mixed results over time in the US. For Asia-Pacific banks, Fu et al. (2015) find negative links between capital and liquidity creation,

[1] Banks create liquidity through loans to businesses to hire and invest (Levine and Zervos, 1998) and deposits providing households with safe returns and easy access to their savings (Diamond and Dybvig, 1983). Banks also create liquidity with off-balance sheet loan commitments that help firms plan future investments; credit card lines of credit that let households smooth consumption, and other off-balance sheet activities that allow financial market participants to manage risks, arbitrage market imbalances, and offer a variety of investment vehicles to the public (Merton and Perold, 1993; Holmstrom and Tirole, 1998).

[2] Bank liquidity creation determinants studied include competition (Jiang, Levine, and Lin, 2019; Berger and Boot, 2024); corporate governance (Díaz and Huang, 2017); CEO optimism (Huang, Chen, and Chen, 2018); peer-group behavior (Silva, 2019); prudential regulation and supervision (Distinguin, Roulet, and Tarazi, 2013; Nguyen et al., 2020).

but Gupta et al. (2023) find a mixed association. For Russian banks, Fungáčová et al. (2021) find associations between bank capital and liquidity creation vary by bank type.

Literature on taxes and bank behavior relies on changes in corporate income taxes or other taxes imposed on both banks and non-financial firms (Keen and DeMooij, 2016; Schepens, 2016; Pennacchi, 2019; Celerier, Kick, and Ongena, 2020).[3] This also applies when taxes are employed indirectly as determinants of liquidity creation through instrumental variables (Berger and Bouwman, 2009). However, this evidence cannot identify how tax affects bank liquidity creation or differentiate between the hypotheses. These taxes affect demand and supply for banking services that contribute to liquidity creation, but not necessarily for their liquidity creation properties. For example, corporate taxes may alter demand for bank loans by inducing non-financial firms to increase leverage, rather than seeking liquidity (Feld, Heckemeyer, and Overesch, 2013; Faccio and Xu 2015; Heider and Ljungqvist, 2015).

In contrast, we exploit a gross profit tax that exclusively targets banks, enabling us to directly test the effects of bank taxes on liquidity creation and distinguish between the *Risk Absorption* and *Financial Fragility-Crowding Out Hypotheses*.[4] We employ the comprehensive bank liquidity creation measure of Berger and Bouwman (2009) that incorporates the effects of all categories of assets, liabilities, and off-balance sheet activities. We also test the mechanism driving our findings and investigate which asset-side, liability-side, and off-balance sheet-side liquidity creation services are most impacted by taxes. We use semi-annual financial statements for a sample of Japanese commercial banks over the period 1998-2002, straddling the

[3] Keen and DeMooij (2010) and Pennachi (2019) focus on the impact of corporate income taxes on bank behavior. Likewise, Schepens (2016) and Celerier, Kick, and Ongena (2020) examine the effect of the Allowance for Corporate Equity (ACE) on banks. The ACE tax (which applied to both banks and corporates) allows for the deduction of a notional return on equity from taxable income.

[4] A number of studies investigate bank specific taxes, primarily focusing on European bank levies. Although these Pigouvian-type levies apply exclusively to banks, their purpose is to create disincentives for increasing systemic risk by taxing bank liabilities or assets, rather than bank profits (Belluci et al., 2023; Bremus, Schmidt, and Tonzer, 2020; Capelle-Blancard and Havrylchyk, 2017). In contrast, to such levies, the tax we investigate in this paper is akin to a corporate income tax, specifically targeting banks' gross profits. Gross profits comprise the sum of net interest income, net trading income, and net fee and commission income, before overhead, administrative or loan write-off deductions. In contrast to corporate income taxes, banks cannot readily reduce their exposures to the gross profit tax by inflating these aforementioned expenses. Consequently, a gross profit tax is ideal for investigating the impact of corporate income taxation on the core liquidity creation function of banks.

introduction of the tax in 2000. To account for Japan-specific differences in the reporting requirements, we adjust the measure using the approach of Gunji et al. (2021).

We find that tax-affected banks reduce liquidity creation by 2.9% relative to unaffected counterparts. The decline in liquidity creation is largely driven by fewer long-term risky loans to corporates and households and a shift toward holding safer, more liquid assets, including government bonds. These results are in line with the notion of a drain in liquidity for private sector investments, with potential implications for the financial system and the real economy. Our findings of reduced liquidity creation and shift from riskier loans to safer bonds are both consistent with the empirical domination of the *Risk Absorption Hypothesis.*

Our results may also reflect in part substitution effects away from risky loans because the Tokyo bank tax does not allow for the deductibility of loan write offs. However, we also document negative effects of taxes on capital and retained earnings, suggesting that the reduction in liquidity creation can be attributed significantly to the income effects from the tax. The loss of capital and ability to replenish it from retained earnings leaves little buffer to absorb risks, also consistent with the empirical domination of the *Risk Absorption Hypothesis.*

Our findings are also consistent with previous studies on other impacts of the Tokyo bank tax. Focusing on market reactions, Imai and Hull (2012) find the surprise announcement of the tax led to negative abnormal stock returns of firms expected to suffer credit supply losses from the taxed banks. Focusing on the real economy, Sobiech et al. (2021) find that the Tokyo bank tax negatively affected the investment behavior of corporate borrowers. We expand on previous studies by focusing on banks' liquidity provision to a wide range of stakeholders, extending beyond the impacts on corporate borrowers only. This approach enables us to evaluate the impact of the Tokyo bank tax on a broader spectrum of liquidity-creating activities such as the provision of liquid liabilities through deposits, as well as liquidity-hoarding activities such as investments in government bonds and cash holdings.

To ensure robustness, we conduct additional tests. These include the use of a continuous treatment indicator – capturing the relative business exposure to the Tokyo prefecture of affected

banks – as well as alternative samples with restrictive criteria for covariate balance between treated and control groups of banks. We further use a matching approach where we match treated and control banks on earnings and loan quality. We also investigate the impact of confounding events, including capital injections; merger and acquisitions; changes in monetary policy in the form of quantitative easing in Japan; and the bursting of the dot-com bubble in the US. We also assess the internal validity of our findings via a placebo test. The effects of the tax repeal using the standard event study approach and the heterogeneity-robust difference-in-differences estimator is also conducted (Chaisemartin et al. 2024). These additional investigations corroborate the causal interpretation of our main findings.

The remainder of the paper is structured as follows. Section 2 provides a background to the current study. The sample and methodology are described in Section 3. Section 4 discusses the main results. Section 5 concludes with some research and policy conclusions.

2. Background

In the 1980s, Japan witnessed the formation and then bursting of a stock market and real estate bubble. This was followed by a severe banking crisis, which had a long-lasting impact ('lost decades') on the banking system and real economy from the 1990s onwards.[5] Many Japanese banks with extensive equity holdings in real estate companies and loans collateralized by real estate, experienced dramatic declines in the value of their assets and capital. The effects of the crisis on bank profits were severe, with write-downs and losses amounting to ¥46.5 trillion ($431.3 billion) during the second half of the 1990s (Bank of Japan, 2000). The bankruptcy of some of Japan's largest banks in 1997 brought the banking system close to the brink of collapse. To rescue the ailing banks, the Japanese Government stepped in with large-scale capital injections using public funds amounting to ¥9,8 trillion ($90.9 billion) equivalent to 1.9% GDP.

[5] For a more detailed discussion of the banking crisis and recent evolution of Japanese banking, see Uchida and Udell (2014, 2019, 2024).

The financial crisis and subsequent slowdown in economic activity led to a large decline in tax revenues of local governments in the late 1990s. The Tokyo Government incurred an estimated revenue shortfall amounting to ¥700 billion ($6.4 billion) in 1999. To reduce the sensitivity of local tax revenues to economic fluctuations, the Tokyo Government introduced what was later better known as the Tokyo bank tax. It was levied at a rate of three percent on bank gross profits comprising the sum of net interest income, net trading income, as well as net fee and commission income. As such, taxable earnings comprised interest income net of interest expenses. Notably, unlike corporate income tax, operating expenses and loan write-off deductions were excluded from the taxable calculation. At the time, gross profits constituted a more stable tax base than the more volatile net profits.

After its initial announcement on February 7, 2000, the tax became effective on April 1, 2000, and was to be levied over a five-year period. The tax was exclusive to the prefecture of Tokyo and did not apply to other parts of Japan. It specifically targeted banks, while excluding non-financial firms. To be liable for the tax, banks had to meet two criteria. First, they needed to have a presence in the Tokyo prefecture, either through branches or a headquarters. Second, they had to have deposits exceeding ¥5 trillion or (approximately) $46 billion (DeWit, 2000). Banks with deposits below this deposit threshold or without a physical presence in Tokyo were exempt. The affected banks viewed the tax as an undue financial burden and filed a lawsuit against the Tokyo Government in 2000. Two years later, the Tokyo District Court ruled the tax void, citing its unfair treatment of the banking industry. Following the court's decision, the Tokyo Government ceased collecting the tax, and refunded the amounts previously collected.

The tax affected 17 commercial banks.[6] Among the commercial bank types affected by the tax were city and regional banks. These types of banks account for approximately 85% of the total assets of the banking industry in Japan. City and regional banks provide financing to companies but may differ in the size of the firms they lend to. While regional banks typically focus on small

[6] A number of non-commercial banks such as Shinkin Central Bank were also affected. Foreign banks were not subject to the provisions of the Tokyo bank tax.

to medium-sized domestic companies, city banks also serve large corporations domestically and overseas.[7]

Given their size, city and regional banks represent an integral part of Japan's payment system. These banks perform the twin role of distributing currency, and producing and servicing demand deposits. Regional and city banks also engage actively in the trading of financial derivatives with a particular focus on interest rate swaps. They also pursue traditional off-balance sheet activities including the provision of standby letters of credit and other commitments.

Despite the deregulation of the Japanese banking industry, city and regional banks maintained the characteristics of traditional financial intermediaries throughout the 1990s. In terms of balance sheet composition, loans made up the majority of assets of city and regional banks. These assets were funded mainly by deposits, albeit to a lesser extent for city relative to regional banks. The equity capital ratio of both city and regional banks was approximately 4%. During the 2000s, security holdings and government bonds became relatively more important, particularly for city banks. To fund assets, regional banks increased their reliance on deposits, while city banks began to reduce dependence on deposit funding. Overall, there was a proliferation of liquid demand deposits relative to other forms of deposits. City banks also held considerably more equity capital during the 2000s.

