Centre for Responsible Banking & Finance
RBF

University of St Andrews
School of Management

WORKING PAPERS IN RESPONSIBLE BANKING & FINANCE

Taxation and Financial Intermediation: Evidence from a Quasi-Natural Experiment

By *Sanjay Banerji, Dimitris K. Chronopoulos, Anna L. Sobiech, John O.S. Wilson*

Abstract: In this study, we investigate the impact of taxes on loan supply, pricing of loans and deposits, and the monitoring efforts of banks. Using a difference-in-differences approach, which relies on the exogenous variation of tax imposed on gross profits of Japanese banks operating in Tokyo (known as the Tokyo bank tax), we find that affected banks increase both net interest margins, and net interest and fee margins. Depositors are most affected by adjustments to interest and fee rates at banks following the imposition of the tax. The imposition of the Tokyo bank tax also reduces the credit supply of affected banks relative to non-affected counterparts. Moreover, banks subject to the Tokyo bank tax appear to reduce effort devoted to the monitoring of existing borrowers.

WP Nº 18-001

1st Quarter 2018

University of St Andrews
Scotland's first university
600 YEARS
1413 – 2013

Taxation and Financial Intermediation: Evidence from a Quasi-Natural Experiment

Sanjay Banerji
University of Nottingham
Sanjay.Banerji@nottingham.ac.uk

Dimitris K. Chronopoulos
School of Management, University of St Andrews
dc45@st-andrews.ac.uk

Anna L. Sobiech*
School of Management, University of St Andrews
als23@st-andrews.ac.uk

John O.S. Wilson
School of Management, University of St Andrews
jsw7@st-andrews.ac.uk

Draft: 23 November 2017

Abstract

In this study, we investigate the impact of taxes on loan supply, pricing of loans and deposits, and the monitoring efforts of banks. Using a difference-in-differences approach, which relies on the exogenous variation of tax imposed on gross profits of Japanese banks operating in Tokyo (known as the Tokyo bank tax), we find that affected banks increase both net interest margins, and net interest and fee margins. Depositors are most affected by adjustments to interest and fee rates at banks following the imposition of the tax. The imposition of the Tokyo bank tax also reduces the credit supply of affected banks relative to non-affected counterparts. Moreover, banks subject to the Tokyo bank tax appear to reduce effort devoted to the monitoring of existing borrowers.

Keywords: bank taxation; net interest margin; Japanese banks; natural experiment, monitoring

JEL Classification: G21, G28

* Corresponding author: Anna L. Sobiech, Centre for Responsible Banking & Finance, School of Management, Gateway Building, University of St Andrews, St Andrews, Fife, KY16 9RJ, UK.

The authors would like to thank Dimitris Andriosopoulos, Tony Anhert, Allen Berger, Lamont Black, Jaap Bos, Matias Busch, Santiago Carbo, Barbara Casu, Francesca Corelli, Manthos Delis, Bob DeYoung, Franco Fiordelisi, Scott Frame, Bill Francis, Iftekhar Hasan, Yazhou He, Neeltje van Horen, Vasso Ioannidou, Charlie Kahn, Neil Kellard, Sotirios Kokas, Jose Linares Zegarra, Fan Liu, Jose Martin-Flores, David Marques Ibanez, Alex Michaelides, Phil Molyneux, Steven Ongena, George Panos, Joe Peek, Dimitris Petmezas, Francisco Rodrigues, Raluca Roman, Richard Rosen, Bert Scholtens, Tony Saunders, Phil Strahan, John Thornton, Hirofumi Uchida, Greg Udell, Larry Wall and Magnus Willesson for useful discussions, comments and suggestions. We also thank participants at: the Financial Intermediation Network of European Studies Workshops in Durham and Essex; the Money Banking and Finance Conference in Rome; the Mid-West Finance Association Conference in Chicago; the Financial Engineering and Banking Society Conference in Glasgow; the European Financial Management Association Conference in Athens; and the Financial Management Association Conference in Boston. The usual disclaimer applies.

1. Introduction

This study investigates the impact of taxation on the financial intermediation activities of banks in Japan. Taxing banks has received widespread media coverage and attention in policy circles in many developed economies following the global financial crisis, where taxpayer funded bank bailouts led to large fiscal deficits. As part of a range of policy reforms, proposals to increase bank taxes have been suggested as a means to replenish government coffers and contain excessive risk-taking of banks. Opponents of such proposals contend that increasing taxes would have adverse consequences for customers if banks pass on any resultant cost increases by reduced lending, lower deposit rates or higher loan rates.

Anticipating and assessing the effects of taxation on the behaviour of banks is not straightforward. Depending on the type and size of the tax imposed, and the prevailing market conditions under which banks operate, banks may choose to absorb any increase in costs by reducing costly activities such as monitoring of borrowers, or instead pass increased costs onto customers by restricting credit supply, reducing deposit rates or increasing loan rates. Moreover, establishing a causal link from tax to bank behaviour is difficult, given that tax policy changes often form part of a broad package of regulatory and fiscal reforms, which are often anticipated in advance by market participants, and phased in gradually over an extended period.

In this paper, we utilise a quasi-natural experiment to investigate how the unexpected imposition of a special tax on gross profits (known locally as the Tokyo bank tax) in 2000 influenced the lending, deposit taking, pricing and monitoring behaviour of Japanese banks.[1] This tax was levied on commercial banks with sizeable financial intermediation activities in Tokyo, and had the objective of generating additional tax revenue for the Tokyo Government. The Tokyo Bank Tax was levied on gross profits (composed of net interest, net fee and commission and

[1] In the early 2000s, the banking sector in Japan was emerging gradually from a severe financial crisis. For extensive discussions of the financial crisis and its global repercussions see: Peek and Rosengren (2000); Hoshi and Kashyap (2000); Ito and Patrick (2005). For a more recent overview see Uchida and Udell (2014).

trading income).[2] As such the tax was tantamount to a tax on the financial intermediation activities of banks. Using this differential tax treatment to overcome identification concerns, we investigate whether there is a causal link from tax to the financial intermediation activities of banks. As such, we make a significant contribution to a small, but important literature on the taxation of banks. The results of our study have relevance beyond Japan, by contributing to and informing ongoing discussions amongst academics and policy makers as to the best way to reform and design the taxation of banks following the global financial crisis.

To inform our theoretical framework and research hypotheses we draw on prior theoretical contributions related to agency issues and contractual hazards in financial intermediation settings (Diamond 1984; Holmström and Tirole 1997). We develop a theoretical model (in Section 3) that describes the relationship between bank monitoring, the intermediation process and product pricing. A basic assumption underlying this model is that the outcome of a borrower's investment project is not perfectly observed by the lender in the absence of monitoring. The model also incorporates the possibility of strategic default by borrowers. As a consequence, banks monitor borrowers closely in order to prevent them from defaulting on their loans. Given that the introduction of a gross profit tax reduces the resources available to banks to perform monitoring, our model predicts an increase in the probability of borrower default. Faced with loan losses arising from borrower defaults, banks reduce loan rates. This reduction in loan rates provides an incentive for borrowers not to default. Banks also reduce the size of their respective loan portfolios in order to compensate for the combined losses arising from the reduction in loan rates, reduced monitoring and increased taxation. On the liability side, our model predicts a reduction in the volume and rate of interest paid on deposits, and under certain conditions the reduction in deposit rates exceeds that of loan rates. The intuition that depositors rather than borrowers bear the brunt of any tax is that the latter have a tendency to default. As a consequence, resources are required to enable monitoring activity and prevent borrower default.

[2] In contrast to net profits, gross profits exclude expenses such as personnel costs, loan loss provisions, and write-offs (Japan Bankers Association 2006).

Our dataset comprises semi-annual financial accounts for a sample of 126 banks over the period 1998-2001 (which straddles the introduction of the Tokyo bank tax in 2000). In order to assess the effects of the gross-profit tax on the financial intermediation activities of banks, we classify banks into those that are affected by the Tokyo bank tax and those that are not. Based on this classification, we use a difference-in-differences approach to compare the difference in behaviour of the affected banks between the pre-tax and post-tax period with the same difference in the behaviour of the unaffected group of banks. We corroborate the evidence presented from the difference-in-differences analysis with a regression discontinuity analysis and an event study.

By way of preview, the main findings of the empirical analysis suggest a causal link between the Tokyo bank tax and the financial intermediation activities of banks. In response to an unexpected tax on gross profit, banks increase net interest and net interest and fee margins. A decomposition of the net interest margin into deposit and loan pricing components indicates that both the interest rates paid to depositors and charged to borrowers decline following the introduction of the Tokyo bank tax. This implies a pronounced pass-through effect from banks to depositors. Further analysis reveals that when faced with additional taxes, affected banks reduce total lending. Furthermore, banks subject to the tax experience a decrease in rate-sensitive deposits on a larger scale than counterparts unaffected by the tax. These results are indicative of rate adjustments (in particular) for deposit products with relatively high interest rates, and confirm a partial pass-through effect of the tax from banks to depositors. These results are consistent regardless of the estimation method employed.

Our theoretical model also predicts that the channel through which a tax on gross profit leads to contraction in financial intermediation is via a reduction in the level of bank monitoring of borrowers. We investigate the validity of this prediction via a series of empirical tests employing a data set of banks and borrowing firms. Underlying these aforementioned tests is the assumption that the cost of monitoring borrowing firms is lower when these firms are geographically proximate to their lending bank or are less informationally opaque (with a credit rating assigned by a third-party agency). Thus following an increase in taxation, affected banks

seek to reduce monitoring costs by rebalancing their respective loan portfolios toward those borrowers that are geographically proximate or less informationally opaque. Moreover, bank monitoring is of value to borrowing firms by providing valuable information to external stakeholders (investors, bondholders). This reduces the cost of external funding and enhances the overall market values of borrowing firms. Thus following an increase in taxation, if affected banks reduce monitoring of borrowing firms, this is reflected in an increase in the cost of financing (bond issuance) and a decline in market values (returns to investors) of firms with existing borrowing relationships with banks affected by the Tokyo bank tax.

The results of the aforementioned series of tests are as follows. Banks subject to the provisions of the Tokyo bank tax reduce the costs of monitoring by reducing lending to firms located at distance (relative to counterparts that are geographically proximate), and to firms that are less informationally opaque. The costs of debt issuance increase for firms that borrow from affected banks, suggesting that the monitoring of these borrowers deteriorates after the introduction of the Tokyo bank tax. Finally, the market value of firms which borrow from affected banks reacts more negatively to the announcement of the tax than the market value of firms not borrowing from affected banks. Taken together these results provide corroborating evidence in support of the monitoring channel identified by our theoretical model.

Our analysis contributes to several literatures. We contribute to a small literature that examines the pass-through effects of taxes to bank customers.[3] The results emanating from this literature are rather mixed. Early evidence suggests that taxes feed through to higher levels of bank profitability (Demirgüç-Kunt and Huizinga 2001). Huizinga et al. (2014) extend this analysis by accounting for international double taxation, and find that these taxes are almost fully passed through to bank customers. Other evidence, presented by Albertazzi and Gambacorta (2010) and

[3] Several studies investigate the implications of taxation on the capital structure of banks. Hemmelgarn and Teichmann (2014) and Keen and De Mooij (2016) provide cross country analyses of the impact of the asymmetric tax treatment of debt and equity on capital structure decisions of banks. Schepens (2016) finds that banks in Belgium increased equity capital following a policy change (known as allowance for corporate equity) that reduced the relative tax advantage of debt funding. Celerier et al. (2017) investigate the impact of a tax policy change in Italy. The authors find that banks increase equity capital when equity and debt are treated symmetrically by tax authorities. Moreover, such a symmetric tax treatment of debt and equity leads to a large expansion in bank lending.

Chiorazzo and Milani (2011) for large samples of European banks, and Capelle-Blancard and Havrylchyk (2017) for Hungary suggests that banks shift most of their respective tax burdens onto customers, with borrowers bearing most of the tax burden via increased loan rates or a reduction in credit access. For a large sample of European banks, Kogler (2016) finds that bank taxes only lead to small increases in net interest margins via increases in loan rates. Deposit rates paid to savers are unaffected. The level of competition and capitalization affect the pass-through of taxes. Other studies find no evidence of a change in loan or deposit rates following the introduction of bank taxes (Capelle-Blancard and Havrylchyk 2014; Buch et al. 2016). Instead the increased costs arising from the tax burden is absorbed by banks. Our contribution to this strand of literature is manifold. First we derive our empirical hypotheses from a new theoretical model which incorporates a moral hazard problem for the borrower. This allows for a consideration of the monitoring function of banks and its interplay with taxes. As such our model departs from the Monti-Klein approach, which is used extensively in this literature (Klein 1971; Monti 1972). Second, we focus on a relatively simple gross-profit tax to investigate whether taxes affect bank behaviour. Assessing the effect on bank behaviour of a tax applied to net profit is difficult given that banks can use loan loss provisions and other forms of discretionary expense to reduce tax liability (Andries et al. 2017). A tax levied on gross profit limits this possibility, and enables a thorough assessment of the effects of tax on the financial intermediation activities of banks. Third, in line with prior literature we find strong support for a pass-through effect of taxes to bank depositors. However, we divert from previous findings with respect to bank behaviour towards borrowers. As predicted by our theoretical model (and contrary to previous evidence) we find that banks faced with an increase in taxes on gross profits reduce both deposit and loan rates. Therefore, banks that are left with fewer resources to monitor borrowers as a result of the tax, are forced to switch from a 'stick' (monitoring) to a 'carrot' (reduced loan rate) approach in order to discourage loan default.

We extend the literature that explores the determinants of bank monitoring effort. Previous research suggests that the extent to which banks engage in the processing of borrower-

related information (loan monitoring) depends on: loan contract design (Cerqueiro et al. 2016); managerial contracting (Udell 1989); lending technology (Mester et al. 2007); and organisational form (Stein 2002); as well as the structure of bank-firm relationships (Carletti 2004). Competition, capital requirements (Almazan 2002), and market power (Caminal and Matutes 2002) are also impact on monitoring. The novelty of our work lies in our analysis of how bank monitoring effort changes in response to taxation. In a simple model, we show that taxes on gross profits reduce the incentive to exert sufficient levels of monitoring effort.