3. Methodology

3.1 Empirical model

Our identification strategy is based on a difference-in-differences estimation where we compare the liquidity creation of banks affected by the Tokyo bank tax to their counterparts unaffected by the tax. We classify the 17 commercial banks that are liable to the Tokyo bank tax as treated banks and banks that are not liable as the control group. The control group comprises

[7] At the onset of the Japanese banking crisis commencing in the early 1990s, city banks began to drastically retreat from their international activities evidenced by a decline in overseas lending (Peek and Rosengren, 2000).

banks without branches or headquarter in Tokyo as well as Tokyo-based banks below the size threshold of ¥5 trillion (approximately $46 billion). Our model to be estimated is:

$$y_{it} = \delta \underbrace{Bank_i^{Taxed} \times Post_t}_{TAX_{i,t}} + \beta X_{i,t-1} + \alpha_i + \gamma_t + \epsilon_{it} \quad (1)$$

In Equation (1), i and t denote bank and time (half year), respectively. y_{it} represents our measures of bank liquidity creation (discussed in Section 3.2). $TAX_{i,t}$ is an indicator variable that equals zero for all banks in the pre-Tokyo bank tax period and one for those banks that are taxed when the Tokyo bank tax is enacted. The coefficient δ captures the impact of the Tokyo bank tax on bank behavior.

$X_{i,t-1}$ represents a vector of bank-level control variables that vary over time and across banks. These control variables account for factors that could influence the level of bank liquidity creation as well as any observed pre-intervention differences in the characteristics of treated and non-treated banks. We include *bank size* measured as the log of total assets. *Market share* is measured as the proportion of individual bank assets to total aggregate assets. *Asset quality* is measured by the ratio of non-performing loans to total assets. *Earnings* are defined as net income before taxes plus loan loss provisions, divided by total assets (Altamuro and Beatty, 2010). In order to avoid simultaneity each control variable enters the model lagged by one period. Bank fixed effects, α_i, and time fixed effects, γ_t, capture the unobserved characteristics of banks and economy wide disturbances. ϵ_{it} is the error term. Standard errors are clustered at the bank level to account for within-bank correlation (Bertrand, Duflo, and Mullainathan, 2004).

3.2 Liquidity creation measurement

We construct the liquidity creation measure by classifying balance sheet and off-balance sheet items as liquid, semi-liquid, or illiquid, and assigning weights corresponding to each item's contribution to liquidity creation. Items that create liquidity are assigned a positive weight (0.5). These include illiquid assets (corporate bonds) and liquid liabilities (deposits). Items that do not contribute to liquidity creation are assigned a negative weight (-0.5). These include liquid assets (government bonds), illiquid liabilities and equity. Items with a neutral effect on liquidity creation

are assigned a weight of zero. These include semi-liquid assets, semi-liquid liabilities (time-deposits), as well as semi-liquid off-balance sheet items.

The liquidity creation measure include some items specific to the accounting conventions and reporting requirements for US banks, which differ from those prevailing in Japan (Black and White, 2003). To account for these differences, we follow the classification and weighting scheme developed by Gunji et al. (2021). The classification and weights of the balance sheet and off-balance sheet items used to construct the Japan-adjusted measure is provided in Appendix 1, Tables 1.1 - 1.3.

We construct narrow and broad measures of bank liquidity creation. We also normalize these measures by beginning of period total assets. The narrow measure (*LCn/TA*) includes only bank balance sheet items, while the broad measure (*LC/TA*) includes both bank balance and off-balance sheet items. See Appendix 2 for definitions and weights.

Table 1 reports the mean and standard deviation of the bank liquidity creation measures for treated and non-treated banks before and after the introduction of the Tokyo bank tax.[8] Comparing the broad liquidity creation measure with the narrow measure, we observe that the former is larger for both groups of banks. This suggests that off-balance sheet activities of Japanese banks generally contribute to creating rather than destroying liquidity. Examining changes in liquidity creation in the before and after periods for both types of banks, we observe a reduction in the (broad) liquidity creation measure for treated banks of 5.4%, and a 6.2% increase in liquidity creation for unaffected counterparts.

A benefit of using the liquidity creation measure is that it captures a large range of banking activities. This is particularly relevant for investigating tax effects, given that taxes can prompt many types of behavioral responses that may be captured by this measure**.**

[8] Summary statistics for all variables used in our analysis are provided in Appendix 4, while Appendix 5 provides a list of variable definitions.

3.3 Data

The main focus of the empirical analysis conducted in this paper is on commercial banks operating in Japan during the period from April 1998 to March 2002. We obtain detailed semi-annual balance sheet and income statement data from Nikkei NEEDS Financial Quest. We hand collect additional data on the location of bank offices and tax payments from Japanese annual *yūhō* reports. The sample period straddles the introduction of the Tokyo bank tax in April 2000. In order to guarantee sufficient overlap in the distribution of the covariates across the treated and non-treated banks, we restrict our analysis to commercial banks that share common characteristics in terms of size and legal form.[9] Our sample comprises publicly listed city and regional banks. Trust banks and long-term credit banks are excluded from the sample, since these types of banks have business models that are fundamentally different from those pursued by commercial banks.

Following established practice in liquidity creation literature, our study focuses on banks with similar size distributions. To ensure sufficient overlap in the size distribution of banks in the treatment and control group, we exclude control banks with an asset size below that of the smallest treated bank. Our final sample is an unbalanced panel of 433 bank-year observations of 57 Japanese commercial banks (8 City banks and 49 Regional banks). Of the 57 commercial banks in our sample, 17 banks were affected by the Tokyo bank tax. Table 1 also reports the mean and standard deviation for each of the control variables used in our empirical analysis for both treated and non-treated banks before and after the introduction of the Tokyo bank tax. Overall, the summary statistics confirm that the treated and control group banks are on average relatively similar across a number of covariates. We list the names of banks included in our sample in Appendix 3.

[9] Using a more homogenous sample allows for better statistical inference in difference-in-differences studies (Imbens and Rubin, 2015). Our results hold when using the full sample of Japanese commercial banks (available upon request). In robustness tests, we also perform additional matching of treated and control banks (see section 5.2).

4. Findings

4.1 Main results

Table 2 presents our main results. In Column 1 we report estimates using the broad liquidity creation measure as the dependent variable controlling for time and bank fixed effects only. The estimated δ coefficient is -0.036, and is statistically significant at the 1% level. This suggests that banks affected by the Tokyo bank tax experience a 2.9% reduction in liquidity creation relative to unaffected counterparts.[10] The economic significance of the impact of the tax on bank liquidity creation is considerable. To illustrate this point, consider the average treated bank in our sample which created liquidity in the amount of ¥9.6 trillion ($89 billion) in the pre-treatment period. The 2.9% reduction in the broad liquidity measure implies a loss of ¥278 billion ($2.57 billion) in liquidity creation for the average treated bank.[11]

In Column 2, the dependent variable is the narrow liquidity creation measure. The results using this measure are similar in both size and significance to the results for our broad liquidity creation measure. This suggests that the reduction in liquidity creation by the taxed banks is not due to changes in OBS activities. The effect of taxation on liquidity creation is robust when we control for bank-level time varying characteristics (shown in Column 3 and 4) and adding $time \times region$ fixed effects (Column 5 and 6), albeit the coefficients become marginally smaller.[12] Overall the results suggest that bank liquidity creation is sensitive to tax. We observe a decrease in bank liquidity creation following the imposition of the gross profit tax. This finding is in line with the *Risk Absorption Hypothesis*.

To explore the effects of the tax in more detail, we decompose our bank liquidity creation measure into its asset and liability components. This allows us to examine whether the reduction in bank liquidity creation is driven by adjustments on the asset- or liability-side of banks' balance

[10] We use the approximation by Kennedy (1981) to transform the dummy coefficient into a percentage expression using: $p = 100 \times (exp[c - 0.5 \times V(c)] - 1)$. p is the percentage change in the dependent variable, c is the coefficient estimate for the dummy variable (TAX) and $V(c)$ is the estimated variance for this coefficient.
[11] This compares to ¥3.3 billion ($30 million) of tax paid to the Tokyo Government by the average bank.
[12] We introduce region-time effects to control for time varying local economic conditions. Region refers to Japanese eight regions: Hokkaido, Tohoku, Kanto, Chubu, Kinki, Chugoku, Shikoku, and Kyushu.

sheets. We also examine the impact of the tax on bank capital as this allows us to investigate whether capital is the underlying mechanism via which tax impacts bank liquidity creation.

4.2 Effects of tax on capital and components of liquidity creation

We augment our main analysis by investigating the extent to which the Tokyo bank tax affects bank capital and the components of liquidity creation. First, we re-estimate Equation 1 with bank capital and retained earnings as outcome variables to test for the presence of the tax income effect. This allows us to cast light on the underlying mechanism driving relations between taxes and bank liquidity creation. We define capital as the ratio of equity capital to total assets and retained earnings as the ratio of retained earnings to total assets. Table 3 Panel A Columns 1 to 2 report the results. The coefficient on the capital is negative and statistically significant, suggesting that the tax leads to a decrease in the capital ratio. The coefficient on the ratio of retained earnings to total assets is also negative and statistically significant. The coefficient of 0.007 corresponds to a 0.7% reduction in retained earnings. With the average treated bank retaining earnings of around ¥187 billion ($1.73 billion) in the pre-treatment period, this amounts to a reduction of ¥1.3 billion ($12 million) of retained earnings for the average treated bank in response to the tax. As such, our results lend support to the notion that the Tokyo bank tax affects bank liquidity creation via income effects.

Next, we decompose the liquidity creation measure into asset-side, liability-side, and off-the-balance-sheet measures (see Appendix 2 for definitions). We then use these measures as outcome variables to re-estimate Equation 1. The asset-side liquidity creation measure allows us to examine whether banks reduce overall liquidity creation by creating less liquidity for bank customers that demand funds (corporate borrowers). Conversely, the liability-side liquidity creation measure allows us to investigate whether liquidity creation declines for bank customers that provide funds (depositors).