Our analysis contributes to a long established literature that examines the determinants of interest margins for financial institutions. The results of prior research suggests that the size, capitalisation, credit and liquidity risk of banks along with competition, regulation and supervision are important determinants of bank interest margins (Ho and Saunders 1981; Allen 1988; Valverde and Fernandez 2007, Kitamura et al. 2015). Our approach augments these aforementioned studies by incorporating taxation as a key determinant of bank margins. The difference-in-differences approach used in the empirical analysis allows us to isolate the specific implications for interest margins of tax differences across banks, and decompose the net interest margin to investigate the effect of taxes on deposit and loan pricing.

Finally, our analysis contributes to the recent literature that explores the impact of negative exogenous shocks on bank credit supply. For example, Buch et al. (2016) find that banks subject to extra taxes do not on average reduce lending. However, banks most affected by the imposition of these taxes (those with higher market share) extend fewer loans than less affected counterparts. Schandlbauer (2017) shows that banks reduce lending following an increase in taxes. This is more evident for less well-capitalised banks, which have more limited opportunities for increasing debt in order to benefit from tax shields. Cornett et al. (2011) show that fewer new loans are originated when banks are exposed to liquidity risk. The results of the present study lend some support to prior literature by finding that the Tokyo bank tax leads affected banks to contract credit supply. We also identify an overall reduction in the flow of intermediated funds.

Banks affected by the Tokyo bank tax did not only extend fewer loans, but also held fewer interest rate-sensitive deposits.

In summary, this study provides new insights as to the effects of taxation on bank behaviour, and the extent to which banks pass on the increased burden of higher costs to customers via changes in pricing and lending strategies. As such the results have relevance for policymakers tasked with monitoring the effects of taxation on banks, the wider financial system and the real economy.

2. Background

To estimate the impact of taxes on bank behaviour, we exploit a differential tax treatment of banks that occurred in Japan in 2000 when the Tokyo Government levied a special tax that affected one group of banks, but left other banks unaffected. This decision was motivated by the urgent need to generate tax revenues for Tokyo, where the revenues raised from corporate income taxes declined by more than 25 percent between 1996 and 1999.

The Tokyo Government selected banks liable for the tax based on three criteria. First, banks with a physical presence in Tokyo would have gross profits generated in this metropolitan area taxed by the Tokyo Government. Banks without headquarters or branches in Tokyo were exempt from the tax. Second, only domestic banks were liable for the tax. Foreign banks (including those with operations in Tokyo) were not liable for the tax. Third, banks with average deposits exceeding ¥5 trillion over the past five years were subject to the tax (DeWit 2000). Banks with deposits below this threshold were not liable for the tax.

A timeline of key events surrounding the announcement, introduction and the repeal of the Tokyo bank tax is summarised in Table 1. The Tokyo Government planned to levy the bank tax over a period of five fiscal years. However, following a successful legal challenge by banks, the tax was not levied over the full period. By the end of the second year, the Tokyo District Court declared the bank tax to be void followed by a final decision against the tax by the Tokyo High Court. For the purposes of the empirical analysis conducted in the present study, we consider the declaration of the District Court shortly before the end of fiscal year 2001 as the date which marks

the official termination of the Tokyo bank tax. After this declaration, the Tokyo Government ceased collecting tax liabilities associated with the Tokyo bank tax.

[Insert Table 1 about here]

The imposition of the Tokyo bank tax occurred during the period when the Japanese banking system was recovering from a major financial crisis, during which time some of the largest financial institutions failed. To resolve the banking crisis and to contain the negative impact on the economy, the government implemented a large-scale and far-reaching programme of reforms. This programme included: recapitalising distressed banks; creating a new financial supervisor: and establishing a support scheme for distressed non-financial firms. While none of these interventions were implemented over the same period as the Tokyo bank tax, the recapitalisation of distressed banks (under the terms of the Prompt Recapitalisation Act) as well as mergers between established banks could potentially act as confounding events, and affect the results of any investigation of the impact of the Tokyo Bank Tax on bank behaviour. We investigate this possibility in Section B2 of the Online Appendix.

The Tokyo bank tax levied on gross profit represents a direct form of a tax on financial intermediation services. Gross profits comprise three components. First is the net interest margin, defined as the difference between interest income and expenses. This margin relates to a bank's core function as a financial intermediary, encapsulating the price of intermediation of funds from savers (depositors) to borrowers (entrepreneurs). The net interest margin is by far the largest component of gross profit, accounting on average for 80% of gross profits during the sample period. The second and third components are the net fee and commission margin and the net trading margin.

3. Model and Hypotheses

3.1 A simple model of intermediation

Banks in our framework design loan contracts and monitor borrower behaviour. Such actions aim to curb borrowers' moral hazard resulting in tendencies towards strategic default or outright repudiation of loans. This activity has provided a unifying theme in models of financial

intermediation (Diamond 1984; Rajan 1992; Besanko and Kanatas 1993; Holmström and Tirole 1997; Repullo and Suarez 1998).

We consider a one-period model of financial intermediation with a single representative bank that performs tasks as an active lender and passive holder of deposits. The bank operates in a competitive market for deposits, which are used to finance loans to individual borrowers. While the bank pays a competitive rate to depositors, it decides upon loan size, loan rate and the effort devoted to the ex-post monitoring of borrowers.

The ex-post monitoring of borrowers is costly, but reduces the probability of loan default. The bank's monitoring effort reduces the risk of loan default, and leads to a decline in the spread between deposit and loan interest rates. The model posits that if a tax is levied on the profit the bank earns from offering financial intermediation services to borrowers and depositors, then such a tax affects directly core financial intermediation activities including the volume of loans and deposits, and the interest rates for depositors and borrowers.

The bank engages with both borrowers and depositors via a set of loan and deposit contracts. In the remainder of this section, we present a model which addresses how key contractual variables, such as the size of loans and deposits, loan and deposit rates, and monitoring effort are affected by a sudden increase in tax. For the purposes of exposition, we assume that depositors and borrowers are two distinct sets of agents. This allows us to analyse the features of loan and deposit contracts separately, before combining these to examine the overall impact of taxes on financial intermediation.

Loan Contracts – Borrowers

Each borrower has a project which produces a cash flow with a technology given by a concave production function, $f(L)$, where L denotes the loan amount. We impose the following assumption on the technology: $f'(L) > 0$ and $f''(L) < 0$. An example of such a technology is $f(L) = A\sqrt{L}$, where A is a parameter. Borrowers do not have any internal means of finance, and so rely on bank financing. The bank charges interest rate R against a loan amount L. The bank also chooses the probability, p, of monitoring each borrower that deters strategic default. Given the

one-period nature of the model capturing the relationship between the borrowers and the bank, there is no scope for reputation building by the borrower (which would emerge from repeated interactions). Hence, borrowers are more likely to default strategically after securing financing. Financial intermediation and lending in particular is special in this context, since banks can use information and expertise to monitor borrowers in order to deter strategic default.

A borrower may or may not behave honestly depending on the payoff (gains and costs) associated with such behaviours. If the bank charges a loan rate R, on a loan amount L, disbursed to a borrower, the pay-off of an honest borrower (who repays the total loan obligation) is $f(L) - RL$. Whether a borrower repays a loan depends on the bank's monitoring effort, p. If the borrower intends to behave dishonestly, then a cost is incurred which takes a fraction α of output $f(L)$. If the borrower gets caught by the bank, RL is paid back and legal and other pecuniary expenses amounting to c are incurred. The borrower's expected pay-off from dishonest behaviour is $p[\alpha f(L) - RL - c] + (1-p)f(L)$. Hence the borrower's incentive compatibility condition is $f(L) - RL \geq p[\alpha f(L) - RL - c] + (1-p)f(L)$, which re-arranging reduces to $p[(1-\alpha)f(L) + c] \geq (1-p)RL$. This can be written in the equality form as:

$$RL = \frac{p[(1-\alpha)f(L)+c]}{(1-p)} \quad (1)$$

Equation (1) is the reduced form version of the borrower's incentive constraint precluding default, and states that the total obligation of the borrower must not exceed a multiple of the expected costs from default.[4]

Loan Contracts – Bank and Borrowers

The bank's profit after tax earned from financial intermediation activities is $\big(RL - r_d D + r_f S\big)(1-\tau) - h(p)$, where τ is the tax rate, r_d is the rate paid on deposits, and D is the amount of deposits. The cost of monitoring, $h(p)$, is an increasing and convex function of the bank's monitoring effort with $h^{/}(p) > 0 \; and \; h^{//}(p) > 0$. An example of such a monitoring cost function is: $h(p) = ap + \frac{1}{2}bp^2$, where $a > 0$ and $b > 0$ are constant, and where the cost of monitoring

[4] In Equation (1) the present value of the equilibrium loan can be written as: $L = \frac{p[(1-\alpha)f(L)+c]}{(1-p)R}$.

tends to increase rapidly with the effort devoted to monitoring. The bank holds a safe asset, $S > 0$ and earns a risk free return, r_f.

The bank's balance sheet comprising the sources of funds, D, equals the total uses of the fund, which are: the sum of loan disbursements, L; reserve requirements, X; and the safe asset, S. This can be expressed as:

$$D = L + X + S \tag{2}$$

Since the reserve requirement is mandatory and a constant fraction of the total deposits, $X = \beta D$, $0 < \beta < 1$. Incorporating X into (2) gives:

$$D(1-\beta) = L + S \tag{3}$$

Assuming that the bank earns a return of $r_0 = 0$ on reserves, the profit (after using the identity of balance sheet and reserve requirements as given in (2) and (3) respectively) can be expressed as $\pi^b = \left[RL - r_d D + r_f\{D(1-\beta) - L\}\right](1-\tau) - h(p)$, which can be rewritten as:

$$\pi^b = \left[RL - \{r_d - r_f(1-\beta)\}D - r_f L\right](1-\tau) - h(p) \tag{4}$$

This yields the bank's objective function, where the bank maximizes profit by choosing R, L, and p, subject to (1). That is, the bank offers a combination of the loan rate R, and the loan size L, and commits to a monitoring policy p, to maximise profit as given in (4). Incorporating (1) into (4), yields the objective function in reduced form:

$$\pi^b(p, L) = \left[\frac{p[(1-\alpha)f(L)+c]}{(1-p)} - \{r_d - r_f(1-\beta)\}D - r_f L\right](1-\tau) - h(p),$$

where $\pi^b(p, L)$ is the bank's profit function with two choice variables, p and L. The reduced form profit function above includes: (i) the incentive compatibility condition; (ii) the balance sheet identity; and (iii) the reserve requirement constraint.

The first-order conditions with respect to L and p for the optimum are:

$p(1-\alpha)f'(L) = r_f(1-p)$, which can also be expressed as:

$$\frac{p(1-\alpha)f'(L)}{(1-p)} = r_f \tag{5}$$

and

$$\frac{[(1-\alpha)f(L)+c](1-\tau)}{(1-p)^2} = h'(p) \tag{6}$$

The incentive constraint preventing strategic default is given by:

$$RL = p\ \frac{(1-\alpha)f(L)+c}{(1-p)} \tag{7}$$

Equations (5) and (6) determine jointly the optimal loan amount (L^*) and monitoring effort (p^*) of the bank. The optimal values in Equation (7) can be substituted to solve for the optimal R^* as a function of the tax rate, technology, costs of default, and other parameters. Equation (5) describes the trade-off for the optimal disbursement of the loan. The left-hand side represents the incremental productivity of the loan, while the right-hand side is the marginal cost of loan, which is the risk-free rate that the bank could have earned.

Equations (6) and (7) can be combined to derive the relationship between the loan rate (R^*), monitoring effort (p^*) and the tax rate τ:

$$R^*L^*(1-\tau) = ph^{/}(p)(1-p) \tag{8}$$

The left-hand side of Equation (8) is the bank's marginal after-tax loan loss from a reduction in monitoring activity. The right-hand side captures the marginal savings from a reduction in monitoring activity. Equation (8) also captures the relationship between R^* and τ. We return to this relationship later when discussing Hypothesis 4.

The model so far completes the borrowing side of the bank loan where the optimal borrowing rate is $R^*(r_f, \tau)$, the optimal loan amount issued by the bank is $L^*(r_f, \tau)$ and the optimal probability of monitoring is $p^*(r_f, \tau)$. Next, we discuss the deposit contracts offered by the bank under competitive market conditions.

Deposit Contracts – Bank and Depositors:

Depositors of the bank are agents who smooth consumption over time (as in any standard model). We assume two periods, $t = 0, 1$. Depositors have endowments of w_0 at period 0 and w_1 at period 1 with $w_0 > w_1$. If depositors deposit D with a bank and are promised a deposit rate equal to r_d, then the depositors' budget constraints are $w_0 = c_0 + D$ and $w_1 + Dr_d = c_1$, in each of the two periods, $t = 0, 1$, respectively, where c_t denotes the consumption of the depositors at time t.

If the depositor's utility function is $u(c_0) + \theta u(c_1)$, then intertemporal maximization of utility would generate an optimal deposit function of $D^* = D^*(r_d)$. For example, if the depositor has a logarithmic utility function, then the optimal deposit function is given by $D^* = \frac{1}{1+\theta}\left(w_0 - \frac{w_1}{r_d}\right)$.[5] Thus for any deposit rate, r_d offered by banks, individual depositors save D^*.

We assume that the competitive structure of the market, results in an equilibrium determination of the deposit rate where banks earn zero profit and depositors maximize utility. Proceeding with the logarithmic utility function of the depositors, a bank's competitive zero profit condition implies that the following condition holds for all banks:

$$\pi^{b*}(p, L) = \left[p^* \frac{(1-\alpha)f(L^*)+c}{(1-p^*)} - \{r_d - r_f(1-\beta)\}\frac{1}{1+\theta}\left(w_0 - \frac{w_1}{r_d}\right) - r_f L^*\right](1-\tau) - h(p^*) = 0 \qquad (9)$$

where * denotes a variable set at the optimal level given by Equations (5) and (6). Equation (9) determines the optimal deposit rate $r_d = r_d(\tau)$. Deposits are determined by $D^* = \frac{1}{1+\theta}\left(w_0 - \frac{w_1}{r_d(\tau)}\right)$.

3.2 Hypotheses

Our hypotheses follow from the comparative statics results when all key endogenous variables are subject to changes arising from an exogenous increase of the tax rate. In this section, we list our testable hypotheses. A proof of each hypothesis (unless in the text below) are provided in Section A of the Online Appendix.

The first two hypotheses are related to the effect of a tax on the bank's deposit rate and volume.