A priori, we would expect taxes that drain capital and deplete retained earnings to have negative implications for bank asset-side liquidity creation. In the presence of binding regulatory

capital constraints, a tax-induced decrease in capital increases the likelihood of violating capital requirements. To substitute for lower loss absorption capacity, banks may reduce asset risk by shifting toward assets with lower risk-weights. We expect this tax-induced substitution effect to manifest in lower asset-side liquidity creation as banks shift out of liquidity-creating assets (e.g. corporate loans) into liquidity-destroying assets (e.g. government bonds).

Table 3 Panel B presents the results of regressing asset-side, liability-side, and off-balance-sheet liquidity creation (normalized by total assets) on bank tax. We find that the Tokyo bank tax reduces asset-side, but has no impact on liability-side liquidity creation. The 2.8% decline in asset-side liquidity creation is relatively large in economic terms, while off-balance-sheet liquidity creation declines by a mere 0.25%. This suggests that the reduction in bank liquidity creation occurs primarily on the asset-side of bank balance sheets.

Overall, our analysis reveals that the reduction in bank liquidity creation results from a decline in liquidity created on the asset-side of bank balance sheets. Liquidity creation on the liability-side of bank balance sheets is not affected by the tax, and as such does not offset the negative tax effects observed on asset-side liquidity creation. The absence of a tax effect on liability-side liquidity creation suggests that tax-affected banks continue to create liquidity for depositors, but transform less of these funds into illiquid assets.

To further investigate the type of assets banks adjust when reducing liquidity creation, we further decompose asset-side liquidity creation into illiquid, semi-liquid, and liquid asset components. We do the same for the liability-side and off the balance sheet liquidity creation. These decompositions yield additional insights regarding the underlying mechanism driving the observed decline in liquidity creation following an increase in bank taxation.

Table 3 Panel C reports the results from regressing components of asset-side liquidity creation on bank tax. We find that tax-affected banks increase liquid as well as semi-liquid assets. Neither of these classes of assets create liquidity. Specifically, liquid assets deplete liquidity creation, while semi-liquid assets have no effect on liquidity creation. Panel D reports the results for liability-side components. In line with results reported in Panel B, we find that the tax has no

effect on illiquid, semi-liquid or liquid liabilities. Panel E Column 1 and 2 report the results for off-balance sheet items. The coefficient for liquid off-balance sheet items is positive and statistically significant, but close to zero. This suggests that the tax effect is relatively weak for this component.

Our analysis of asset and liability components indicates that the negative effect of tax on bank liquidity creation results from a shift toward more liquid assets. While holding more liquid assets reduces the liquidity risk of a bank, it also reduces liquidity creation. The shift in asset-side liquidity creation towards safer, more liquid assets supports the notion that the Tokyo bank tax reduces banks' ability to absorb risk.

We further decompose the components of asset-side liquidity creation to explore which specific balance sheet items contribute to effects reported above. Table 4 shows the results for components of liquid assets (Panel A), as well as semi and illiquid assets (Panel B). In Panel A, the coefficients for cash and due from banks, call loans and bills bought as well as government bonds are positive and statistically significant. This suggests that banks increase their holdings of liquidity destroying assets. In Panel B, the coefficient for total loans is negative and statistically significant. From our decomposition of total loans, we find that the negative effect of the tax on total loans is primarily driven by a reduction in illiquid loans (Column 4). The coefficient is negative and statistically significant. Together with the observed shift towards more liquid assets, this shift away from illiquid loans further supports the *Risk Absorption Hypothesis*.

4.3 The risk absorption function of capital

The results presented thus far suggest that the Tokyo bank tax negatively affects asset-side liquidity creation, consistent with the *Risk Absorption Hypothesis*. In order to shed further light on this finding, we examine whether banks with *ex ante* higher or lower capital react differently to the tax. If the Tokyo bank tax impacts asset-side liquidity creation via the risk absorption function of bank capital, we would expect that the negative tax effect on bank asset-side liquidity creation is weaker (stronger) for banks with higher (lower) *ex ante* capital.

We augment Equation (1) with the interaction terms $TAX \times low\ capital99$ and $TAX \times high\ capital99$. *low capital99* (*high capital99)* is a dummy variable that is equal to one for banks that are one standard deviation below (above) the average value of the ratio of tier 1 capital to total assets in 1999 (the year prior to the introduction of the tax), and zero otherwise. The ratio is normalized to have zero mean and unit variance.[13] We then re-estimate Equation 1 using asset-side, liability-side and off-balance-sheet liquidity creation, as dependent variables.

Table 5 Panel A reports the results. The coefficients on *TAX* in Panel A, Columns 1 and 3 indicate that for the average bank, asset-side liquidity creation and off-balance-sheet liquidity creation decreases with tax. Regarding the interaction terms, we observe in Column 1 that the interaction term enters the regression with a positive sign, suggesting that the tax effect on asset-side liquidity creation is significantly weaker (stronger) for banks with *ex ante* higher (lower) capital. For instance, in Column 1, the coefficient of -0.045 on $TAX \times low\ capital99$ implies that the impact for a bank with one standard deviation below average capital ratio is much stronger than for the average bank. This suggests that poorly (low) capitalized banks reduce asset-side liquidity creation more than the average bank.

To further investigate the impact of the tax via the risk absorption function of capital, we estimate the effect of the tax on bank risk. Based on our previous findings, we conjecture that the risk profile of banks with *ex ante* lower capital is likely to be more sensitive to the imposition of the tax. We construct three measures of risk. To measure portfolio risk, we use risk-weighted assets to total assets. For overall risk we use the natural logarithm of the Z-score[14], as well as the volatility of return on assets. We estimate an augmented version of Equation 1 with the interaction terms $TAX \times low\ capital99$ and $TAX \times high\ capital99$. Table 5 Panel B reports the results. The coefficients on $TAX \times low\ capital99$ are negative for the risk-weighted assets ratio and the volatility of returns and positive for the Z-score. These findings suggest that in response

[13] Since the dummy variables *low capital99* and *high capital99* are not time varying, they are subsumed by the bank fixed effects.

[14] The Z-score is calculated as the sum of return on assets and the capital ratio, divided by the standard deviation of return on assets. We calculate the standard deviation over a period of three years.

to the introduction of the Tokyo bank tax, less well-capitalized banks decrease portfolio risk, while shifting asset portfolios toward more liquid assets, thus lowering their default risk. As such our findings lend further support to the *Risk Absorption Hypothesis*, and suggest that the reduction in liquidity creation following the introduction of the tax is accompanied by a reduction in risk for poorly capitalized banks.

Overall, our results suggest that banks differ in the extent to which they adjust the composition of asset-side liquidity creation. Consistent with the notion that capital enables banks to manage and absorb risk, we find that low-capitalized banks reduce asset-side liquidity creation much more than the average bank. Overall, our analysis reveals that the negative impact of taxes on bank liquidity creation is more pronounced for *ex ante* lower capitalized banks.

5. Robustness tests

5.1 Continuous treatment

To further verify the robustness of our results, we exploit differences in the tax treatment intensity of banks. Banks subject to the Tokyo bank tax vary in their business exposure to the Tokyo area, and hence in the amount of gross profit subject to the tax. We expect that the liquidity creation of banks with more business exposure to the Tokyo prefecture would decline by more following the introduction of the tax. In order to capture bank exposure to the Tokyo area, we calculate the number of branches in Tokyo as a share of the total number of domestic branches ($Tokyo\ branches_i$) for each bank in our sample for the year 1999 (pre-treatment year).[15] Multiplying $Tokyo\ branches_i$ by $Bank_i^{Taxed}$ and $Post_t$, we construct $TAX_{continous}$. In order to assess whether banks with more exposure to the Tokyo area were more affected by the tax, we replace TAX with $TAX_{continous}$, and re-estimate Equation (1). Table 6 reports the results, which suggest that banks with more exposure to the tax decreased liquidity creation relatively more than less exposed counterparts.

[15] Local prefecture taxes are allocated according to the number of employees as well as the size of offices.

5.2 Balance in covariates

To identify causal effects, difference-in-differences settings require that treatment and control groups are balanced across pre-treatment characteristics. In order to alleviate concerns that our results are driven by differences in the characteristics of banks in the treatment and control group, we make use of a strategy that is commonly employed in difference-in-differences studies when treatment affects all units, but varies in intensity (Card, 1992; Cooper et al., 2011; Draca, Machin, and Van Reenen, 2011). In line with this approach, we consider only the treated banks and divide them into two groups based on the intensity of banks being affected by the Tokyo bank tax.[16] We measure treatment intensity using the approach as outlined in Section 5.1. We then classify banks that have a high exposure to the Tokyo area (above sample average) as treated banks, and those with a low exposure (below sample average) as control banks. Table 7, Panel A, reports the pre-treatment mean for the two groups. We use Welch's t-test to test for differences in means between high- and low-exposure taxed banks. Overall, the computed statistics suggest that the characteristics of treated and control banks in this restricted sample become balanced across all considered observable characteristics (relative to our main sample). Table 7, Panel B, reports the results of estimating Equation (1) using our newly formed groups. The results further support our baseline findings reported in Table 2, and confirm that our conclusions are unlikely to be driven by differences in bank characteristics across treated and control banks.

Next, we control for differences in treated and control banks related to their earnings profile and loan write downs. As shown in Table 1, treated banks had on average negative earnings while control group banks had on average positive earnings.[17] In the wake of the banking crisis in the late 1990s, Japanese banks incurred large loan-write downs causing earnings to be negative and eroding bank capital. To alleviate concerns that differences in banks' earnings or loan write downs rather than the tax are driving our results, we match treated and control

[16] A downside of this approach is that it reduces the sample size considerably given that we only have 17 treated banks.
[17] Notably, the Tokyo bank tax was applied to gross profits. Consequently, even banks reporting negative net profits would still be subject to the tax.

group banks based on their earnings and loan write downs in the pre-tax period. To match banks, we use a propensity score matching with single nearest-neighbor and match on earnings (return on assets), as well as loans to bankrupt borrowers, delinquent loans, and restructured loans, normalized by total loans. Using the matched sample, we estimate Equation 1. Results are reported in Panel C in Table 7. The results are qualitatively and quantitatively similar to our baseline results. Coefficients are negative and statistically significant for liquidity creation, asset-side liquidity creation, capital and retained earnings suggesting that the tax rather than differences in banks earnings profile and loan write downs are driving our results.