***Hypothesis* 1:** In response to increased taxes on bank profit, the deposit rate falls unambiguously ($\frac{dr_d}{d\tau} < 0$).

***Hypothesis* 2**: The volume of deposits falls in response to increased taxes on bank profits ($\frac{dD^*}{d\tau} < 0$).

[5] The first order condition for a logarithmic utility function is: $\frac{1}{w_0 - D} = \frac{\theta r_d}{w_1 + r_d D}$. By rearranging, we get the equation for $D^* = \frac{1}{1+\theta}\left(w_0 - \frac{w_1}{r_d}\right)$

The next set of hypotheses follow directly from the analysis of the bank's optimal contract design with borrowers. Our third hypothesis considers the effect of a tax on the bank's volume of lending, while hypotheses 4 and 5 deal with the effect of a tax on the lending rate.

***Hypothesis* 3**: The bank reduces the volume of loans in response to taxes ($\frac{dL^*}{d\tau} < 0$).

Hypothesis 4: The bank may reduce the loan rate.

Hypothesis 4 is concerned with the sign of $\frac{dR^*}{d\tau}$. In order to examine the impact of τ on R^*, we write Equation (8) in the following form:

$R^* = \frac{p^* h^{'}(p^*)(1-p^*)}{L^*(1-\tau)} = \frac{G(p)}{L^*(1-\tau)}$, where $G(p^*) \equiv p^* h'(p^*)(1-p^*)$.

First, we consider the case where taxes have no impact on bank monitoring effort. In order words, p^* is independent of the tax rate and is constant. In this case, an increase in the tax rate leads to an increase in the loan rate (the denominator of $\frac{G(p)}{L^*(1-\tau)}$ diminishes as $\frac{dL^*}{d\tau} < 0$, and the term $(1-\tau)$ decreases). An increase of the loan rate allows the bank to recover some of its costs that arise from higher taxes, and from a decline in the volume of loans (see Hypothesis 3).[6] This is the direct tax pass-through effect where part of the increased cost arising from an increase in taxes is absorbed by clients (borrowers) who now pay a higher price (loan rate).

Second, we consider the case where taxes have an impact on the bank's monitoring effort. In this case p^* is dependent on the tax rate. As shown in Hypothesis 6 (below), taxes can curb the effort that the bank devotes to monitoring borrowers, and as a consequence increases the risk of strategic default among borrowers. Formally, $\frac{dp^*}{d\tau} < 0$ and $G'(p^*) > 0$, which implies that the numerator also decreases as the tax rate increases. The combined impact of the tax rate on the numerator and denominator of $\frac{G(p)}{L^*(1-\tau)}$ however makes changes in the direction of the loan rate ambiguous. Taking a logarithmic differentiation of $R^* = \frac{G(p)}{L^*(1-\tau)}$, we obtain the following expression $\frac{dR^*}{d\tau}\frac{1}{R^*} = \frac{G'(p^*)}{G(p)}\frac{dp^*}{d\tau} - \frac{dL^*}{d\tau}\frac{1}{L^*} - \frac{1}{(1-\tau)}$. If $\frac{G'(p^*)}{G(p)}\frac{dp^*}{d\tau} > \frac{dL^*}{d\tau}\frac{1}{L^*} + \frac{1}{(1-\tau)}$, the loan rate decreases.

[6] An increase in the loan rate in response to higher tax rates is also in line with the prediction of a standard Monti-Klein model.

By decreasing the loan rate the bank prevents strategic defaults, which would have otherwise increased if the bank had opted for a higher loan rate while reducing monitoring effort. We call this the borrowers' incentive effect as it reduces their pay-off in default even when the bank's monitoring effort is lower.

In summary, the net effect on the loan rate of a tax on bank profit depends on the relative strength of the incentive effect. The prevalence of the incentive effect over the pass-through effect would prompt a reduction in loan rate. In contrast, where the pass-through effect dominates the incentive effect, there would be an increase in the loan rate.[7]

> ***Hypothesis 5:*** If the incentive effect dominates the tax pass-through effect, the loan and deposit rate both decrease. The relative magnitude of the downward adjustment of the two rates is ambiguous.

Formally, the change of the spread between the loan and deposit rate, $\frac{dR^*}{d\tau}\frac{1}{R^*} - \frac{dr_d}{d\tau}\frac{1}{r_d}$, is expected to decrease under the following conditions: $\frac{dr_d}{d\tau} < 0$ (Hypothesis 1) and $\frac{dR^*}{d\tau}\frac{1}{R^*} < 0$ if $\frac{G^{'}(p^*)}{G(p)}\frac{\mathrm{d}p^*}{\mathrm{d}\tau} - \frac{dL^*}{d\tau}\frac{1}{L^*} + \frac{1}{(1-\tau)} > 0$ (Hypothesis 4). Using expressions from Hypothesis 3 (see Appendix) gives: $\frac{dR^*}{d\tau}\frac{1}{R^*} - \frac{dr_d}{d\tau}\frac{1}{r_d} = \left[\left(\frac{G^{'}(p^*)p(1-p)}{G(p)}a - 1\right)\epsilon_L - \epsilon_{r_d}\right] < 0$ where $\epsilon_L = \frac{dL^*}{d\tau}\frac{(1-\tau)}{L^*}$ (the tax elasticity of L^*) and $\epsilon_{r_d} = \frac{dr_d}{d\tau}\frac{(1-\tau)}{r_d}$ (the tax elasticity of r_d). If $\frac{G^{'}(p^*)p}{G(p)} > 1$ (the incentive effect), the tax elasticities, ϵ_L and ϵ_{r_d}, are negative since $(1-p) < 1$ and $a < 1$. The change in the spread between the loan and deposit rate is $\frac{dR^*}{d\tau}\frac{1}{R^*} - \frac{dr_d}{d\tau}\frac{1}{r_d} = \epsilon_L - \epsilon_{r_d} < 0$. If the incentive effect is negligible, i.e. $\frac{G^{'}(p^*)p}{G(p)} \cong 0$, the change in the spread between the loan and deposit rate is $\frac{dR^*}{d\tau}\frac{1}{R^*} - \frac{dr_d}{d\tau}\frac{1}{r_d} = \epsilon_L - \epsilon_{r_d} > 0$.

[7] The combined outcome of lower loan rates (Hypothesis 4) and lower loan volumes (Hypothesis 3) predicted by our model is similar to other models of financial intermediation (Stiglitz and Weiss 1981; Besanko and Kanatas 1993; Bester 1994). However, our model differs from previous models as we show that taxes can have similar effects through the channels of strategic borrower default and bank monitoring effort.

Our sixth and last hypothesis relates to the bank's monitoring efforts with respect to a change in the tax rate.

***Hypothesis* 6**: The optimal monitoring will decrease in response to taxes (i.e. $\frac{\mathrm{d}p^*}{\mathrm{d}\tau} < 0$).

This hypothesis describes the tax wealth effect on the bank's monitoring effort. As marginal gains from recovering money from defaults are partly taxed away, the bank adjusts by reducing its monitoring costs at the margin.

4. Empirical Strategy

In this section we describe our research design, identification strategy, sample and variables used in the empirical analysis.

4.1 Research Design

For our research design to be valid, an important requirement is shock exogeneity. Tax changes often violate exogeneity assumptions because governments propose them far in advance of imposition and collection. If taxpayers anticipate and change behaviour prior to a change in taxation, potential outcomes are likely to be correlated with the policy intervention.

In this respect, the Tokyo bank tax is an exception for two reasons. First, the tax was planned in great secrecy giving banks no time to make strategic adjustments as a means of avoiding the Tokyo bank tax. No details were revealed to the public prior to its first announcement on 8th February 2000 (DeWit, 2000). We verify this through a news wire search, where we find no press coverage discussing the Tokyo bank tax prior to this date. At the first public announcement, the Tokyo Government issued a preliminary list with banks selected to pay the Tokyo bank tax. These banks would later all be obliged to make tax payments to the Tokyo Government. Second, it is unlikely that banks could predict the type of tax change. For the tax proposal to become legally binding, it took approximately eight weeks. This period was marked by a high level of uncertainty as various decisions regarding the design of the bank tax were taken. Final terms and conditions of the bank tax were not revealed until one week prior to its formal adoption. In addition, the rule which legitimised the adoption of the Tokyo bank tax was based on an unusual interpretation of Japanese tax law. The Tokyo Government exploited a loophole in

the tax system which entitled local governments to implement certain tax policies without the consent of the federal government (Ishi 2001). Although tax policies are not exclusively decided at federal level in Japan, the introduction of a special tax for banks on a local level was rather unusual. Due to the potential interaction with other types of bank regulation, bank taxation is generally considered as a policy tool used at national level. We check for anticipation effects in our robustness tests (discussed in Section B1 of the Online Appendix) by introducing a placebo tax in the period just prior to the introduction of the Tokyo bank tax. If banks anticipated the tax change, we would expect to pick up a change in behaviour during this period. Our results are not indicative of any anticipatory effects (with the relationship between the Tokyo bank tax and our outcome variables proving to be insignificant).

Our research design also rests on the assumption that the adoption of the Tokyo bank tax triggered a change in bank behaviour. If the Tokyo bank tax did not represent a significant increase in the tax liabilities of affected banks, we would be concerned about a potentially weak effect from the introduction of the Tokyo Bank tax. We examine the tax payments made in relation to the Tokyo bank tax relative to other tax payments made during the fiscal year. In fiscal year 2000, the Tokyo Government collected bank taxes in the amount of ¥111 billion, representing around 30% of banks' overall tax expenses in that year.

4.2 Identification Strategy

Our assumption is that exogenous variation in taxation affects the ability of banks to act as financial intermediaries. We classify banks into treated banks (those that are liable to pay the Tokyo bank tax) and control banks (those that are not). Based on this classification we use a difference-in-differences approach, which compares the difference in the outcome of the treated banks between the pre-tax period and the post-tax period with the same difference in the outcome of the non-treated banks. To investigate the effect of the Tokyo bank tax on bank behaviour, we estimate a regression of the form:

$$Y_{it} = \delta \underbrace{Bank_i^{Taxed} * Post_t}_{TAX_{i,t}} + \boldsymbol{\beta X}_{i,t-1} + \alpha_i + \gamma_t + \epsilon_{it}, \quad (10)$$

where i denotes bank and t denotes time. Y_{it} represents each of the dependent variables: net interest margin, net interest and fee margin, mark-up, and markdown, amount of loans granted, core and non-core deposits (see Section 4.3.2 for a discussion of variables). $Bank_i^{Taxed}$ is an indicator variable which captures whether a bank is liable for the Tokyo bank tax or not. The indicator variable $Post_t$ equals one after the Tokyo bank tax is introduced and zero otherwise. Therefore, the dichotomous treatment indicator $TAX_{i,t}$ is zero for all banks in the pre-Tokyo bank tax period and one for those banks that are taxed when the Tokyo bank tax comes into effect. $X_{i,t-1}$ is a vector of bank-level control variables that vary over time and across banks. These control variables include capital adequacy, asset quality, management efficiency, earnings, liquidity, diversification, size and market share. Each of these controls enters the model lagged by one period to avoid simultaneity. The model also includes time dummies, γ_t, to capture time effects common to all banks, as well as, bank specific fixed effects, α_i, to control for unobserved bank level heterogeneity. ϵ_{it} is a stochastic error term.

Estimation of Equation (10) is executed using Ordinary Least Squares (OLS), with standard errors that are robust to heteroscedasticity and clustered at the bank level to control for within-bank correlation (Arellano 1987). The coefficient of interest is δ, which represents the impact of the Tokyo bank tax on bank behaviour.

A key identification assumption behind our estimation strategy is that, in the absence of treatment, the difference-in-differences estimator is zero; the so-called parallel trend assumption. This assumption requires that the trend in the outcome variable is similar for both treatment and control groups in the pre-tax (shock) period. To check whether the parallel trend assumption is satisfied we repeat the analysis in periods when there was no change in the taxes. We find that the coefficients on $TAX_{i,t}$ do not differ from zero (see Section B1 of Online Appendix).

4.3 Data

4.3.1 Sample

The data used in our analysis is compiled from the Japan Bankers Association dataset, which provides detailed balance sheet and income statement for all 148 of its member-banks on

an individual bank basis. Results reported here are all from the semi-annual frequency dataset. The period of analysis, spans March 1998 (fiscal year 1997) through September 2001 (fiscal year 2001). This period is determined primarily by the introduction of the Tokyo bank tax and the availability of semi-annual data. The Tokyo bank tax became effective on 1st April 2000. This divides our sample into a pre-intervention period of two and a half years, and an intervention period of one and a half years.

Our sample of commercial banks comprises both City and Regional banks.[8] Trust banks and Long-Term Credit banks are excluded from our sample, since these types of banks have supervisory procedures and business models that are fundamentally different from commercial banks. The restriction of our sample to commercial banks ensures sufficient overlap in the distribution of the covariates across treated and untreated banks, thus allowing the correct statistical inference to be drawn (Imbens and Rubin 2015).

Banks which either fail or went into public administration during the period of our analysis are excluded from the sample.[9] We also identify one incidence of a merger between a treated and a non-treated bank.[10] To ensure the separability of treatment and control groups, these banks are also excluded from our sample. Our final sample is an unbalanced panel of 998 bank-year observations of 126 Japanese commercial banks (9 City banks and 117 Regional banks). Of the 126 commercial banks in our sample, 17 banks were subject to the Tokyo bank tax.

4.3.2 Variables

[8] City banks are large in size with branches in major cities throughout Japan and beyond. These banks have a wide geographic scope, and a diversified portfolio of clients and products (including private banking and asset management). Regional banks are regulated under the terms of the Banking Act. These institutions operate within one of the 47 prefectures (administrative regions) in Japan. These banks are normally headquartered in the capital city of a prefecture, and carry out the vast majority of their business within a given prefecture, acting as an important source of finance for medium sized firms and local government. The majority of Regional banks are quoted publicly, and the largest offer a full range of banking and financial services.

[9] The following banks were excluded from the sample: Hokkaido Takushoku Bank (failed November 17, 1997), Tokuyo City Bank (failed Nov 27, 1997), Tokyo Sowa Bank (under public administration, June 12, 1999), Kokumin Bank (under public administration, April 11, 1999), Niigata Chuo Bank (under public administration, October 2, 1999), Ishikawa Bank (failed, March 2001), Chubu Bank (failed, March 8, 2001), Kyoto Kyoei Bank (failed, October 14, 1997), Kofuku Bank (under public administration, May 22, 1999), Kansai Sawayaka Bank (formerly Kofuku Bank), Namihaya Bank (under public administration, August 7, 1999), Midori Bank (failed, May 15,1998). (Source: Bank of Japan, Deposit Insurance Corporation Japan, Financial Services Agency Japan).