5.3 Confounding events

Mergers and Acquisitions

Our difference-in-differences approach identifies the effect of the Tokyo bank tax on bank liquidity creation. One potential confounder of this identification is the merger and acquisition (M&A) activity involving banks in our sample. Bank mergers may have effects on our outcome variables similar to those attributed to the Tokyo bank tax. In order to check the robustness of our findings to bank M&A activity we include a dummy variable in the difference-in-differences regressions, which takes the value of one if a bank was involved in an M&A in that period and zero otherwise. The results which are reported in Table 8 Column 1 suggest that the tax effects on the different aspects of bank behavior are similar to the estimates reported in our main difference-in-differences analysis.

We also follow an alternative approach suggested by Hosono, Sakai and Tsuru (2009) of creating a sample of *pro forma* banks. Specifically, we treat acquiring and merging banks as a single institution before the merger by combining pre-merger financial statements of these banks. We then re-estimate Equation 1 using this sample of *pro forma* banks. If the effects of mergers rather than tax effects are driving our results, we would expect to see little or no tax effect on bank liquidity creation. Table 8, Columns 3 and 4 show significant negative coefficients on tax, suggesting that mergers are unlikely to be a driving factor behind our main findings.

Capital Injections

Prior empirical evidence suggests that capital injections cause a contraction in bank liquidity creation (Berger et al, 2016). To alleviate concerns that capital injections could potentially confound our analysis, we focus on the Prompt Recapitalization Act (PRA) enacted by the Japanese government in March 1998. Under this act, some banks in our sample received public capital injections. Importantly, however, none of the banks in our sample received a capital injection that coincided with the introduction of the Tokyo bank tax. Moreover, banks across the treatment and control group were subject to capital injections.

To control for the effects of capital injections, we re-estimate Equation 1 including a capital injection dummy variable, which takes the value one if a bank received capital under the Prompt Recapitalization Act in a given half-year period, and zero otherwise. Table 8, Columns 5 and 6, report these estimates. The coefficients on the capital injection dummy variable are positive and statistically significant, suggesting a positive relation between capital injection and bank liquidity creation - in line with theory which predicts higher capital enhances bank liquidity creation (Bhattacharya and Thakor 1993). Importantly, in both specifications, the sign, magnitude and significance on the coefficient on *TAX* are similar to those reported in Table 2.

Quantitative Easing

An alternative source of variation which could act as a confounder to our results is the quantitative easing (QE) program enacted by the Bank of Japan in March 2001. Given that QE affects all banks operating in Japan, banks with greater exposure to QE differ in their liquidity creation compared to counterparts with smaller exposures.[18] In the present setting, if banks unaffected by the Tokyo bank tax hold proportionally more QE-eligible assets on their balance

[18] That is, as the Bank of Japan buys QE eligible assets, the prices of these assets appreciate and banks that hold more of these should experience higher increases in equity (Adrian and Shin, 2010 2014; Brunnermeier and Sannikov, 2016). This may create additional risk-bearing capacity for these banks to invest in long-term illiquid assets, increasing liquidity creation.

sheets, we could observe a higher liquidity creation at these banks relative to their Tokyo bank tax affected counterparts.

To address this concern, we augment Equation (1) with two additional variables. QE is a dummy with value one for all periods after March 2001, and zero otherwise. Additionally, we introduce *EligibleAsset*, defined as the ratio of government bonds to total assets, along with its interaction with QE. We then re-estimate this augmented version of Equation (1). The results which are tabulated in columns 7 and 8 of Table 8 suggest that our main findings hold even after explicitly controlling for the possible effects of QE on liquidity creation.

Bursting of the Dot-com Bubble

The introduction of the Tokyo bank tax coincided with the bursting of the dot-com bubble (boom), which had a significant impact on stock markets around the world. From a peak value in April 2000, the Japanese Nikkei index declined by 20 percent in two months, and continued on a downward trend until 2003. Given that the banks affected by the tax had a high exposure to Tokyo city (Japan's financial center), it is reasonable to conjecture that these banks would be disproportionately affected by the dot-com bust. Moreover, many of the city banks also had considerable exposure to the US (epicenter of the Dot-com bust) via their subsidiaries. In order to alleviate concerns that the bursting of the dot-com bubble confounds our results, we exclude city banks from our sample. This allows us to focus exclusively on regional banks. While all regional banks in our sample have some exposure to the Tokyo area, this exposure is considerably less relative to that of city banks. Moreover, regional banks are less active in trading-related activities and have no subsidiaries operating in the US. Consequently, these banks are exposed less directly to trading losses emanating from the dot-com bust and the drastic decline in the Nikkei index. By excluding city banks from the sample, we are left with a sample of banks that are more homogenous in terms of business model (limited trading) and business exposure to the city of Tokyo and the US. Using the sample of regional banks only, we re-estimate Equation 1. Table 8,

Columns 9 and 10 report the results. The coefficient on liquidity creation is negative and statistically significant suggesting that our findings are robust and not driven by the dot-com bust.

5.4 Parallel trends

A key assumption underpinning our identification strategy – commonly referred to as the parallel trends assumption – is that treated and control banks demonstrate similar trends in liquidity creation in the absence of treatment. In this section, we first graphically check whether our assumption holds. We also perform a placebo test by estimating Equation 1 replacing the treatment indicator with a placebo treatment.

Next, we examine dynamics in liquidity creation over the lifetime of the tax. This is of particular interest given that the Tokyo bank tax was planned initially to be levied over a five-year period, but was suddenly repealed two years after enactment following a court order by the Tokyo High Court ruling the tax to be against the principles of fair taxation. The Tokyo Government abolished the tax in March 2002. Figure 1 shows the dynamics of liquidity creation around the introduction and repeal of the Tokyo bank tax. Prior to the introduction of the Tokyo bank tax in April 2000, we observe that treated and control banks exhibit similar trajectories in total liquidity creation, as well as asset-side and liability-side liquidity creation. This suggests that the parallel trends assumption for the period prior to the introduction of the tax is not violated, and that anticipation effects are not present. With the introduction of the Tokyo bank tax, the dynamic effects corroborate that tax-affected banks reduce liquidity creation and asset-side liquidity creation but not liability-side liquidity creation, in line with our baseline regression results reported in Table 2 and 3. Figure 1 shows that the impact is most prominent in the year immediately following the introduction of the tax. With the repeal of the tax at the end of fiscal year 2002, the dynamics change again. The upward trend substantiates that banks increase liquidity creation in the immediate period after the repeal of the tax. This suggests that bank liquidity creation responds positively to the abolition of the tax. This effect may be in part due to the windfall income when the Tokyo Government reimbursed the tax payments.

Placebo test

Although not directly testable, placebo tests can to some extent mitigate concerns regarding parallel trend violations. We conduct a placebo test by assuming falsely that the Tokyo bank tax was introduced one year prior to actual adoption. This tests for potential anticipation effects that might lead to pre-emptive behavior on the part of affected banks. Table 9 presents results. None of the coefficients on *Placebo-Tax* are significant. Together, our findings suggest that the parallel trends assumption is not violated; anticipation effects are not present; and the observed changes in the outcome variables are associated with the introduction of the Tokyo bank tax.

5.5 Repeal of the tax

Our analysis thus far has focused on the effects of the Tokyo bank tax on bank capital and liquidity creation. In this section, we examine the impact of the repeal of the tax. Initially, the Tokyo bank tax was intended to be in place for five years. However, it was repealed just two years after its introduction, following a ruling by the Tokyo High Court. The court deemed the tax excessively burdensome for banks and ordered the Tokyo Government to refund the collected taxes, along with accrued interest. Despite this ruling, the Tokyo Government soon announced new local tax measures. In place of the repealed tax, a new local business tax was enacted in 2003. While similar to the original Tokyo bank tax, this new tax applied not only to large banks but to all corporations exceeding a certain size threshold. The repeal of the Tokyo bank tax, coinciding with the introduction of a new local tax scheme affecting large banks, presents challenges for our analysis. Given that the two taxes not only coincided, but were also similar in nature. Consequently,, it is unclear as to the extent (if any) of the impact of the tax repeal on bank liquidity creation.

To examine the impact of the tax repeal, we perform an event study following Freyaldenhoven et al. (2021). Specifically, we estimate a standard dynamic two-way-fixed effects model given as: $y_{it} = \sum_{k=-5}^{k=5} \beta_k \, TAX_{i,t-k} + \beta X_{i,t-1} + \alpha_i + \gamma_t + \epsilon_{it}$. Figure 2 shows the corresponding event-study plots for bank capital, retained earnings and liquidity creation using

a time window of five periods ($k = 5$) before and after the introduction of the Tokyo bank tax. These plots confirm our baseline findings by showing that the introduction of the tax had a significant negative impact on bank capital, retained earnings and liquidity creation. With respect to the repeal of the tax, the event plots present a more nuanced picture. The coefficient for the post-repeal period is positive but not statistically significant. However, we do observe a statistically significant positive difference between the coefficients during the pre- and post-repeal periods. This suggests that the repeal alleviated much of the negative impacts, albeit it did not fully reverse the effects of the Tokyo bank tax. The incomplete recovery may also be attributed to the confounding effect of the new local business tax introduced by the Tokyo Government, which likely dampened the full positive impact of the repeal.

Motivated by concerns that OLS estimates may be biased when treatment effects are heterogeneous (Sloczynski, 2020), we next apply the heterogeneity-robust difference-in-differences estimator developed by Chaisemartin et al. (2024). This approach allows us to separately assess the effects of the introduction and the repeal of the Tokyo bank tax on bank liquidity creation. We estimate the weighted average slope (WAS) parameter, with Table 10 providing distinct estimates for both the introduction and the repeal. The estimates for the introduction align with our baseline results from Tables 2 and 3 (Panel A), indicating the robustness of our findings across different difference-in-differences estimators. For the repeal, the coefficient for liquidity creation is positive, but not statistically significant, while the coefficients for capital and retained earnings are near zero (and also not significant). Consistent with the event study results, this suggests that the repeal did not fully reverse the effects of the Tokyo bank tax. As noted previously, this may be due to the introduction of a new local business tax acting as a confounding factor.

6. Conclusion

We expand the research literature on bank liquidity creation and the real economy and financial system by examining the effects of taxes on bank liquidity creation. We leverage a unique

quasi-natural experimental research design centered on the introduction of the Tokyo bank tax. We find support for the *Risk Absorption Hypothesis* over the *Financial Fragility-Crowding Out Hypothesis* and document the presence of a tax income effect. Taxes negatively affect bank capital and retained earnings, encouraging banks to shift towards less risky assets while reducing liquidity available to the public. These findings underscore the potential unintended consequences of bank tax policies and suggest implications for policy makers tasked with designing tax schemes for banks, especially amidst ongoing regulatory reforms and debates concerning capital regulations in the post-crisis and post-pandemic eras (Van der Weide and Zhang, 2019; Ambrocio, Hasan, and Siddique, 2024).