[10] Hachijuni Bank (treated) acquires Niigata Chuo Bank (non-treated), September 29, 2000; (Financial Services Agency Japan).

In order to investigate the impact of the introduction of the Tokyo bank tax on bank behaviour, and in line with our hypotheses, we employ several dependent variables. The main variable of interest is the *net interest margin*, which is defined as interest income minus interest expenses over total assets. We use the *net interest margin* to capture a bank's ability to generate profits via financial intermediation. We also calculate the *net interest and fee margin*. This would account for a potential shift in the pricing of loans and deposits from a rate-based approach to a fee-based approach as a response to the Tokyo bank tax.

In principle, a pass-through of taxes could occur through an increase in the interest rate on loans or through a decrease in the interest rate on deposits. To investigate the effect of the tax on the pricing of loans and deposits, we calculate a *markdown* and *mark-up*. These are calculated using implicit interest rates on deposits and loans. Following prior literature, we define the implicit deposit (loan) rate as the ratio of interest expenses (income) to total deposits (loans) (Becker 1975). These implicit rates reflect the average interest rates over various types of deposits and loans respectively. We then calculate the *mark-up* (*markdown*) as the spread between the implicit loan (deposit) rate and the money market interest rate (Albertazzi and Gambacorta, 2010).

In order to assess the effect of the Tokyo bank tax on the funds channelled from savers to borrowers, we use total loans, core and non-core deposits, denoted as *loanvol*, *coredepovol* and *noncoredepovol* respectively. We take the natural logarithm of these variables. Core deposits are those that have low interest-rate sensitivity. These include current, ordinary, savings and deposits at notice. Non-core deposits are those that have high interest-rate sensitivity, including time, instalment and negotiable certificates of deposits (Aonokazu, 2006). Core and non-core deposits are reported at an annual frequency.

Panel A of Table 2 provides detailed definitions of the outcome variables used in our analysis. Table 3 reports means and standard deviations of the same variables for treated and non-treated banks before and after the introduction of the Tokyo bank tax at the beginning of the new fiscal year in April 2000. Panel A of Table 3 shows that non-treated banks are slightly more

profitable in intermediating funds (1.99%) than treated counterparts (1.33%). This pattern remains when fees are also considered. This is due to treated banks charging on average slightly lower rates on loans granted (2.27%) and paying higher rates to depositors (0.67%) relative to non-treated counterparts (2.54% and 0.27%). Treated banks are larger than non-treated counterparts (in terms of total loans).

[Insert Table 2 about here]

[Insert Table 3 about here]

Bank-specific covariates include financial characteristics used typically by supervisors to monitor the performance and safety and soundness of banks. These include capital adequacy, asset quality, management efficiency, earnings and liquidity. We also include three additional covariates in order to capture any effects related to bank size, diversification, and market share.[11] Panel B of Table 2 provides detailed definitions of the covariates used in our empirical analysis. The comparability of treated and non-treated banks is assessed based on these aforementioned observable covariates by examining their respective moments and empirical distributions. Panel B of Table 3 reports means and standard deviations of these variables for treated and non-treated banks before and after the introduction of the Tokyo bank tax. Overall, the summary statistics confirm that treated and non-treated banks are on average relatively similar across a number of dimensions. There are however, dimensions in which the two groups differ. We adjust statistically for such observed pre-intervention differences in the characteristics of treated and non-treated banks, by including all the aforementioned bank-specific control variables in our estimable model.

5. Findings

Table 4 presents the results of estimating Equation (10). We find that the coefficients on TAX reported in Columns 1 and 2 are positive and statistically significant at the 1% level. This is consistent with our hypothesis that banks widen margins as a response to the Tokyo bank tax. The net interest margin (*nim*) and the net interest and fee margin (*nifm*) widen by 6.2 basis points

[11] All regressions reported below include an income-based diversification measure. Nevertheless, our results do not change if an asset diversification measure is included as well. This implies that our findings are robust to differences in portfolio or business activities of banks included in our sample.

and 8.2 basis points respectively, on average, after the introduction of the Tokyo bank tax. These coefficients also indicate that the impact of the tax on bank margins is economically significant since taxed banks increase both their *nim* and *nifm* by about 20% of their respective within sample standard deviation. As such, these findings are consistent with banks passing some of the costs associated with the imposition of the tax onto customers via adjustments in interest and fee rates.

[Insert Table 4 around here]

To disentangle the effect of the Tokyo bank tax on borrowers and depositors, we decompose the net interest margin into a *mark-up* and *markdown*. The results reported in Columns 3 and 4 of Table 4 indicate that both the *mark-up* and *markdown* decrease once the Tokyo bank tax is introduced. However, the *markdown* declines by two basis points more than the *mark-up*, which is in line with a widening of the net interest margin. Specifically, the *mark-up* declines on average by 8.3 basis points, whereas the *markdown* declines by 10.3 basis points. A declining *mark-up* is in line with our hypothesis that banks reduce their lending rate as a response to the tax. Overall, these results suggest a pronounced pass-through effect to depositors who shoulder a considerable portion of the increased tax burden arising from the introduction of the Tokyo bank tax. These results are also in line with prior evidence suggesting that taxes on banks are passed through to customers (Demirgüç-Kunt and Huizinga 2001).

Column 5 of Table 4 summarises the estimated relationship between the Tokyo bank tax and bank credit supply. The coefficient on TAX is negative and statistically significant at the 5% level. This finding indicates that banks when faced with the Tokyo bank tax reduce lending. The effect is also economically significant. Treated banks reduce total lending by 2.8% more than non-treated counterparts on average. The average affected bank contracts credit supply by ¥354bn. This decline in the credit extended by affected banks implies a sizeable reduction in funding for real economic activity. This supports our second hypothesis which contends that the imposition of the Tokyo bank tax affects the entire economy via a contraction in credit supply. Our findings

also accord with recent documented evidence of an adverse effect of taxes on credit supply (Buch et al. 2016; Schandlbauer 2017).

Finally, Columns 6 and 7 provide estimates of the tax effect on the volume of core deposits and non-core deposits. Banks affected by the Tokyo bank tax hold fewer non-core deposits (*noncoredepovol*) than banks in the control group. In the aftermath of the Tokyo bank tax, non-core deposits on average decline by 5.74 percent more for treated banks. Core deposits remain unchanged. These results are indicative of rate adjustments for deposit types with relatively high interest rates, and are consistent with the notion that banks affected by the tax accept fewer deposits. Our findings further substantiate a partial pass-through effect of the tax burden from banks to depositors.

6. Testing the Bank Monitoring Channel

Our theoretical model predicts that the channel through which a tax on gross profit leads to contraction in financial intermediation is via a drop in the monitoring effort expended by affected banks. In this section, we present the results of several tests conducted at the bank and borrower level, which provide corroborating evidence in support of the monitoring channel.

6.1 Bank monitoring and the loan portfolio

In order to investigate whether the Tokyo bank tax affects financial intermediation activity via an adverse impact on banks' monitoring effort, we analyse changes in the structure of the loan portfolios of affected banks around the time of the introduction of the tax. First, we examine changes in the loan portfolios of banks in relation to the geographic proximity of their respective borrowers. Geographic proximity between banks and borrowers may reduce asymmetric information, which in turn lowers the cost of monitoring.[12] Prior evidence suggests that banks face higher costs in collecting soft information on distant borrowers relative to more geographically proximate counterparts (Sufi 2007; Knyazeva and Knyazeva 2012; Cotugno et al. 2013). Moreover, theory shows that banks may reject loan applications from firms that are

[12] This is an assumption adopted in a number of theoretical papers, which investigate the impact of geographic proximity on: banks' decision to diversify (Almazan 2002), banks' ability to extract informational rents (Hauswald and Marquez 2006); and banks' competitive location (Lederer and Hurter, 1986).

located at distance, given that the reliability of soft information regarding the creditworthiness of the borrower decreases with distance (Hauswald and Marquez, 2006). In view of these empirical and theoretical findings we postulate that following the imposition of the Tokyo bank tax affected banks reduce the proportion of their overall lending towards borrowers that are geographically distant.

To test this hypothesis, we collect data on the loans outstanding to individual listed firms for each bank in our sample. The data are compiled from the Nikkei NEEDS Financial Quest database. The data are reported on an annual frequency. Each firm and bank included in this database has a unique geographic area code based on the location of their headquarters. We compute distances between banks and borrowing firms based on these area codes. Using these distances we create two portfolios, which we term 'local' and 'distant'. The local portfolio (LP) contains all loans granted to firms located in the same area code as the bank is located. The distant portfolio (DLP) contains loans granted to firms outside the area code where the bank is located. To test the monitoring channel we estimate the following model:

$$Portfolio_{i,t} = \delta TAX_{i,t} + \boldsymbol{\beta X}_{i,t-1} + \alpha_i + \gamma_t + \epsilon_{it}, \quad (11)$$

where $Portfolio_{i,t}$ represents LP or DLP as a proportion of total loans. The explanatory and control variables are as defined in Table 2.

The results of estimating Equation (11) are reported in Panel A of Table 5. We find that both local and distant loan portfolios as shares of affected banks total loans decline after the introduction of the tax, reflecting an overall decline in the supply of credit granted by affected banks. However, the DLP declines proportionately more than the LP. The difference in the decline of the DLP relative to the LP is significant at the 10% level.

Overall these results suggest that banks affected by the imposition of the Tokyo bank tax reduce lending to firms located at distance relative to those which are geographically proximate. As such this lends support to the contention that the introduction of the Tokyo bank tax reduces the level of monitoring by affected banks. The robustness of these findings are verified by a placebo test whereby we show that local and distant portfolios do not change when we falsely

assume that the Tokyo tax is introduced one year prior to its actual adoption. The results of this test are reported in Panel A of Table B4 in the Online Appendix.

As a further test of whether banks respond to the tax by reducing lending to borrowing firms that entail higher monitoring costs, we follow Sufi (2007) and classify borrowing firms as transparent and opaque. We use these classifications to construct two portfolios. The transparent portfolio (TP) contains all loans granted to firms with a rating from the Rating and Investment Information, a Japanese rating agency.[13] The opaque portfolio (OP) contains loans granted to unrated firms. We use the TP and OP to estimate Equation (11). The point estimates presented in Panel B of Table 5 suggest that affected banks reduce lending to unrated firms by more than to rated counterparts. This finding provides further support to the contention that the introduction of the Tokyo bank tax reduces the level of monitoring by affected banks.

[Insert Table 5 around here]

6.2 Bank monitoring and borrowing firms

6.2.1 Evidence from the bond market

We also test for the existence of the monitoring channel predicted by our model by examining the value of bank monitoring to borrowing firms. To this end we first examine the effect of the announcement of the tax on the borrowing costs of firms. Here we focus on external public debt. Prior theoretical and empirical literature suggests that bank monitoring of corporate creditworthiness benefits to firms' claimants (Holmström and Tirole 1997; Datta et al. 1999). These benefits arise due to banks' superior access to private information on borrowers (Fama 1985), as well as to their efficiency and flexibility in restructuring and renegotiating debt claims (Berlin and Loeys 1988; Gertner and Scharfstein 1991; Denis and Mihov 2003). In line with this literature, we postulate that if an increase in taxes reduces the monitoring effort expended by banks, we expect to observe higher at-issue yield spreads for public (straight) bond offerings from firms that also borrow from banks that are liable to pay the Tokyo bank tax.

[13] Unfortunately, due to data unavailability on rating information on Japanese listed companies our sample is restricted between 1999 and 2001. This data unavailability prevents us from conducting a placebo test to verify the robustness of this analysis.

In order to test this hypothesis, we collect data on Japanese bond issues from Thomson Reuters' SDC Platinum database and merge it with financial statements of bond issuing firms drawn from Datastream. Following standard practice in corporate bond pricing literature we restrict our sample to straight bonds with fixed coupon rates (Gande et al. 1997; Datta et al. 1999). In doing so, we avoid complications of measuring yields for convertible and floating rate bond issues. We use our sample to estimate the following regression equation:

$$BPS_{f,j,t} = \alpha + \delta TAX_{f,t}^{Bond} + \beta X_{f,j,t} + \xi_f + \gamma_t + \varepsilon_{f,j,t}, \quad (12)$$

where BPS is the premium of the at-issue yield spread of the debt security *j* over the yield of a Japanese government security of comparable maturity. $TAX_{f,t}^{Bond}$ is a dummy variable that equals zero for all bonds issued by a firm f in the pre-Tokyo bank tax period t and one for those bonds issued by firms that are customers of taxed banks when the Tokyo bank tax comes into effect. More specifically, we consider the two largest banks the firm is banking with (in terms of loans granted to the firm) in classifying firms into treatment and control groups. This is done on the basis that the two largest banks a firm banks with typically have similar loan shares among bank lenders of the firms in our sample, and are therefore similarly incentivised to monitor the borrowing firms. $X_{f,j,t}$ represents a vector of bond and firm specific variables comprising: maturity (measured in years to maturity); amount (the natural logarithm of the size of the bond issue); size (the natural logarithm of the total assets of the issuing firm) and leverage (total debt scaled by total assets). We also control for Keiretsu affiliation[14], industry, prefecture and bank type effects. The model also includes time effects, γ_t, and firm specific fixed effects, ξ_f. $\varepsilon_{f,j,t}$ is a stochastic error term.

The estimation of Equation (12) is reported in Panel A of Table 6. All statistically significant control variables have the expected sign. The at-issue yield spread reduces with size (as larger firms are considered safer investments) and increases with leverage (since more debt

[14] Keiretsu are groups of Japanese firms and financial institutions that are financially inter-connected, leading to close cooperation (Hoshi et al. 1991; Berglof and Perotti 1994). The importance of Keiretsu in the Japanese economy, as well as the strength of the links between Keiretsu members is contested (Miwa and Ramseyer 2002; Ramseyer and Miwa 2002).

exacerbates risk shifting and asset substitution agency conflicts). More interesting (for our purposes) is that the at-issue yield spread increases by 22 basis points for bond issues offered by firms banking with taxed banks after the introduction of the Tokyo bank tax. This increase in the spread is economically and statistically significant (the latter at the 5% level), and is congruent with the contention of our theoretical model that the monitoring of borrowers by affected banks deteriorates after the introduction of the Tokyo bank tax. To validate this finding, in Panel B of Table B4 in the Online Appendix we report the results of a placebo test where we show no change in the spread in the 12 months prior to the introduction of the Tokyo bank tax

[Insert Table 6 around here]

6.2.2 Evidence from the stock market

As an alternative approach to testing the monitoring channel, we investigate the effect of the announcement of the Tokyo bank tax on the stock prices of firms borrowing from affected banks. We postulate that if the increase in taxes reduces the monitoring effort expended by affected banks (as predicted by our theoretical model) we expect to observe negative abnormal returns for firms that borrow from banks subject to the Tokyo bank tax, upon the announcement of the tax. Our hypothesis aligns with extant literature, which views bank monitoring as a value enhancing function for the borrowing firm (Diamond 1991; Bhattacharya and Thakor 1993; Billett et al. 1995). This is due to bank monitoring raising the probability of firm success through enforcing either efficient project choice or level of entrepreneurial effort, which mitigates the moral hazard faced by outside shareholders and other investors (Seward 1990; Besanko and Kanatas 1993).

In testing our hypothesis we obtain stock market data for all listed Japanese firms recorded in the Japan Company Handbook (excluding banks) from Datastream. Following Brown and Warner (1985), we calculate cumulative abnormal returns using the risk-adjusted market model as $CAR[0,n]_f = \sum_{t=0}^{n} AR_{f,t}$, where $CAR[0,n]_f$ is the cumulative abnormal return for firm f for event days 0 through n. $AR_{f,t}$ is calculated as $AR_{f,t} = R_{f,t} - (\hat{\alpha} + \hat{\beta} R_{M,t})$, where $AR_{f,t}$ is the abnormal return for firm f on event day t, $R_{i,t}$ is the actual return on firm f for event day t, and

$R_{M,t}$ is the daily return of the market portfolio approximated by the Tokyo Stock Price Index (Topix). $\hat{\alpha}$ and $\hat{\beta}$ are estimated from the equation $R_{f,t} = \alpha_f + \beta_f R_{M,t} + \varepsilon_{f,t}$ over the interval from 260 to 20 trading days before the event date. We subsequently regress these CARs on a treatment group dummy and a number of control variables. Specifically, we estimate the following regression equation:

$$CAR[0,n]_f = \alpha + \beta TAX_f^{Stock} + X_f'\gamma + \varepsilon_f. \quad (13)$$

TAX_f^{Stock} is a dummy variable which takes the value of one if the firm's largest bank lenders are subject to the Tokyo bank tax and zero otherwise. As above, we consider the two largest banks the firm is banking with (in terms of loans granted to the firm) in classifying firms into treatment and control groups. X_f denotes a vector of firm specific variables comprising: size (market capitalization); risk (volatility of stock returns); and access to alternative sources of finance (a dummy variable that takes the value of one if the firm has issued a bond within the past three years and zero otherwise).[15] We also control for Keiretsu affiliation, industry, and prefecture and bank type effects. Standard errors are clustered at the bank level.

Panel B of Table 6 provides estimates of Equation (13) for CARs of different length. In Column 1, where we consider the abnormal return on the day of the Tokyo tax announcement (CAR[0,0]) the coefficient on TAX_f^{Stock} is -0.203, and is statistically significant at the 1% level. The difference in CARs between treated and non-treated firms increases slightly when we consider longer event windows. Specifically, when CAR[0,3] is considered (Column 2), the coefficient on TAX_f^{Stock} is -0.286. This increases to -0.295 when CAR[0,5] is used in Column 3. These coefficients are also statistically significant at the 5% level. The negative signs on the coefficients indicate that the market value of firms which borrow from soon to be taxed banks reacts more negatively to the announcement of the tax than the market value of firms not borrowing from affected banks. These results are in line with the hypothesis that a reduction in bank monitoring activity can have a value destroying impact on the borrowing firm. This argument finds additional support from a

[15] Data on Japanese bond issues are obtained from Thomson Reuters' SDC Platinum database.

placebo test conducted in the month prior to the introduction of the Tokyo Bank tax, the results of which are reported in Panel C of Table B4 in the Online Appendix. Overall, Table 6 provides evidence in support of the monitoring channel identified by our model in Section 3 through which a tax levied on banks' gross profits adversely affects financial intermediation.

8. Conclusion

The effect of taxation on the behaviour of banks is likely to depend on the type and size of the tax imposed, prevailing market conditions and the extent to which banks choose to pass through any resultant increases in costs to customers. In this study, we derive a theoretical model, which leads to several testable propositions related to how bank behaviour changes in response to a sudden imposition of a tax on gross profitability. Testing these aforementioned propositions empirically is challenging given identification concerns. This challenge is overcome in this study by utilising the case of the Tokyo bank tax, which was imposed on gross profits of Japanese banks operating in Tokyo, but left other banks operating in Japan unaffected.

Our theoretical model, derived hypotheses and research design rests on the assumption that the introduction of the Tokyo bank tax triggered a change in bank behaviour and affected the ability of banks to act as financial intermediaries with possible implications for loan supply, pricing of loans and deposits, and the monitoring of borrowers. The results derived from our estimable (difference-in-differences) model suggests that banks subject to the tax increased both, net interest and net interest and fee margins in response to an unexpected tax on gross profitability. An analysis of the deposit and loan interest rate components of the net interest margin suggests that rates paid to depositors and charged to borrowers decline following the introduction of the Tokyo bank tax. Deposit rates decline by a greater degree than loan rates, implying that banks subject to the tax pass through the effects of the tax to depositors. These banks also reduce total lending. On the liability side, the introduction of the Tokyo bank tax leads to a significant outflow of rate-sensitive deposits for banks subject to the tax compared to unaffected counterparts. These findings are robust to a battery of additional tests.

We conduct an extensive analysis to explore the extent to which banks subject to the Tokyo bank tax reduce monitoring of borrowers. Banks subject to the provisions of the Tokyo bank tax reduce lending to firms located at distance relative to counterparts that are geographically proximate, and to firms which are more informationally opaque relative to less opaque counterparts. The costs of debt issuance increase and market valuations decrease for firms that are customers of banks subject to the Tokyo bank tax.

Overall, the findings of this study suggest that taxes play an important role in affecting the behaviour of banks. The extent to which banks pass through any higher costs associated with tax increases to customers has implications for the cost and availability of credit to borrowers, and the interest rates paid to depositors. As such the results of this study have relevance to policymakers engaged in designing and monitoring the effectiveness of tax regimes in the banking industry.

References

Albertazzi, U. and Gambacorta, L., 2010. Bank Profitability and Taxation. *Journal of Banking & Finance*, 34(11), pp.2801–2810.

Allen, L., 1988. The Determinants of Bank Interest Margins: A Note. *Journal of Financial and Quantitative Analysis*, 23(2), pp.231–235.

Almazan, A., 2002. A Model of Competition in Banking: Bank Capital vs Expertise. *Journal of Financial Intermediation*, 11(1), pp.87-121.

Andries, K., Gallemore, J. and Jacob, M., 2017. The Effect of Corporate Taxation on Bank Transparency: Evidence from Loan Loss Provisions. *Journal of Accounting and Economics*, 63(2), pp.307-328.

Aonokazu, H., 2006. The Present Value of Banks' Liquid Deposits and Measures of Interest Rate Risk. *Imes Discussion Paper Series*, 2006-J-9.

Arellano, M., 1987. Computing Robust Standard Errors for Within Group Estimators. *Oxford Bulletin of Economics and Statistics*, 48(4), pp.431–434.

Becker, W.E.J., 1975. Determinants of the United States Currency-Demand Deposit Ratio. *Journal of Finance*, 30(1), pp.57–74.

Berglof, E. and Perotti, E., 1994. The Governance Structure of the Japanese Financial Keiretsu. *Journal of Financial Economics*, 36(2), pp.259–284.

Berlin, M. and Loeys, J., 1988. Bond Covenants and Delegated Monitoring. *The Journal of Finance*, 43(2), pp.397–412.

Besanko, D. and Kanatas, G., 1993. Credit Market Equilibrium with Bank Monitoring and Moral Hazard. *Review of Financial Studies*, 6(1), pp.213–232.

Bester, H., 1994. The Role of Collateral in a Model of Debt Renegotiation. *Journal of Money Credit and Banking*, 26(1), pp.72–86.

Bhattacharya, S. and Thakor, A. V., 1993. Contemporary Banking Theory. *Journal of Financial Intermediation*, 3(1), pp.2–50.

Billett, M.T., Flannery, M.J. and Garfinkel, J.A., 1995. The Effect of Lender Identity on a Borrowing Firm's Equity Return. *Journal of Finance*, 50(2), pp.699–718.

Black, L. and Hazelwood, L., 2013. The Effect of TARP on Bank Risk-Taking. *Journal of Financial Stability*, 9(4), pp.790–803.

Boehmer, E., Masumeci, J. and Poulsen, A.B., 1991. Event-Study Methodology under Conditions of

Event-Induced Variance. *Journal of Financial Economics*, 30(2), pp.253–272.

Brown, S.J. and Warner, J.B., 1985. Using Daily Stock Returns. *Journal of Financial Economics*, 14(1), pp.3–31.

Buch, C.M., Hilberg, B. and Tonzer, L., 2016. Taxing Banks: An Evaluation of the German Bank Levy. *Journal of Banking & Finance*, 73, pp. 52–66.

Capelle-Blancard, G. and Havrylchyk, O., 2017. Incidence of Bank Levy and Bank Market Power. *Review of Finance*, 21(3),pp.1023-1046.

Capelle-Blancard, G. and Havrylchyk, O., 2014. The Ability of Banks to Shift Corporate Income Taxes to Customers. In R. de Mooij and G. Nicodème, eds. *Taxation and Regulation of the Financial Sector*. Boston: MIT Press, pp. 253–278.

Caminal, R. & Matutes, C., 2002. Market Power and Banking Failures. *International Journal of Industrial Organisation*, 20, pp.1341–1361.

Carletti, E., 2004. The Structure of Bank Relationships, Endogenous Monitoring, and Loan Rates. *Journal of Financial Intermediation*, 13(1), pp.58-86.

Celerier, C., Kick, T. and Ongena, S., 2017. Changes in the Cost of Bank Equity and the Supply of Bank Credit. *Centre for Economic Policy Research Working* Paper, Number DP12172.

Cerqueiro, G., Ongena, S. and Roszbach, K., 2016. Collateralization, Bank Loan Rates, and Monitoring. Journal of Finance, 71(3), pp.1295-1322.

Chiorazzo, V. and Milani, C., 2011. The Impact of Taxation on Bank Profits: Evidence from EU Banks. *Journal of Banking & Finance*, 35(12), pp.3202–3212.

Cornett, M.M., McNutt, J.J., Strahan, P.E. and Tehranian, H. , 2011. Liquidity Risk Management and Credit Supply in the Financial Crisis. *Journal of Financial Economics*, 101(2), pp.297–312.

Cotugno, M., Monferra, S. and Sampagnaro, G., 2013. Relationship Lending, Hierarchical Distance, and Credit Tightening: Evidence from the Financial Crisis. *Journal of Banking & Finance* 37(5), pp.1372-1385.

Datta, S., Iskandar-Datta, M. and Patel, A., 1999. Bank Monitoring and the Pricing of Corporate Public Debt. *Journal of Financial Economics*, 51(3), pp.435–449.

Demirgüç-Kunt, A. and Huizinga, H., 2001. The Taxation of Domestic and Foreign Banking. *Journal of Public Economics*, 79(3), pp.429–453.

Denis, D.J. and Mihov, V.T., 2003. The Choice Among Bank Debt, Non-Bank Private Debt, and Public Debt: Evidence From New Corporate Borrowings. *Journal of Financial Economics*, 70(1), pp.3–28.

DeWit, A., 2000. The Income Tax and the Tokyo Bank Tax. *Asian Perspectives*, 24(4), pp.197–216.

Diamond, D.W., 1984. Financial Intermediation and Delegated Monitoring. *Review of Economic Studies*, 51(3), pp.393–414.

Diamond, D.W., 1991. Monitoring and Reputation : The Choice between Bank Loans and Directly Placed Debt. *Journal of Political Economy*, 99(4), pp.689–721.

Fama, E.F., 1985. What's Different About Banks? *Journal of Monetary Economics*, 15(1), pp.29–39.

Gande, A., Puri, M., Saunders, A. and Walter, I.., 1997. Bank Underwriting of Debt Securities: Modern Evidence. *Review of Financial Studies*, 10(4), pp.1175–1202.

Gertner, R. and Scharfstein, D., 1991. A Theory of Workouts and the Effects of Reorganization Law. *Journal of Finance*, 46, pp.1189–1222.

Hauswald, R. and Marquez, R., 2006. Competition and Strategic Information Acquisition in Credit Markets. *Review of Financial Studies*, 19, (3), pp.967–1000.

Hemmelgarn, T. and Teichmann, D., 2014. Tax Reforms and the Capital Structure of Banks. *International Tax and Public Finance*, 21(4), pp.645–693.

Ho, T. and Saunders, A., 1981. The Determinants of Bank Interest Margins: Theory and Empirical Evidence. *Journal of Financial and Quantitative Analysis*, 16(4), pp.581–600.

Holmström, B. and Tirole, J., 1997. Financial Intermediation, Loanable Funds, and the Real Sector. *Quarterly Journal of Economics*, 112(3), pp.663–691.

Hoshi, T., Kashyap, A. and Scharfstein, D., 1991. Corporate Structure. Liquidity, and Investment: Evidence from Japanese Industrial Groups. *Quarterly Journal of Economics,* 106(1), pp.33–60.

Hoshi, T. and Kashyap, A., 2000. The Japanese Banking Crisis: Where Did It Come From and How Will It End? In B. S. Bernanke and J. J. Rotemberg, eds. *Macroeconomics Annual 1999*. Boston: MIT, pp. 129–212.

Huizinga, B.H., Voget, J. and Wagner, W., 2014. International Taxation and Cross-Border Banking. *American Economic Journal: Economic Policy*, 6(2), pp.94–125.

Imbens, G. and Rubin, D., 2015. *Assessing Overlap in Covariate Distributions* Online., Cambridge: Cambridge University Press.

Ishi, H., 2001. *The Japanese Tax System* 3rd ed., Oxford: Oxford University Press.