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Tables and Figures

Table 1 | Summary Statistics

Treated banks	Before				After			
	Mean	*SD*	*Min*	*Max*	*Mean*	*SD*	*Min*	*Max*
Liquidity creation (*LC/TA*)	36.88	5.1	24.61	51.15	35.15	5.87	19.22	45.35
Liquidity creation (*LCn/TA*)	34.98	5.04	21.43	49.4	33.7	5.96	17.23	43.61
Capital ratio	3.77	1.22	1.47	6.71	4.59	1.03	2.85	7.65
Asset Quality	2.78	2.01	0	9.4	3.78	1.45	2.23	7.71
Earnings	-0.14	0.86	-3.38	0.89	0.43	0.18	-0.06	0.89
Market Share	3.23	2.8	0.23	9.55	3.3	2.8	0.7	8.99
Size (log)	30.43	1.02	28.4	32.04	30.46	1.01	29.33	31.99
Number of banks	17				16			

Control banks	Before				After			
	Mean	*SD*	*Min*	*Max*	*Mean*	*SD*	*Min*	*Max*
Liquidity creation (LC/TA)	32.19	4.44	18.85	41.28	33.35	4.98	20.18	44.35
Liquidity creation (LCn/TA)	31.09	4.32	18.1	40.52	32.43	4.85	19.7	43.67
Capital ratio	4.26	1.13	0.13	6.75	5.23	1.26	1.92	8.64
Asset Quality	2.32	1.9	0	9.32	3.99	1.87	1.12	10.64
Earnings	0.21	0.7	-3.22	1.37	0.23	0.62	-3.51	0.95
Market Share	0.38	0.12	0.14	0.73	0.41	0.13	0.22	0.74
Size (log)	28.73	0.29	28.33	29.4	28.77	0.3	28.34	29.36
Number of banks	40				40			

The table presents means and standard deviations, minimum and maximum of both dependent and control variables used in our analysis before and after the introduction of the Tokyo bank tax and by treatment status. The broad liquidity creation (*LC/TA*) measure includes balance sheet as well as off-balance sheet items. The narrow liquidity creation measure (*LCn/TA*) excludes off-balance sheet items. Both measures express liquidity created in Japanese yen per one Japanese yen of total assets employed. Capital ratio is defined as ratio of equity to total assets. The set of control variables include asset quality, earnings, size, and market share. Asset quality is measured by the ratio of non-performing loans to total assets. Earnings are defined as net income divided by total assets. Bank size is measured as the natural logarithm of total assets. Market share is measured as the proportion of an individual banks' assets to total aggregate assets. Variables are reported in percent.

Table 2 | Tax and bank liquidity creation

	(1) *LC/TA*	(2) *LCn/TA*	(3) *LC/TA*	(4) *LCn/TA*	(5) *LC/TA*	(6) *LCn/TA*
TAX	-0.036***	-0.033***	-0.033**	-0.031**	-0.025**	-0.023**
	(0.013)	(0.012)	(0.011)	(0.011)	(0.010)	(0.010)
Asset Quality			-0.001	-0.001	-0.001	-0.001
			(0.002)	(0.002)	(0.003)	(0.003)
Earnings			0.000	0.000	0.002	0.002
			(0.003)	(0.003)	(0.003)	(0.003)
Market Share			-0.020	-0.016	-0.004	-0.000
			(0.043)	(0.040)	(0.028)	(0.027)
Size			-0.082**	-0.084***	-0.103*	-0.102*
			(0.031)	(0.030)	(0.053)	(0.051)
Constant	0.325***	0.311***	1.62***	1.619***	1.977**	1.953**
	(0.003)	(0.003)	(0.467)	(0.444)	(0.798)	(0.759)
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	-	-
Time*Region FE	-	-	-	-	Yes	Yes
R^2	0.165	0.186	0.218	0.238	0.832	0.833
N	447	447	447	447	446	446

This table reports the results of ordinary least square regressions using a sample of 57 Japanese banks spanning the period from April 1998 to March 2002. The dependent variable *LC/TA* and *LCn/TA* (narrow) are the liquidity creation measures as defined in Section 3.2 using the classification of bank activities by Gunji et al. (2021). See Appendix Table 1.1-1.3 for a full list of balance sheet items and corresponding weights. The main explanatory variable is *TAX*, an indicator variable equal to one for banks affected by the Tokyo bank tax when it comes into effect and zero otherwise. In Column 1 and 2, we introduce time and bank fixed effect. In Column 3 and 4, we additionally control for potential heterogeneity between treated and control banks by adding the lagged values of asset quality, earnings, market share, and size. Asset quality is measured by the ratio of non-performing loans to total assets. Earnings are defined as net income divided by total assets. Bank size is measured as the natural logarithm of total assets. Market share is measured as the proportion of an individual banks' assets to total assets. In Column 5 and 6, we additionally introduce time*region fixed effects. There are eight regions in Japan: Hokkaido, Tohoku, Kanto, Chubu, Kinki, Chugoku, Shikoku, and Kyushu. N is number of observations. Robust standard errors clustered at the bank level are reported in parentheses. ***, **, *, indicate significance at the 1%, 5%, and 10% level respectively.

Table 3 | Capital and components of liquidity creation

Panel A: Capital	*Capital/TA*	*Retained earnings/TA*	
TAX	-0.005***	-0.007***	
	(0.002)	(0.001)	
Panel B: Components of *LC/TA*	*LC-Asset/TA*	*LC-Liabilities/TA*	*LC-Off-balance/TA*
TAX	-0.034***	0.001	-0.003***
	(0.010)	(0.004)	(0.001)
Panel C: LC-Assets	*illiquid (+0.5)*	*semi-liquid (0)*	*liquid (-0.5)*
TAX	-0.027*	0.011	0.025*
	(0.014)	(0.011)	(0.014)
Panel D : LC-Liabilities	*illiquid (-0.5)*	*semi-liquid (0)*	*liquid (+0.5)*
TAX	-0.003	0.014	0.009
	(0.003)	(0.023)	(0.010)
Panel E: LC-Off-balance sheet	*illiquid (+0.5)*	-	*liquid (-0.5)*
TAX	0.002	-	0.007***
	(0.001)	-	(0.002)

This table reports the results of ordinary least square regressions using a sample of 57 Japanese banks spanning the period from April 1998 to March 2002. The main explanatory variable is *TAX*, an indicator variable equal to one for banks affected by the Tokyo bank tax when it comes into effect and zero otherwise. The dependent variables in Panel A are the capital ratio defined as equity capital to total assets; the change in the natural logarithm of capital; and the change in the natural logarithm of total assets. The dependent variables in Panel B are asset-side, liability-side, off-balance-sheet liquidity creation. See Appendix Table 1.1-1.3 for a full list of balance sheet items and corresponding weights. The dependent variables in Panel C are illiquid assets, semi-liquid assets and liquid assets. The dependent variables in Panel D are illiquid liabilities, semi-liquid liabilities, and liquid liabilities. The dependent variables in Panel E are illiquid off-balance sheet and liquid off-balance sheet items. All dependent LC-variables are normalised by total beginning-of-period assets and measured using weights presented in Appendix 2. Terms in brackets indicate weights of liquidity creation measure. A constant, a set of time dummies and bank specific fixed effects are included across all regressions. Robust standard errors clustered at the bank level are reported in parentheses. ***, **, *, indicate significance at the 1%, 5%, and 10% level respectively.

Table 4 | Liquid and illiquid assets

Panel A: Liquid Assets	*Cash and Due from Banks/TA*	*Call loans & Bills Bought/TA*	*Trading Account Securities/TA*	*Government Bonds/TA*
TAX	0.011***	0.005**	-0.002**	0.019**
	(0.004)	(0.002)	(0.001)	(0.009)
Panel B: Loan Categories	*Total Loans/TA*	*Bills Discounted/TA (semi-liquid)*	*Loans on Bills/TA (semi-liquid)*	*Loans on Deeds/TA (illiquid)*
TAX	-0.012*	0.001**	-0.002	-0.026***
	(0.007)	(0.001)	(0.002)	(0.009)

This table reports the results of ordinary least square regressions using a sample of 57 Japanese banks spanning the period from April 1998 to March 2002. The main explanatory variable is *TAX*, an indicator variable equal to one for banks affected by the Tokyo bank tax when it comes into effect and zero otherwise. The dependent variables in Panel A are subcategories of liquid assets: cash and due from banks (column 1), call loans and bills bought (column 2), trading account securities (column 3), government bonds (column 4). The dependent variables in Panel B are subcategories of loans: Total loans (column 1), bills discounted (column 2), loans on bills (column 3), loans on deeds (column 4). Dependent variables in Panel A, and B are normalised by total assets. A constant, a set of time dummies and bank specific fixed effects are included across all regressions. Robust standard errors clustered at the bank level are reported in parentheses. ***, **, *, indicate significance at the 1%, 5%, and 10% level respectively.

Table 5 | The risk absorption function of capital

Panel A: Components	*LC-Asset/TA*	*LC-Liabilities/TA*	*LC-Off-balance/TA*
TAX	-0.038***	0.008*	-0.003**
	(0.010)	(0.005)	(0.001)
$TAX \times low\ capital'99$	-0.045***	-0.017***	-0.004**
	(0.017)	(0.005)	(0.002)
$TAX \times high\ capital'99$	0.022	-0.013	0.002
	(0.016)	(0.008)	(0.002)
Panel B: Portfolio risk	*RWA/TA*	*Log(Z-score)*	σ*ROA*
TAX	-0.012	-0.461*	0.000
	(0.009)	(0.250)	(0.001)
$TAX \times low\ capital'99$	-0.043***	0.968***	-0.005***
	(0.009)	(0.350)	(0.001)
$TAX \times high\ capital'99$	0.030	0.354	-0.001
	(0.027)	(0.372)	(0.001)

This table reports the results of ordinary least square regressions using a sample of 57 Japanese banks spanning the period from April 1998 to March 2002. The dependent variables in Panel A are asset-side, liability-side, off-balance-sheet liquidity creation. See Appendix Table 1.1-1.3 for a full list of balance sheet items and corresponding weights. The dependent variables in Panel B are risk weighted assets to total assets, the natural logarithm of the Z-score, and the volatility of returns on assets. The interaction term *low capital99* (*high capital99)* is a dummy variable equal to one for banks that are a standard deviation below (above) mean value of the ratio of tier 1 capital to total assets in 1999. 1999 marks the year prior to the introduction of the tax. The ratio is normalized to have zero mean and unit variance such that *TAX* shows the impact for the average bank, while the coefficient on the interaction term *TAX* with capital indicates the impact of tax for banks with below/above average capital ratios. A constant, a set of time dummies and bank specific fixed effects are included across all regressions. Robust standard errors clustered at the bank level are reported in parentheses. ***, **, *, indicate significance at the 1%, 5%, and 10% level respectively.