Ito, T. and Patrick, H. 2005. Problems and Prescriptions For the Japanese Economy: An Overview. In T. Ito, H. Patrick, and D.E. Weinstein, eds. *Reviving Japan's Economy: Problems and*

Prescriptions, Cambridge, MA: MIT Press, 2005.

Japan Bankers Association, 2006. *Original Title (Japanese): Chotto benkyō-ben: ginkō no taishyakutaishōhyō - sonekikeisansho.*, Tokyo.

Keen, M. and de Mooij, R.A., 2016. Debt, Taxes, and Banks. *Journal of Money Credit and Banking*, 48(1), pp.5–33.

Klein, M.A. 1971. A theory of the banking firm. Journal of Money, Credit and Banking, 3 (1971), pp. 205-218

Knyazeva, A. and Knyazeva, D., 2012. Does Being Your Bank's Neighbour Matter? Journal of Banking & Finance 36(4), pp.1194-1209.

Kogler, M., 2016. On the Incidence of Bank Levies : Theory and Evidence. University of St Gallen *Working Paper*, Number 1606.

Lederer, P.J., and Hurter, A., 1986. Competition of Firms: Discriminatory Pricing and Location. Econometrica, 54 (3), pp. 623-40.

Meji-Gakuin, 2008. *Judicial Decisions: Tokyo Bank Tax Case (Original Japanese title: Tokyobu-ginkozei-jiken)*, Available at: http://www.meijigakuin.ac.jp/~watax/F19-hanketsu-genbun.pdf.

Mester, L.J., Nakamura, L.I. and Renault, M., 2007. Transactions Accounts and Loan Monitoring. *Review of Financial Studies*, 20(3), pp.529-556.

Miwa, Y. and Ramseyer, J.M., 2002. Banks and Economic Growth: Implications from Japanese History. *Journal of Law and Economics*, 45(1), pp.127–164.

Monti, M., 1972. "Deposit, Credit, and Interest Rate Determination Under Alternative Bank

Objectives". In G.P. Szego and K. Shell, eds. *Mathematical Methods in Investment and Finance*, Amsterdam: North-Holland, pp. 431-454

Peek, J. and Rosengren, E.S., 2000. Collateral Damage: Effects of the Japanese Bank Crisis on Real Activity in the United States. *American Economic Review*, 90(1), pp.30–45.

Rajan, R., 1992. Insiders and Outsiders: The Choice Between Informed and Arm's Length Debt. *Journal of Finance*, 47, pp.1367–1400.

Ramseyer, J.M. and Miwa, Y. 2002. The Fable of the Keiretsu. *Journal of Economics and Management Strategy*, 11(2), pp.169–224.

Repullo, R. and Suarez, J., 1998. Monitoring, Liquidiation, and Security Design. *Review of Financial Studies*, 11(1), pp.163–187.

Schandlbauer, A., 2017. How do Financial Institutions React to a Tax Increase? *Journal of Financial* Intermediation, 30(3),pp.86-106.

Schepens, G., 2016. Taxes and Bank Capital Structure. *Journal of Financial Economics*, 120, (3), pp.185-600.

Seward, J.K., 1990. Corporate Financial Policy and the Theory of Financial Intermediation. *Journal of Finance*, 45(2), pp.351–377.

Stein, J.C., 2002. Information Production and Capital Allocation: Decentralized Versus Hierarchical Firms. *Journal of Finance*, *57*(5), pp.1891-1921.

Stiglitz, J.E. and Weiss, A., 1981. Credit Rationing in Markets with Imperfect Information. *American Economic Review*, 71(3), pp.393–410.

Sufi, A., 2007. Information asymmetry and Financing Arrangements: Evidence from Syndicated Lending. *Journal of Finance*, 62 (2), pp. 629-668.

Uchida, H. and Udell, G.F., 2014. Banking In Japan. In A. N. Berger, P. Molyneux, and J. O. S. Wilson, eds. *Oxford Handbook of Banking*. Oxford: Oxford University Press, pp. 873–912.

Udell, G.F., 1989. Loan Quality, Commercial Loan Review and Loan Officer Contracting. *Journal of Banking & Finance*, 13(3), pp.367-382.

Valverde, S. and Fernandez, F., 2007. The Determinants of Bank Margins in European Banking. *Journal of Banking & Finance*, 31(7), pp.2043–2063.

Tables

Table 1 Timeline of Events

Fiscal year	Date	Event
1999	February 7, 2000	Ishihara announces plan to levy a special bank tax, selects banks for tax treatment
	March 23, 2000	Tokyo Assembly of Public Finance approves bank tax
2000	April 1, 2000	Tokyo bank tax adopted
	October 18, 2000	Lawsuit filed against Tokyo Government
2001	July 7, 2001	Tokyo Government collects tax revenue*
	March 26, 2002	District Court declares bank tax to be void

Source: Meji-Gakuin (2008), The Japan Times, Ministry of Finance (Japan)

In common with the US, the Japanese taxation system generally delays the recognition of income for tax purposes until the income has been realised. Banks affected by the Tokyo bank tax filed tax returns at the end of fiscal year 2000 (fiscal year 2000 = 1st April 2000 - 30th March 2001). Tax payments were due by the end of the third month after filing.

Table 2 Variable definitions and Sources

Variable name	Definition	Data Source
Panel A: Dependent variables		
Net Interest Margin *nim*	$\frac{(Interest\ Income - Interest\ Expenses)}{Total\ Assets}$	Japan Bankers Association
Net Interest and Fee Margin *nifm*	$nim + \frac{Fee\ Income - Fee\ Expense}{Total\ Assets}$	Japan Bankers Association
Mark-up *mark-up*	$\frac{Loan\ Interest\ Income}{Total\ Loans} - Money\ Market\ Rate$	Japan Bankers Association and Bank of Japan
Markdown *markdown*	$\frac{Deposit\ Interest\ Expenses}{Total\ Deposits} - Money\ Market\ Rate$	Japan Bankers Association and Bank of Japan
Loan Volume *loanvol*	$log(Loans)$	Japan Bankers Association
Core Deposit Volume *coredepovol*	$log(Core\ Deposits)$ Core Deposits include: current deposits, ordinary deposits, savings deposits and deposits at notice	Japan Bankers Association and (Aonokazu 2006, p.3)
Non-Core Deposit Volume *noncoredepovol*	log($Noncore\ Deposits$) Non-core deposits include: time deposits, instalment deposits and negotiable certificates of deposits	Japan Bankers Association and (Aonokazu 2006, p.3)
Panel B: Control variables		
Capital Adequacy	$\frac{(Tier\ I\ Capital)}{Total\ Assets}$	Japan Bankers Association
Asset Quality	$\frac{Nonperforming\ Loans}{Total\ Assets}$	Japan Bankers Association
Management Efficiency	$\frac{Operating\ Expense}{Operating\ Income}$	Japan Bankers Association
Earnings	$\frac{Net\ Income}{Total\ Assets}$	Japan Bankers Association and Bank of Japan
Liquidity	$\frac{Cash}{Total\ Assets}$	Japan Bankers Association
Diversification	$\frac{Operating\ Income - Interest\ Income}{Operating\ Income}$	Japan Bankers Association
Size	$log(Total\ Assets)$	Japan Bankers Association
Market Share	$\frac{Total\ Assets_i}{\sum_i^N Total\ Assets}$	Japan Bankers Association

Table 3 Summary Statistics

Variables	Taxed banks		Non-taxed banks	
	Before	*After*	*Before*	*After*
Panel A: Dependent Variables				
Net Interest Margin (%)	1.33	1.31	1.99	1.89
	(0.28)	(0.26)	(0.23)	(0.24)
Net Interest and Fee Margin (%)	1.48	1.48	2.09	1.99
	(0.29)	(0.28)	(0.21)	(0.20)
Mark-up (%)	2.27	2.15	2.54	2.49
	(0.23)	(0.15)	(0.32)	(0.33)
Mark-down (%)	0.67	0.46	0.27	0.17
	(0.43)	(0.33)	(0.14)	(0.10)
Total Loans (¥ Trillion)	11.81	11.46	0.97	0.97
	(0.92)	(0.89)	(0.76)	(0.77)
Core Deposits (¥ Trillion)	4.22	5.15	0.31	0.36
	(0.90)	(0.88)	(0.92)	(0.95)
Non-core Deposits (¥ Trillion)	8.32	8.16	0.87	0.88
	(0.84)	(0.83)	(0.74)	(0.75)
Panel B: Control Variables				
Capital Adequacy (%)	2.88	3.49	1.88	2.19
	(1.03)	(1.04)	(0.82)	(1.03)
Asset Quality (%)	2.93	4.08	2.71	4.86
	(2.93)	(1.64)	(2.14)	(2.18)
Management Efficiency (%)	0.97	1.09	1.03	1.05
	(0.16)	(0.10)	(0.15)	(0.33)
Earnings (%)	-0.23	0.10	-0.09	-0.03
	(0.64)	(0.22)	(0.62)	(0.43)
Liquidity (%)	4.93	4.85	3.44	3.28
	(2.69)	(2.06)	(2.08)	(1.78)
Diversification (%)	27.12	31.23	17.12	17.05
	(12.07)	(9.93)	(6.66)	(6.17)
Size (¥ Trillion)	27.3	26.4	1.81	1.85
	(22.8)	(22.2)	(1.28)	(1.32)
Market Share (%)	3.38	3.52	0.23	0.24
	(2.79)	(3.13)	(0.16)	(0.17)
Number of Observations	85	50	542	321
Number of Banks	17	17	109	109

The table presents means and standard deviations (in parenthesis) of both dependent and control variables used in our analysis before and after the introduction of the Tokyo bank tax and by treatment status.

Table 4 Difference-in-Differences: Main Findings

	nim	nifm	mark-up	markdown	loanvol	coredepovol	noncoredepo
TAX	0.062***	0.082***	-0.083***	-0.103***	-0.028**	0.008	-0.057***
	(0.021)	(0.023)	(0.027)	(0.025)	(0.011)	(0.019)	(0.014)
Capital Adequacy	0.044***	0.045***	-0.019	-0.046***	0.010***	0.025**	-0.00001
	(0.008)	(0.010)	(0.012)	(0.012)	(0.003)	(0.010)	(0.004)
Asset Quality	0.0001	-0.003	0.007	0.005	0.0004	-0.001	0.006***
	(0.005)	(0.005)	(0.004)	(0.004)	(0.002)	(0.003)	(0.002)
Management Efficiency	-0.068	-0.104	-0.035	0.067	0.009	-0.016	0.002
	(0.054)	(0.063)	(0.045)	(0.042)	(0.017)	(0.050)	(0.024)
Earnings	0.035***	0.036***	0.017*	-0.026*	-0.001	0.012	0.003
	(0.010)	(0.011)	(0.010)	(0.013)	(0.003)	(0.010)	(0.005)
Liquidity	-0.006**	-0.008**	0.001	0.010**	-0.002*	-0.002	0.001
	(0.003)	(0.003)	(0.004)	(0.005)	(0.001)	(0.002)	(0.001)
Market Share	0.287***	0.293***	0.314***	0.267	0.039	-0.164*	0.120***
	(0.085)	(0.089)	(0.127)	(0.186)	(0.027)	(0.092)	(0.039)
Diversification	-0.001	-0.001	-0.0005	0.0006	-0.0002	0.0002	-0.0004*
	(0.001)	(0.001)	(0.0007)	(0.0006)	(0.0002)	(0.0002)	(0.0002)
Size	-0.435**	-0.424**	-0.254**	-0.030	0.863***	1.116***	0.903***
	(0.183)	(0.172)	(0.122)	(0.060)	(0.042)	(0.136)	(0.058)
Constant	14.079***	13.914***	9.429***	0.941	3.504***	-4.745	2.180
	(5.138)	(4.828)	(3.415)	(1.700)	(1.186)	(3.848)	(1.636)
N	998	998	998	998	998	500	500
R^2	0.41	0.37	0.63	0.59	0.85	0.85	0.88

This table reports the results of ordinary least square regressions using a sample of 126 Japanese banks spanning the period from March 1998 to September 2001. The dependent variables are defined in Table 2. 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. To control for potential heterogeneity between treated and control banks the lagged values of capital adequacy, asset quality, management efficiency, earnings, liquidity, market share, diversification and size (please see Table 2 for definitions of these variables) are included in all regressions as further control variables. 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 5 Testing the Bank Monitoring Channel – Bank based analysis

Panel A: Distance based portfolios		
	Local Portfolio	Distant Portfolio
TAX	-0.002**	-0.004*
	(0.001)	(0.002)
Control variables	YES	YES
N	457	457
R^2	0.15	0.46
Panel B: Rated based portfolios		
	Transparent Portfolio	Opaque Portfolio
TAX	-0.003***	-0.004***
	(0.001)	(0.001)
Control variables	YES	YES
N	379	379
R^2	0.39	0.47

Panel A reports the results of ordinary least square (OLS) regressions using a sample of 126 Japanese banks spanning the period from 1998 to 2001. The dependent variables are the shares of the local portfolio, LP (loans granted to firms located in the same area code as the bank is located) and distant portfolio, DLP (loans granted to firms outside the area code where the bank is located) to the banks total loan portfolio. 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. Panel B reports the results of OLS regressions using a sample of 126 Japanese banks spanning the period from 1999 to 2001, due to data limitations on borrowing firms' ratings. The dependent variables are the shares of the transparent portfolio, TP (loans granted to firms rated by a third party) and opaque portfolio, OP (loans granted to unrated firms) to the banks total loan portfolio. 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. To control for potential heterogeneity between treated and control banks the lagged values of capital adequacy, asset quality, management efficiency, earnings, liquidity, market share, diversification and size (please see Table 2 for definitions of these variables) are included in all regressions as further control variables. 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 6 Testing the Bank Monitoring Channel – Borrower based analysis

Panel A: Borrowers' cost of public debt			
	BPS		
TAX^{Bond}	22.57**		
	(9.41)		
Maturity	-0.001		
	(0.002)		
Amount	-2.182		
	(5.71)		
Size	-67.42**		
	(25.35)		
Leverage	151.43**		
	(70.82)		
Other control variables	YES		
N	660		
R^2	0.734		
Panel B: Borrowers' market value			
	CAR[0,0]	CAR[0,3]	CAR[0,5]
TAX^{Stock}	-0.203***	-0.286**	-0.295**
	(0.062)	(0.111)	(0.111)
Size	-0.001	0.032	0.025
	(0.016)	(0.020)	(0.020)
Risk	-0.126	-0.065	-0.107
	(0.205)	(0.185)	(0.185)
Access to finance	0.022	-0.089	-0.078
	(0.049)	(0.136)	(0.135)
Other control variables	YES	YES	YES
N	928	928	928
R^2	0.101	0.181	0.176

Panel A reports results on the effect of the Tokyo bank tax on the borrowers' cost of public debt using bonds issued during the period spanning fiscal year 1997 to fiscal year 2001. The dependent variable, BPS, is the at-issue yield spread in basis points of the debt security over that of a corresponding Japanese government security of comparable maturity. TAX^{Bond} is an indicator variable equal to one if the two largest banks the firm is banking with (in terms of loans granted to the firm) are affected by the Tokyo bank tax when it comes into effect and zero otherwise. *Maturity* is the number of years of the security until maturity. *Amount* is the natural logarithm of the size of bond issue. *Size* is the natural logarithm of issuing firm's total assets. *Leverage* is the ratio of total debt to total assets of the issuing firm. Panel B reports coefficient estimates of OLS regressions of cumulative abnormal returns (CAR) for all listed Japanese firms included in the Japan Company Handbook (excluding banks) surrounding the announcement of the Tokyo bank tax. The event day 0 is February 7, 2000, when the Tokyo governor announced the plan to levy the Tokyo bank tax. The CAR is measured on the day of the announcement only, from day 0 to day 3, and from day 0 to day 5, as indicated. TAX^{Stock} denotes the treatment group dummy which takes

the value of one if the two largest banks the firm is banking with (in terms of loans granted to the firm) are taxed and zero otherwise. *Market cap* is the natural logarithm of the firm's total market capitalization a month before the Tokyo bank tax announcement. *Risk* is the standard deviation of the firm's stock returns during the estimation period [-260,-20]. *Access to finance* is a dummy variable that equals one if the firm has issued at least one bond in the 3 years prior to the Tokyo tax bank announcement. Other control variables include industry, prefecture, bank-type and Keiretsu affiliation dummies. Robust standard errors clustered at the firm level are reported in parentheses.***, **, *, indicate significance at the 1%, 5%, and 10% level respectively.

Online Appendix to Taxation and Financial Intermediation: Evidence from a Quasi-Natural Experiment

This appendix provides the proofs of our theoretical model (Section A), and a detailed discussion of potentially confounding effects as well as results from a number of robustness tests that support a causal interpretation of the findings obtained from our baseline model discussed in the paper (Section B).

Appendix A: Model Proofs

Hypothesis 1:

To derive hypotheses (1) and (2), we rely on the following two equations:

$$\left[\frac{(1-\alpha)f(L^*)+p^*c}{(1-p^*)} - \{r_d - r_f(1-\beta)\}\frac{1}{1+\theta}\left(w_0 - \frac{w_1}{r_d}\right) - r_f L^*\right](1-\tau) - h(p^*) = 0,$$

and $D^* = \frac{1}{1+\theta}\left(w_0 - \frac{w_1}{r_d}\right)$.

The first equation is the competitive bank's break-even condition reported in Equation (9) in the main text, while the second is the depositor's optimal level of deposits. The first equation implicitly defines the deposit rate as a function of taxes and can be rewritten as:

$$\left[\frac{(1-\alpha)f(L^*)+p^*c}{(1-p^*)} - r_f L^*\right] - \frac{h(p^*)}{(1-\tau)} = \{r_d - r_f(1-\beta)\}\frac{1}{1+\theta}\left(w_0 - \frac{w_1}{r_d}\right).$$

By using the envelope theorem and implicitly differentiating the zero profit condition with respect to τ, we get $\frac{dr_d}{d\tau} = -\frac{\frac{h(p)}{(1-\tau)^2}}{\frac{1}{1+\theta}\left[\left(w_0 - \frac{w_1}{r_d}\right) + \{r_d - r_f(1-\beta)\}\frac{w_1}{(r_d)^2}\right]} < 0.$

Hypothesis 2:

The proof follows by implicitly differentiating $D^* = \frac{1}{1+\theta}\left(w_0 - \frac{w_1}{r_d}\right)$, which gives rise to the following expression:

$\frac{dD^*}{d\tau} = \left(\frac{1}{(1+\theta)r_d}\right)^2 w_1 \frac{dr_d}{d\tau} < 0$, with $\frac{dr_d}{d\tau} < 0$ as shown in hypothesis 1.

Hypothesis 3 and 6:

In order to derive the hypotheses 3 and 6, we use the first-order conditions given by (5) and (6)

$$r_f = \frac{p(1-\alpha)f'(L)}{(1-p)} \quad (5)$$

$$h'(p) = \frac{[(1-\alpha)f(L)+c](1-\tau)}{(1-p)^2} \quad (6)$$

Differentiating these two equations with respect to the tax, we get a system of simultaneous non-linear equations:

$$\frac{p}{1-p}(1-\alpha)f''(L)\frac{dL}{d\tau} + \frac{(1-\alpha)f'(L)}{(1-p)^2}\frac{dp}{d\tau} = 0$$

$$\frac{(1-\alpha)f'(L)}{(1-p)^2}\frac{dL}{d\tau} + \left[\frac{[(1-\alpha)f(L)+c]2}{(1-p)^3} - \frac{h''(p)}{1-\tau}\right]\frac{dp}{d\tau} = \frac{[(1-\alpha)f(L)+c]}{(1-p)^2(1-\tau)}$$

We simplify both equations by using the first order condition, $p(1-\alpha)f'(L) = r_f(1-p)$ and the incentive constraint $L = p\,\frac{(1-\alpha)f(L)+c}{(1-p)}$:

$$(1-p)r_f a\frac{dL}{d\tau} + \frac{r_f}{p}\frac{dp}{d\tau} = 0 \quad \text{(A-1)}$$

$$\frac{r_f}{p}\frac{dL}{d\tau} + \left[\frac{[(1-\alpha)f(L)+c]2}{(1-p)^2} - \frac{h''(p)(1-p)}{1-\tau}\right]\frac{dp}{d\tau} = \frac{RL}{p(1-p)(1-\tau)}, \quad \text{(A-2)}$$

where $a = \frac{f''(L)}{f'(L)} < 0$

By using Cramer's rule and the implicit function theorem, we get:

$$\frac{dL}{d\tau} = -\frac{RL}{p^2(1-p)(1-\tau)\Delta}r_f < 0 \qquad \text{(Hypothesis 3)}$$

$$\frac{dp}{d\tau} = -\frac{RL}{p(1-\tau)\Delta}ar_f < 0 \qquad \text{(Hypothesis 6).}$$

It must be noted that $\Delta \equiv \pi^b_{pp}(p,L) - \pi^b_{pL}\pi^b_{Lp} > 0$ due to concavity of the objective function implied by the second order condition of the optimization.

A sufficient condition for concavity of the objective condition is as follows:

$\pi^b_{LL}(p,L) < 0, \pi^b_{pp}(p,L) < 0$ and $\pi^b_{LL}(p,L)\,\pi^b_{pp}(p,L) - \pi^b_{pL}\pi^b_{Lp} > 0$,

where subscripts refer to the partial derivatives with respect to the relevant variables.[16] In our model, these conditions are:

$\pi^b_{LL}(p,L) = p\frac{(1-\alpha)f''(L)}{1-p} = r_f a < 0$ where $a = -\frac{f''(L)}{f'(L)}$

[16] For example: $\pi^b_{LL}(p,L) = \frac{\partial \pi^b_L(p,L)}{\partial L}$.

$\pi_{pp}^{b}(p,L) = \frac{[(1-\alpha)f(L)+c]2}{(1-p)^3} - \frac{h^{//}(p)(1-p)}{(1-\tau)} \equiv G(p) < 0$

$\pi_{Lp}^{b} = \frac{r_f}{p(1-p)} = -\pi_{pL}^{b} = \frac{r_f}{p(1-p)}$ and

$\Delta \equiv \pi_{pp}^{b}(p,L) - \pi_{pL}^{b}\pi_{Lp}^{b} = (1-p)r_f aG(p) - (\frac{r_f}{p(1-p)})^2 > 0.$

Appendix B: Robustness Checks

B.1 Falsification tests and sensitivity checks

A key identifying assumption behind the difference-in-differences approach is that outcome variables of treated and non-treated banks demonstrate similar trends in the absence of treatment (Abadie 2005). Although this assumption cannot be tested directly, placebo tests can to some extent mitigate concerns that the parallel trend assumption is violated. We conduct a placebo test by assuming falsely that the Tokyo bank tax was introduced one year prior to actual adoption. By introducing a placebo tax before the actual bank tax was adopted, we also test for potential anticipation effects. Panel A of Table B1 presents results of this test. None of the coefficients on Placebo-Tax are significant. This suggests that: the parallel trend assumption for the pre-period is not violated; anticipation effects are not present; and the effects on the outcome variables reported in Table 4 are associated with the introduction of the Tokyo bank tax.

[Insert Table B1 around here]

To provide additional insights, we also examine whether certain groups of banks in our sample are driving our results. First, we consider the possibility that banks included in our control group and located further away from Tokyo may be exposed to different economic conditions than counterparts operating closer to Tokyo. In order to alleviate such concerns, we restrict our sample to banks which operate predominantly in the three major regions (Kanto, Chubu and Tohoku) that surround the Tokyo prefecture.[17] This restriction excludes banks located in Japan's other major industrial centres (such as the Kansai and Kyushu region), and reduces our sample

[17] Even after dropping the Tohoku region (which is more rural than either Kanto or Chubu), the results remain consistent.

size from 126 banks to 64 banks (comprising 17 treated and 47 non-treated). The results presented in Panel B of Table B1 are consistent with our main findings.

Second, in Panel C of Table B1 we also consider the possibility that banks included in our control group and without any physical presence in Tokyo may behave differently than untaxed banks present in Tokyo. We exclude banks without presence in Tokyo from our sample and re-estimate Equation (10). In all cases, the signs and the coefficients on the TAX variable are similar to those reported in Table 4.

Third, in Panel D of Table B1, we address the possibility that our results are driven by banks included in our control group that are relatively smaller in size compared to the treated banks. To this end we restrict our sample to banks with total assets greater than the median bank in the sample. The results of this analysis are also consistent with our main findings.

Next, we deal with a common issue which often arises in empirical research using panel data in combination with difference-in-differences estimation. The problem arises due to serially correlated dependent variables, long time series, and little variation in the treatment variable (Bertrand et al., 2004). As a result, conventional OLS standard errors of difference-in-differences estimates could be biased downward. To alleviate concerns regarding serial correlation, we cluster the standard errors at the bank level throughout our analysis. To further check the robustness of our results, we collapse our sample period in two (Bertrand et al., 2004). We average the observations in dates prior to the Tokyo bank tax into a single pre-intervention period, and the observations in dates after the introduction of the tax into a single post-intervention period. The results are reported in Panel E of Table B1, and are consistent with the estimated tax effects reported in Table 4.

B.2 Confounding Events

The validity of our approach would be threatened if factors other than the Tokyo bank tax were driving our results. We isolate activities that could have the potential to confound our analysis.

B.2.1 Mergers and Acquisitions

Our difference-in-differences approach in Section 5 identifies the effect of the Tokyo bank tax on the financial intermediation activities of banks. One potential confounder of this identification is the merger and acquisition (M&A) activity involving existing banks in our sample. Bank mergers may have similar effects on our outcome variables of interest as those attributed to the introduction of the Tokyo bank tax. However, such M&A activities are unlikely to affect all our outcome variables simultaneously in the same way as the Tokyo bank tax. For instance, in a perfectly competitive market a bank M&A is likely to result in a reduction in the loan supply, but at the same time push the loan rate upwards (Van Hoose 2010, p.88). In the deposits market, an M&A would bring about a reduction in deposits and a decrease in deposit rates. As a consequence, an M&A would result in a widening of the profit margin for the merging banks, much like the Tokyo bank tax. However, in contrast to the Tokyo bank tax, this would happen via a simultaneous increase in the loan rate and a decrease in the deposit rate. In order to check the robustness of our findings to bank M&A activity we include *Merger*, 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 Panel A of Table B2 indicate that the tax effects on the different aspects of bank behaviour are similar to the estimates from our main difference-in-differences analysis.

In a second step, we attempt to account for the degree of difficulty and challenges bank management faces in consummating a merger. In line with the M&A literature we use the relative size, measured as the ratio of the target to acquirer assets, as a proxy for the complexity of an M&A deal (e.g. Healey and Palepu 1992; Brewer and Jagtiani 2013). We introduce an interaction term between the dummy for treated banks and the relative size of banks involved in an M&A activity, and a triple interaction term between the dummy for the treated banks, the dummy for the enactment of the Tokyo bank tax and the relative size variable. The results, shown in Panel B of Table B2, confirm our expectations that (complex or less so) mergers do not drive our main findings.

[Insert Table B2 about here]

B.2.2 Capital Injections

An alternative source of shock which could act as a confounder to the results of our analysis is the Prompt Recapitalisation Act (PRA) that was enacted by the Japanese government in March 1999. Under this act, some banks in our sample received public capital injections. Recent empirical findings suggest that capital injections result in boosting the credit supply of banks while at the same time increasing the loan rate since banks assume riskier projects (Allen et al. 2011; Black and Hazelwood 2013; Li 2013). Clearly, the effects of public capital injection on credit supply and lending rates are the opposite of what our model predicts for the Tokyo bank tax. Nevertheless, we re-run our difference-in-differences regressions including *PRA*, a dummy variable which takes the value of one if a bank received capital injection under the Prompt Recapitalisation Act in March 1999, and zero otherwise. Results are reported in Panel C of Table B2. In Panel D of Table B2 we re-estimate Equation (10) including additional interaction terms between the treated banks and a proxy for the intensity of bank recapitalization, measured by the ratio of capital injection received by a bank to its total assets, and a triple interaction term between the dummy for the treated banks, the dummy for the enactment of the Tokyo bank tax and the proxy for the intensity of the Prompt Recapitalisation Act. Our main findings remain robust to these tests.