Table 6 | Continuous treatment

	(1) *LC/TA*	(2) *LCn/TA (narrow)*	(3) *LC-Assets/TA*	(4) *LC-Liab./TA*	(5) *LC-Off-BS/TA*	(6) *Capital/TA*
$TAX_{continous}$	-0.156***	-0.143***	-0.146***	0.003	-0.014***	-0.014***
	(0.025)	(0.024)	(0.022)	-0.015	(0.002)	(0.004)
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Covariates	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.291	0.303	0.364	0.614	0.691	0.536
N	442	442	442	442	442	419

This table provides further robustness checks on the effect of the Tokyo bank tax on bank liquidity creation. The dependent variable in Column 1 and 2 are the liquidity creation measures, *LC/TA* and *LCn/TA* (narrow). See Appendix Table 1.1-1.3 for a full list of balance sheet items and corresponding weights. The dependent variable in Column 3 to 5 are the components of the liquidity creation measure: *LC-Assets/TA*, *LC-Liabilities/TA* and *LC-Off-balance-sheet/TA* and in Column 6 the dependent variable is capital defined as equity to total assets. See Appendix 2 for a definition of the LC variables. The explanatory variable $TAX_{continous}$ is the continuous treatment variable. We construct the variable by replacing the binary variable $Bank_i^{Taxed}$ (Equation 1) with a continuous variable, defined as the ratio of the number of branches in Tokyo as a share of the total number of domestic branches of treated bank *i* as of year 1999. The set of covariates include asset quality, earnings, size, and market share. Asset quality is measured by the ratio of non-performing loans to total assets. Earnings are defined as net income divided by total assets. Bank size is measured as the natural logarithm of total assets. Market share is measured as the proportion of an individual banks' assets to total assets. In addition, a set of time dummies and bank specific fixed effects are included across all regressions. Robust standard errors clustered at the bank level are reported in parentheses. ***, **, *, indicate significance at the 1%, 5%, and 10% level respectively.

Table 7 | Balance in covariates

Panel A	N	Asset Quality	Earnings	Market Share	Size
Original sample					
Treated	16	3.57	0.39	0.40	30.48
Control	41	3.76	0.45	3.37	28.73
Δ		-0.19	0.06	-2.97***	-1.76***
Intensity of treatment					
Treated	7	2.46	-0.33	3.59	30.51
Control	9	3.06	-0.14	2.89	30.29
Δ		0.60	0.19	-0.70	-0.22

Panel B	(1)	(2)	(3)	(4)	(5)	(6)
	LC/TA	*LCn/TA*	*LC-Assets/TA*	*LC-Liab./TA*	*LC-Off-BS/TA*	*Capital/TA*
TAX_{int}	-0.070***	-0.066***	-0.062***	-0.004	-0.004***	-0.007***
	(0.013)	(0.012)	(0.009)	(0.006)	(0.001)	(0.002)
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Covariates	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.608	0.599	0.773	0.733	0.754	0.769
N	118	118	118	118	118	118

Panel C	(1)	(2)	(3)	(4)	(5)	(6)
	LC/TA	*LCn/TA*	*LC-Assets/TA*	*LC-Liab./TA*	*Capital/TA*	*Retained earnings/TA*
TAX	-0.130***	-0.124***	-0.123***	-0.001	-0.012***	-0.014**
	(0.026)	(0.022)	(0.020)	(0.007)	(0.003)	(0.004)
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Covariates	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.311	0.331	0.421	0.614	0.581	0.577
N	401	401	401	401	401	401

This table provides further robustness checks on the effect of the Tokyo bank tax on bank liquidity creation. Panel A presents means and standard deviations of variables for the period before the Tokyo bank tax for treatment and control groups defined according to *intensity of treatment*. The intensity of treatment is calculated as the ratio of the number of branches in Tokyo to the total number of domestic branches of bank i as of year 1999. We test for differences in means using Welch's t-test. Differences in means for the original sample are reported for reference. In the sample "*intensity of treatment"*, treated banks are defined as banks liable to the bank tax with an above average exposure to the Tokyo area in the pre-treatment period. Control banks are banks liable to the bank tax with a below average exposure. Panel B reports the results from using the "*intensity of treatment*" sample. Treated banks are defined as banks liable to the bank tax with an above average exposure to the Tokyo area in the pre-treatment period. Control banks are banks liable to the bank tax with a below average exposure. The main explanatory variable is TAX_{int}, an indicator variable equal to one for banks with above average exposure to the Tokyo bank tax when it comes into effect and zero otherwise. Panel C reports the results from using a matched sample of banks. The main explanatory variable is *TAX*, an indicator variable equal to one for banks affected by the Tokyo bank tax when it comes into effect and zero otherwise. Robust standard errors clustered at the bank level are reported in parentheses. ***, **, *, indicate significance at the 1%, 5%, and 10% level respectively.

Table 8 | Confounding events

	(1) *LC/TA*	(2) *LCn/TA*	(3) *LC/TA*	(4) *LCn/TA*	(5) *LC/TA*	(6) *LCn/TA*	(7) *LC/TA*	(8) *LCn/TA*	(9) *LC/TA*	(10) *LNc/TA*
TAX	-0.032***	-0.029**	-0.029*	-0.027*	-0.030**	-0.028**	-0.037***	-0.034***	-0.081***	-0.083***
	(0.012)	(0.011)	(0.017)	(0.016)	(0.012)	(0.011)	(0.012)	(0.011)	(0.004)	(0.004)
Merger dummy	-0.023	-0.022	-	-	-	-				
	(0.020)	(0.019)								
Capital inj. Dummy	-	-	-	-	0.014**	0.012*				
					(0.006)	(0.006)				
$QE \times EligibleAsset$							-0.530***	-0.517***		
							(0.161)	(0.156)		
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.263	0.281	0.204	0.238	0.248	0.266	0.266	0.266	0.561	0.590
N	433	433	379	379	433	433	227	227	371	371

This table reports the results of ordinary least square regressions using a sample of 57 Japanese banks spanning the period from April 1998 to March 2002. The main explanatory variable is *TAX*, an indicator variable equal to one for banks affected by the Tokyo bank tax when it comes into effect and zero otherwise. The dependent variables are the liquidity creation measures, *LC/TA* and *LCn/TA* (narrow). See Appendix Table 1.1-1.3 for a full list of balance sheet items and corresponding weights. Columns 1 and 2 report the results for the regression model (Equation 1) with inclusion of a merger dummy variable. Columns 3 and 4 report the results for a sample of *pro forma* banks. Columns 5 and 6 report the results for the regression model (Equation 1) with inclusion of a capital injection dummy. Columns 7 and 8 report the results for the regression model (Equation 1) controlling for the quantitative easing period starting in March 2001. Column 9 and 10 report the results using a sample limited to regional banks (excluding city banks). The set of covariates include asset quality, earnings, size, and market share. Asset quality is measured by the ratio of non-performing loans to total assets. Earnings are defined as net income divided by total assets. Bank size is measured as the natural logarithm of total assets. Market share is measured as the proportion of an individual banks' assets to total assets. In addition, a set of time dummies and bank specific fixed effects are included across all regressions. Robust standard errors clustered at the bank level are reported in parentheses. ***, **, *, indicate significance at the 1%, 5%, and 10% level respectively.

Table 9 | Placebo tax

	(1) *LC/TA*	(2) *LCn/TA*	(3) *LC-Assets/TA*	(4) *LC-Liab./TA*	(5) *LC-Off-BS/TA*	(6) *Capital/TA*
$TAX_{placebo}$	-0.001 (0.006)	-0.000 (0.006)	-0.004 (0.006)	0.003 (0.002)	-0.001 (0.000)	0.007 (0.004)
Covariates	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.966	0.964	0.959	0.971	0.994	0.920
N	244	244	244	244	244	244

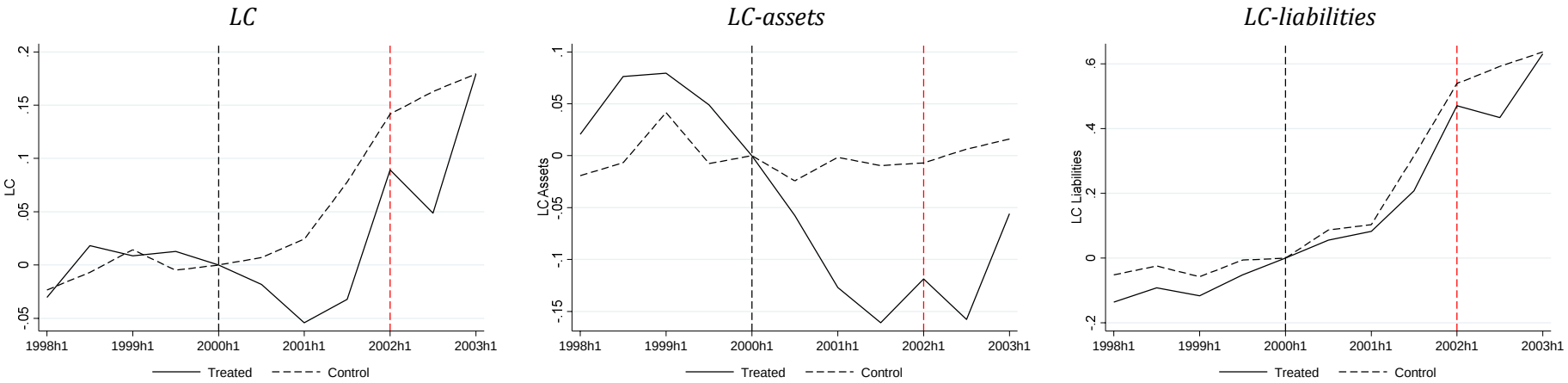
This table provides further robustness checks on the effect of the Tokyo bank tax on bank liquidity creation. The dependent variables are the liquidity creation measures, *LC/TA* and *LCn/TA* (narrow). See Appendix Table 1.1-1.3 for a full list of balance sheet items and corresponding weights. The dependent variable in Column 3 to 5 are the components of the liquidity creation measure: *LC-Assets/TA*, *LC-liabilities/TA* and *LC-Off-balance-sheet/TA.* The explanatory variable $TAX_{placebo}$ is the placebo treatment variable. We construct the variable by multiplying $Treated_i$ (Equation 1) with a placebo treatment ($post_t$ is equal to 1 for the period from April 1999 to March 2000). The set of covariates include asset quality, earnings, size, and market share. Asset quality is measured by the ratio of non-performing loans to total assets. Earnings are defined as net income divided by total assets. Bank size is measured as the natural logarithm of total assets. Market share is measured as the proportion of an individual banks' assets to total assets. In addition, a set of time dummies and bank specific fixed effects are included across all regressions. Robust standard errors clustered at the bank level are reported in parentheses. ***, **, *, indicate significance at the 1%, 5%, and 10% level respectively.

Table 10 | Repeal of the tax

	LC	*Capital/TA*	*Retained earnings/TA*
TAX Introduction	- 0.0121* (0.0055)	-0.0064** (0.0022)	-0.0078** (0.0024)
TAX Repeal	0.0350 (0.0496)	0.0008 (0.0007)	-0.0004 (0.0008)

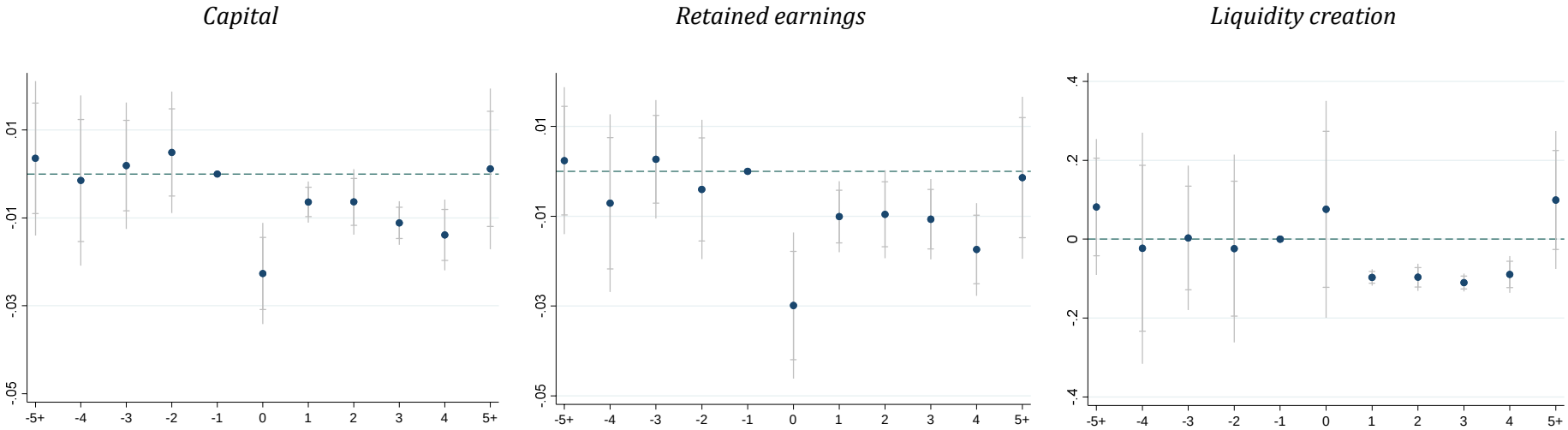
This table shows the average slopes estimates (see Chaisemartin et al. 2024) for the tax introduction and repeal. The sample period from FY1998 to FY2003 comprises the introduction and repeal of the tax. The main explanatory variable *TAX* is zero in the pre-treatment period for all banks, switches to one in April 2000 for all treated units, and takes the value of zero for all banks from March 2002. In addition, a set of time dummies and bank specific fixed effects are included. Standard errors clustered at the bank level are reported in parentheses. ***, **, *, indicate significance at the 1%, 5%, and 10% level respectively

Figure 1 | Bank liquidity creation over time



This figure shows total bank liquidity creation (Column 1), asset-side liquidity creation (Column 2) and liablity-side liquidity creation (Column 3). The tax was introduced in April 2000 (dotted black line) and abolished in March 2002 (dotted red line).

Figure 2 | Event study



This figure shows event study plots for bank capital (Column 1), retained earnings (Column 2) and liquidity creation (Column 3). The x-axis depicts event time. The tax was introduced in April 2000 (t=0) and abolished end of 2002 (t=4). The y-axis depicts the estimated coefficients.

Appendix 1

Table A1.1 Bank assets

ASSETS	Japanese	Liquidity creation	Weight
Cash and Due from Banks	現金預け金	liquid	-0.5
Call loan	コールローン	liquid	-0.5
Receivables under resale agreements	買現先勘定	liquid	-0.5
Receivables under securities borrowing Transactions	債券貸借取引支払保証金	liquid	-0.5
Monetary Claims Bought	買入金銭債権	liquid	-0.5
Trading Account Securities	商品有価証券	liquid	-0.5
Securities related to trading Transactions	特定取引有価証券	liquid	-0.5
Derivatives of securities related to trading transactions	特定取引資産の部合計負債	liquid	-0.5
Trading government bonds	国債	liquid	-0.5
Due from foreign banks (our accounts)	外国他店預け	liquid	-0.5
Bills discounted	割引手形	semi-liquid	0
Loans on bills	手形貸付	semi-liquid	0
Overdrafts	当座貸越	semi-liquid	0
Due from foreign banks (their accounts)	外国他店貸	semi-liquid	0
Municipal bonds	地方債	illiquid	0.5
Collected foreign exchange	取立外国為替	illiquid	0.5
Money trust	金銭の信託	illiquid	0.5
Short-term corporate bonds	短期社債	illiquid	0.5
Corporate bonds	社債	illiquid	0.5
Stocks	株式	illiquid	0.5
Other securities	その他の証券	illiquid	0.5
Loans on deeds	証書貸付	illiquid	0.5
Purchased forex	買入外国為替	illiquid	0.5
Unsettled foreign exchange	未決済為替貸	illiquid	0.5
Prepaid expenses	前払費用	illiquid	0.5
Receivable income	未収収益	illiquid	0.5
Corporate bond issuance costs	社債発行費	illiquid	0.5
Lease investment assets	リース投資資産	illiquid	0.5
Other assets	その他の資産	illiquid	0.5
Tangible fixed assets	有形固定資産	illiquid	0.5
Intangible fixed assets	無形固定資産	illiquid	0.5
Bond deferred assets	債券繰延資産	illiquid	0.5
Prepaid pension costs	前払年金費用	illiquid	0.5
Deferred tax asset	繰延税金資産	illiquid	0.5
Deferred tax assets for revaluation	再評価に係る繰延税金資産	illiquid	0.5
Allowance for doubtful accounts	貸倒引当金	illiquid	0.5
Reserve for investment loss	投資損失引当金	illiquid	0.5

Table A1.2 Bank liabilities and equity

LIABILITIES and EQUITY	Japanese	Liquidity creation	Weight
Certificate of deposit	譲渡性預金	liquid	0.5
Current accounts	当座預金	liquid	0.5
Ordinary deposit	普通預金	liquid	0.5
Savings deposit	貯蓄預金	liquid	0.5
Call money	コールマネー	liquid	0.5
Custody at other foreign stores	外国他店預り	liquid	0.5
Revenue account	売現先勘定	semi-liquid	0
Notification deposit	通知預金	semi-liquid	0
Time deposit	定期預金	semi-liquid	0
Periodic deposit	定期積金	semi-liquid	0
Other deposits	その他の預金	semi-liquid	0
Bonds	債券	semi-liquid	0
Bond loan transaction acceptance collateral	債券貸借取引受入担保金	semi-liquid	0
Bills for sale	売渡手形	semi-liquid	0
Commercial paper	コマーシャル･ペーパー	semi-liquid	0
Borrowing money	借用金	semi-liquid	0
Borrowing from another foreign store	外国他店借	semi-liquid	0
Short-term corporate bonds	短期社債	semi-liquid	0
Corporate bonds	社債	semi-liquid	0
Bonds with stock acquisition rights	新株予約権付社債	semi-liquid	0
Trust account borrowing	信託勘定借	semi-liquid	0
Lease debt	リース債務	semi-liquid	0
Forex for sale	売渡外国為替	illiquid	-0.5
Unpaid forex	未払外国為替	illiquid	-0.5
Unsettled exchange debt	未決済為替借	illiquid	-0.5
Accrued corporate tax, etc.	未払法人税等	illiquid	-0.5
Accrued expenses	未払費用	illiquid	-0.5
Unearned income	前受収益	illiquid	-0.5
Employee deposit	従業員預り金	illiquid	-0.5
Reserves for benefits	給付補塡備金	illiquid	-0.5
Asset retirement obligations	資産除去債務	illiquid	-0.5
Other liabilities	その他の負債	illiquid	-0.5
Bonus reserve	賞与引当金	illiquid	-0.5
Reserve for directors' bonuses	役員賞与引当金	illiquid	-0.5
Retirement benefit reserve	退職給付引当金	illiquid	-0.5
Reserve for retirement benefits for officers	役員退職慰労引当金	illiquid	-0.5
Other reserves	その他の引当金	illiquid	-0.5
Special statutory allowance	特別法上の引当金	illiquid	-0.5
Deferred tax liability	繰延税金負債	illiquid	-0.5
Deferred tax liability for revaluation	再評価に係る繰延税金負債	illiquid	-0.5
Equity	純資産の部合計	illiquid	-0.5

Table A1.3 Off-balance sheet items

OFF BALANCE	Japanese	Liquidity creation	Weight
Commodity securities derived products (asset)	商品有価証券派生商品	liquid	-0.5
Specified transaction securities derivatives (assets)	特定取引有価証券派生商品	liquid	-0.5
Specified financial derivative products (assets)	特定金融派生商品	liquid	-0.5
Futures trading acceptance margin	先物取引受入証拠金	liquid	-0.5
Futures trading difference account (assets)	先物取引差金勘定	liquid	-0.5
Financial derivatives(assets)	金融派生商品	liquid	-0.5
Collateral for receiving financial products, etc.	金融商品等受入担保金	liquid	-0.5
Commodity bonds for sale	売付商品債券	semi-liquid	0
Specified transaction sale bond	特定取引売付債券	semi-liquid	0
Borrowed commodity bonds	借入商品債券	semi-liquid	0
Borrowing specified transaction securities	借入特定取引有価証券	semi-liquid	0
Borrowed securities	借入有価証券	semi-liquid	0
Bonds for sale	売付債券	semi-liquid	0
Commodity securities derived products (liability)	商品有価証券派生商品	semi-liquid	0
Specified transaction securities derivatives (liabilities)	特定取引有価証券派生商品	semi-liquid	0
Specified financial derivative products (liabilities)	特定金融派生商品	semi-liquid	0
Loan securities	貸付有価証券	semi-liquid	0
Futures trading margin	先物取引差入証拠金	semi-liquid	0
Futures trading difference account(liabilities)	先物取引差金勘定	semi-liquid	0
Financial derivatives(liabilities)	金融派生商品	semi-liquid	0
Collateral deposits for financial products, etc.	金融商品等差入担保金	semi-liquid	0
Payment consent in return	支 払 承 諾 見 返	illiquid	0.5

Note: English translation from Nikkie NEEDS Financial Quest.

Appendix 2 | Liquidity creation variable

	LC-Asset	
Illiquid assets (weight = ½)	Semi-liquid assets (weight = 0)	Liquid assets (weight =-½)
	LC-Liabilities	
Liquid liabilities (weight = ½)	Semi-liquid liabilities (weight = 0)	Illiquid liabilities & equity (weight = -½)
	LC-Off-balance-sheet	
Illiquid off-balance-sheet (weight = ½)	Semi-liquid off-balance-sheet (weight = 0)	Liquid off-balance-sheet (weight = -½)
LC/TA	$\frac{0.5 \times (illiquid\ assets\ +\ liquid\ liabilities\ +\ illiquid\ OBS) - 0.5 \times (liquid\ assets\ +\ illiquid\ liabilities\ +\ equity\ +\ liquid\ OBS)}{total\ assets}$	
LCn/TA	$\frac{0.5 \times (illiquid\ assets\ +\ liquid\ liabilities) - 0.5 \times (liquid\ assets\ +\ illiquid\ liabilities\ +\ equity)}{total\ assets}$	
LC-Asset/TA	$\frac{0.5 \times (illiquid\ assets\ ) - 0.5 \times (liquid\ assets\ )}{total\ assets}$	
LC-Liabilities/TA	$\frac{0.5 \times (\ liquid\ liabilities\ ) - 0.5 \times (\ l\ illiquid\ liabilities\ )}{total\ assets}$	
LC-Off-balance sheet/TA	$\frac{0.5 \times (\ illiquid\ OBS) - 0.5 \times (liquid\ OBS)}{total\ assets}$	

This table shows the weights used in calculating the Berger and Bouwman (2009) liquidity creation measure using the classification of bank activities by Gunji, Ono, Shizume, Uchida and Yasuda, 2021 (see Appendix Table 1.1-1.3 for a full list of balance sheet items and corresponding weights).

Appendix 3 | List of banks in sample

Treatment Group	*Control Group (continued)*
Dai-Ichi Kangyo Bank	Ogaki Kyoritsu Bank
Sakura Bank	Juroku Bank
Fuji Bank	Hyakugo Bank
Bank of Tokyo Mitsubishi	Shiga Bank
Asahi Bank	Bank of Kyoto
Sanwa Bank	*Kinki Osaka Bank*
Sumitomo Bank	Nanto Bank
Tokai Bank	San-in Godo Bank
Ashikaga Bank	Chugoku Bank
Joyo Bank	Hiroshima Bank
Chiba Bank	Yamaguchi Bank
Bank of Yokohama	Awa Bank
Hachijuni Bank	Hyakujushi Bank
Hokuriku Bank	Iyo Bank
Shizuoka Bank	Shikoku Bank
Bank of Fukuoka	Eighteenth Bank
North Pacific Bank	Higo Bank
Control Group	Oita Bank
Hokkaido Bank	Kagoshima Bank
Aomori Bank	Nishi-Nippon Bank
Akita Bank	Keiyo Bank
Bank of Iwate	Aichi Bank
77 Bank	Bank of Nagoya
Toho Bank	Bank of Kinki
Gunma Bank	Minato Bank
Musashino Bank	Hiroshima-Sogo Bank
Chiba Kogyo Bank	Fukuoka City Bank
Tokyo Tomin Bank	Yachiyo Bank
Daishi Bank	Michinoku Bank
Hokuetsu Bank	Shonai Bank
Yamanashi Chuo Bank	Yamagata Bank
Hokkoku Bank	Tohoku Bank
Fukui Bank	Kanto Bank
Suruga Bank	Chiba Kogyo Bank

This table provides a list of the names of banks in the sample.

Appendix 4 | Summary statistics

Variable	Mean	SD	p5	p50	p95
Liquidity creation	0.334	0.049	0.258	0.332	0.414
Liquidity creation (narrow)	0.322	0.048	0.248	0.321	0.401
Liquidity creation - Assets	0.218	0.043	0.146	0.221	0.288
Liquidity creation - Liabilities	0.104	0.032	0.060	0.104	0.158
Liquidity creation - Off balance sheet	0.012	0.006	0.004	0.010	0.024
Capital	0.042	0.012	0.022	0.043	0.063
Illiquid assets	0.579	0.067	0.488	0.575	0.679
Semi-liquid assets	0.247	0.047	0.175	0.245	0.319
Liquid assets	0.138	0.045	0.078	0.131	0.221
Illiquid liabilities	0.014	0.007	0.008	0.013	0.030
Semi-liquid liabilities	0.640	0.092	0.471	0.648	0.754
Liquid liabilities	0.270	0.071	0.173	0.264	0.395
Illiquid off-balance-sheet	0.025	0.015	0.008	0.020	0.058
Liquid off-balance-sheet	0.001	0.005	0.000	0.000	0.010
Retained earnings	0.017	0.015	0.000	0.015	0.042
Risk-weighted assets	0.690	2.194	0.475	0.599	0.722
Z-score (log)	2.542	1.304	0.385	2.545	4.395
σROA	0.005	0.012	0.001	0.003	0.014
Cash and Due from Banks	0.035	0.020	0.014	0.030	0.075
Call loans & Bills Bought	0.009	0.009	0.001	0.006	0.027
Trading Account Securities	0.001	0.003	0.000	0.000	0.004
Government Bonds	0.058	0.028	0.022	0.055	0.113
Total Loans	0.693	0.064	0.576	0.702	0.779
Bills Discounted	0.026	0.011	0.011	0.025	0.047
Loans on Bills	0.125	0.036	0.071	0.122	0.187
Loans on Deeds	0.451	0.069	0.342	0.448	0.559
TAX	0.056	0.229	0.000	0.000	1.000
TAX_continuous	0.025	0.103	0.000	0.000	0.097
Placebo tax	0.078	0.268	0.000	0.000	1.000
Asset quality	0.035	0.032	0.000	0.031	0.078
ROA	0.000	0.021	-0.015	0.003	0.007
Market share	0.007	0.015	0.000	0.002	0.059
Size (log)	14.593	1.185	12.821	14.533	17.635
low capital'99 (Dummy)	0.116	0.320	0.000	0.000	1.000
high capital'99 (Dummy)	0.121	0.327	0.000	0.000	1.000
Capital inj. (Dummy)	0.031	0.174	0.000	0.000	0.000
QE x Eligible Asset	0.019	0.036	0.000	0.000	0.098

This table provides summary statistics for all variables used in the analysis.

Appendix 5 | Variable Definitions

Variable	*Definition*
Liquidity creation	See Appendix 2
Liquidity creation (narrow)	See Appendix 2
Liquidity creation - Assets	See Appendix 2
Liquidity creation - Liabilities	See Appendix 2
Liquidity creation - Off balance sheet	See Appendix 2
Capital	Equity to total assets
Illiquid assets	See Appendix 1
Semi-liquid assets	See Appendix 1
Liquid assets	See Appendix 1
Illiquid liabilities	See Appendix 1
Semi-liquid liabilities	See Appendix 1
Liquid liabilities	See Appendix 1
Illiquid off-balance-sheet	See Appendix 1
Liquid off-balance-sheet	See Appendix 1
Retained earnings	Retained earnings to total assets
Risk-weighted assets	Risk-weighted assets to total assets
Z-score (log)	The Z-score is the sum of return on assets and the capital ratio, divided by the standard deviation of return on assets.
σROA	Standard deviation of return on assets over three years
Cash and Due from Banks	See Appendix 1
Call loans & Bills Bought	See Appendix 1
Trading Account Securities	See Appendix 1
Government Bonds	See Appendix 1
Total Loans	See Appendix 1
Bills Discounted	See Appendix 1
Loans on Bills	See Appendix 1
Loans on Deeds	See Appendix 1
TAX	Dummy is equal to one if bank is subject to Tokyo bank tax in 2000, and zero otherwise.
TAX_continuous	Ratio of the number of branches in Tokyo as a share of the total number of domestic branches of bank i as of year 1999
Placebo tax	Bank is subject to placebo treatment during period from April 1999 to March 2000
Asset quality	Non-performing loans to total assets
ROA	Net income divided by total assets
Market share	Proportion of an individual banks' assets to total aggregate assets
Size (log)	Natural logarithm of total assets
low capital'99 (Dummy)	Dummy is equal to one for banks that are one standard deviation below the average value of the ratio of tier 1 capital to total assets in 1999, and zero otherwise
high capital'99 (Dummy)	Dummy is equal to one for banks that are one standard deviation above the average value of the ratio of tier 1 capital to total assets in 1999, and zero otherwise
Capital inj. (Dummy)	Bank received capital injection under the Prompt Recapitalization Act
QE x Eligible Asset	Ratio of government bonds to total assets, interacted with QE, a dummy equal to one in 2001, and zero otherwise

This table provides definitions for all variables used in the analysis.

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