B.3 Alternative Identification Strategy

B.3.1 Regression Discontinuity Design

We take advantage of the transparent assignment mechanism of the Tokyo bank tax and apply a sharp regression discontinuity design. Banks were assigned to the Tokyo bank tax based on a simple and transparent rule. Banks which operated in Tokyo and held funds in excess of ¥5 trillion were assigned to pay the tax, while all other banks were excluded from it. This approach serves as an additional robustness check. In particular, we address concerns of a violation of only-through conditions by using a regression discontinuity design. Because the assignment variable (funds) is unique to the Tokyo bank tax (no other contemporaneous policy assigns treatment

based on the ¥5 trillion funds threshold), a design that takes into account this discontinuity will enable us to retrieve the pure effects of the Tokyo bank tax.

To uncover the average treatment effect, we look at the discontinuity in the conditional expectation of the net interest margin (and other outcome variables) given the amount of funds of bank *i*. Ideally, we would like to compare the outcomes only for those banks whose values are just below and just above the threshold of ¥5 trillion funds because these banks will have on average similar characteristics. However, such an approach will severely limit our sample size and reduce the efficiency of our estimation method. We therefore follow Pettersson-Lidbom (2012) and estimate regressions of the form:

$$Y_{it} = \alpha_i + \beta_t + \gamma TAX_{it} + \theta f(x_{it}) + \sum_k \delta_k COV_{k,i,t-1} + \epsilon_{it}, \quad \text{(B1)}$$

where $f(X)$ is a smooth function of the forcing variable, x_{it} (funds). To improve efficiency, we constrain the regression function to be of the same functional form on both sides of the cut-off. We restrict higher order polynomial to the order of two (Pettersson-Lidbom 2008) .

The results from estimating Equation (B1) are presented in Panel A of Table B3. The striking similarity of estimates lends strong support to the robustness of our original findings. For instance, using the net interest margin as our main outcome variable of interest reveals that the introduction of the Tokyo bank tax results in net interest margins widening by 4.8 basis points. This compares to the original estimate of 6.2 basis points for the difference-in-differences approach.

[Insert Table B3 about here]

B.3.2 Event Study

The results of our theoretical model, backed up by our empirical findings, indicate that the introduction of the Tokyo tax influences interest rates on loans and deposits, and the credit supply of affected banks. Such effects may in turn influence investors' expectations of the likely future profitability of the treated banks in our sample. To assess this proposition, we conduct an event study to evaluate whether the introduction of the Tokyo bank tax led to a reduction in the market value of treated banks. We obtain stock market data for 100 listed Japanese banks (16

treated, 84 non-treated) from Datastream. To this end, we estimate deviations in actual bank stock returns, as a result of the Tokyo bank tax announcement, from expected stock returns. Following Brown and Warner (1985) among others, for each bank we estimate daily abnormal stock returns using the risk-adjusted market model $R_{i,t} = \alpha_i + \beta_i R_{M,t} + \varepsilon_{i,t}$, where $R_{i,t}$ is the daily return of bank i and $R_{M,t}$ is the daily return of the market portfolio approximated by the Tokyo Stock Price Index (Topix). The risk-adjusted market model is estimated over the interval from 260 to 20 trading days before the event date. We use the estimates $\hat{\alpha}_i, \hat{\beta}_i$ to construct abnormal returns in the event window as $AR_{i,t} = R_{i,t} - \left(\hat{\alpha}_i + \hat{\beta}_i R_{M,t}\right)$. We then aggregate daily abnormal returns by averaging them over all banks summing them over the trading days of different event windows to obtain cumulative average abnormal returns (CAAR). Formally, $CAAR = \sum_{t=t_0}^{T} \left(\frac{1}{N}\sum_{i=1}^{N} AR_{i,t}\right)$. Since the Tokyo bank tax applied to a considerable number of banks operating in Tokyo at the same time, this is likely to generate cross-sectional correlation in abnormal returns across treated banks. In order to address this issue, we test for statistical significance in the CAAR using both the adj-Patell and the adj-BMP test statistics proposed by Kolari and Pynnonen (2010), which are modified versions of the standardised tests developed, respectively, by Patell (1976) and (Boehmer et al. 1991).[18]

Panel B of Table B3 reports CAAR over different event windows, Along with adj-Patell and adj-BMP statistics, separately for treated and control banks. CAAR for treated banks on the event window [-5, 5] are negative and statistically significant, according to both statistics, indicating a drop of around 11% in the banks' stock price due to the Tokyo bank tax. There is mixed evidence of a decline in the treated banks' market valuation in the window prior to the introduction of the Tokyo bank tax. This indicates that the tax was largely unanticipated by the investors. On the other hand, the impact of the tax before, after and around its announcement on the non-treated

[18] Kolari and Pynnonen (2010) show that both the adj-Patell and the adj-BMP statistics account for cross-sectional correlation in abnormal returns.

banks is indistinguishable from zero in a statistical sense. Overall, these findings indicate that market participants view the Tokyo bank tax as detrimental to the performance of the affected banks.

References

Abadie, A., 2005. Semiparametric Estimators. *Review of Economic Studies*, 72(1), pp.1–19.

Allen, L., Chakraborty, S. and Watanabe, W., 2011. Regulatory Remedies for Banking Crises: Lessons from Japan. *Journal of International Business Studies*, 42(7), pp.875–893.

Bertrand, M., Duflo, E. and Mullainathan, S., 2004. How Much Should We Trust Differences-in-Differences Estimates? *Quarterly Journal of Economics*, 119(1), pp.249–275.

Black, L. and Hazelwood, L., 2013. The Effect of TARP on Bank Risk-Taking. *Journal of Financial Stability*, 9(4), pp.790–803.

Boehmer, E., Masumeci, J. and Poulsen, A.B., 1991. Event-Study Methodology under Conditions of Event-Induced Variance. *Journal of Financial Economics*, 30(2), pp.253–272.

Brewer, E. and Jagtiani, J., 2013. How Much Did Banks Pay to Become Too-Big-To-Fail and to Become Systemically Important. *Journal of Financial Services Research,* 43(1), pp.1-35.

Brown, S.J. and Warner, J.B., 1985. Using Daily Stock Returns. *Journal of Financial Economics*, 14(1), pp.3–31.

Healey, P.M., Palepu, KG. and Ruback, R.S. (1992. Does corporate performance improve after Mergers? *Journal of Financial Economics*, 31(2), pp.135-175.

van Hoose, D.D., 2010. *The Industrial Organisation of Banking*, Heidelberg: Springer.

Kolari, J.W. and Pynnonen, S., 2010. Event Study Testing with Cross-Sectional Correlation of Abnormal Returns. *Review of Financial Studies*, 23(11), pp.3996–4025.

Li, L., 2013. TARP Funds Distribution and Bank Loan Supply. *Journal of Banking & Finance*, 37(12), pp.4777–4792.

Patell, J.M., 1976. Corporate Forecasts of Earnings per Share and Stock Price Behaviour: Empirical Tests. *Journal of Accounting Research*, 14(2), pp.246–276.

Pettersson-Lidbom, P., 2008. Do Parties Matter for Economic Outcomes? A Regression-Discontinuity Approach. *Journal of the European Economic Associations*, 6(5), pp.1037–1056.

Pettersson-Lidbom, P., 2012. Does the Size of the Legislature affect the Size of Government? *Journal of Public Economics*, 96(3-4), pp.269–278.

Table B1 Robustness Checks

Panel A: Fiscal Year 1999							
	nim	nifm	mark-up	markdown	loanvol	coredepovol	noncoredepovol
Placebo-TAX	0.012	-0.008	0.006	-0.018	-0.013	-0.012	-0.070
	(0.020)	(0.022)	(0.024)	(0.018)	(0.009)	(0.054)	(0.047)
Control	YES	YES	YES	YES	YES	YES	YES
Observations	375	375	375	375	375	250	250
Panel B: Economic Trends							
	nim	nifm	mark-up	markdown	loanvol	coredepovol	noncoredepovol
TAX	0.055**	0.062**	-0.071**	-0.091***	-0.032***	-0.006	-0.043***
	(0.026)	(0.028)	(0.031)	(0.027)	(0.012)	(0.019)	(0.014)
Control	YES	YES	YES	YES	YES	YES	YES
Observations	455	455	455	455	455	228	228
Panel C: Tokyo Presence Sample							
	nim	nifm	mark-up	markdown	loanvol	coredepovol	noncoredepovol
TAX	0.059***	0.077***	-0.079***	-0.097***	-0.027**	0.002	-0.055***
	(0.021)	(0.023)	(0.027)	(0.025)	(0.011)	(0.020)	(0.015)
Control	YES	YES	YES	YES	YES	YES	YES
Observations	894	894	894	894	894	447	447
Panel D: Large Banks Sample							
	nim	nifm	mark-up	markdown	loanvol	coredepovol	noncoredepovol
TAX	0.053**	0.065**	-0.051*	-0.053*	-0.021*	-0.013	-0.030**
	(0.022)	(0.024)	(0.030)	(0.030)	(0.012)	(0.017)	(0.016)
Control	YES	YES	YES	YES	YES	YES	YES
Observations	500	500	500	500	500	251	251
Panel E: Two-Period Sample							
	nim	nifm	mark-up	markdown	loanvol	coredepovol	noncoredepovol
TAX	0.056**	0.078***	-0.065**	-0.085***	-0.017*	0.042**	-0.030**
	(0.025)	(0.028)	(0.033)	(0.030)	(0.010)	(0.020)	(0.012)
Control	YES	YES	YES	YES	YES	YES	YES
Observations	250	250	250	250	250	250	250

This table summarises the results of a number of robustness tests on the effect of the Tokyo bank tax on bank behaviour as well as on the validity of the "parallel trend" assumption. Panel A presents the results of ordinary least squares regressions using a sample spanning the periods before the introduction of the Tokyo bank tax. The main explanatory variable is Placebo-TAX, an indicator variable equal to one for banks affected by the Tokyo bank tax when it comes into effect and zero otherwise, but this time we falsely assume that this happens one year prior to the actual introduction. In Panel B, we restrict our sample to banks with presence in Tokyo, in order to alleviate concerns that some untaxed banks do not compete with taxed banks in Tokyo, and as a consequence may affect our results. In Panel C, we limit our sample to banks which operate predominantly in the three major regions (Kanto, Chubu and Tohoku) that directly surround the Tokyo prefecture, in order to alleviate concerns regarding differential economic climates across Japan driving our main findings. In Panel D, we limit our sample to banks which have total assets greater than that of the median bank, in order to alleviate concerns regarding relatively small sized banks driving our main findings. In Panel E, following Bertrand et al. (2004) we collapse our dataset into a two-period panel, by averaging the observations in dates prior to the Tokyo bank tax into a single pre-intervention period and likewise for the observations in dates after the tax which are averaged into a single post-intervention period, in order to account for problems arising from serially correlated outcomes. The main explanatory variable for Panels B, C, D, and E 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 defined in Table 2. The set of control variables include capital adequacy, asset quality, management efficiency, earnings, liquidity, size, diversification and market share (please see Table 2 for definitions of these variables). 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 B2 Confounding Events

Panel A: Mergers & Acquisitions							
	nim	nifm	mark-up	markdown	loanvol	coredepovol	noncoredepovol
TAX	0.047***	0.068***	-0.074***	-0.080***	-0.029**	0.004	-0.056***
	(0.022)	(0.024)	(0.024)	(0.025)	(0.011)	(0.019)	(0.014)
Control variables	YES	YES	YES	YES	YES	YES	YES
Observations	998	998	998	998	998	500	500
Panel B: Complexity of Mergers & Acquisitions							
	nim	nifm	mark-up	markdown	loanvol	coredepovol	noncoredepovol
TAX	0.072***	0.087***	-0.052*	-0.080***	-0.022*	0.023	-0.040**
	(0.026)	(0.029)	(0.030)	(0.030)	(0.013)	(0.020)	(0.016)
TAX * Relative Size	-0.014	-0.082	-0.142*	-0.054	-0.032	-0.066	-0.075**
	(0.064)	(0.067)	(0.076)	(0.053)	(0.021)	(0.053)	(0.030)
Control variables	YES	YES	YES	YES	YES	YES	YES
Observations	998	998	998	998	998	500	500
Panel C: Prompt Recapitalisation Act							
	nim	nifm	mark-up	markdown	loanvol	coredepovol	noncoredepovol
TAX	0.062**	0.082***	-0.083***	-0.102***	-0.028**	0.007	-0.058***
	(0.021)	(0.023)	(0.027)	(0.024)	(0.011)	(0.020)	(0.014)
Control variables	YES	YES	YES	YES	YES	YES	YES
Observations	998	998	998	998	998	500	500
Panel D: Intensity of Prompt Recapitalisation Act							
	nim	nifm	mark-up	markdown	loanvol	coredepovol	noncoredepovol
TAX	0.053**	0.074***	-0.043	-0.064**	-0.021*	0.027	-0.041***
	(0.022)	(0.025)	(0.028)	(0.026)	(0.012)	(0.020)	(0.014)
TAX * PRA intensity	-1.061	-0.420	-0.637	-0.364	-0.921	-0.562	-0.257
	(1.978)	(2.036)	(2.140)	(1.291)	(0.824)	(2.072)	(0.997)
Control variables	YES	YES	YES	YES	YES	YES	YES
Observations	998	998	998	998	998	500	500

This table reports the results of ordinary least square regressions examining the effect of the Tokyo bank tax on Japanese banks' behaviour using a sample of 126 Japanese banks spanning the period from March 1998 to September 2001. The dependent variables are defined in Table 2. 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 set of control variables include capital adequacy, asset quality, management efficiency, earnings, liquidity, size, diversification and market share (please see Table 2 for definitions of these variables). To rule out the role of mergers and acquisitions (M&A) between banks in our sample the regressions reported in Panel A also include the variable *Merger*, a dummy that equals one when a bank is involved in an M&A and zero otherwise. Panel B regressions include additional interaction terms between the dummy for treated banks and the complexity of M&As, proxied by the relative size of the involved entities, and a triple interaction term between TAX and the proxy for M&A complexity. Panel C regressions include the variable *PRA* to consider the effect of Prompt Recapitalisation Act. *PRA* is a dummy variable which takes the value of one if a bank received capital injection under the Prompt Recapitalisation Act in March 1999, and zero otherwise. Panel D focuses on the intensity of capital injections by including additional interaction terms between the dummy for treated banks and our proxy for the intensity of capital injections, measured by the ratio of a bank's capital injection to its total assets, and a triple interaction term between the dummy for treated banks, the dummy for the introduction of the Tokyo bank tax, and the proxy for the intensity of capital injections. The set of control variables include capital adequacy, asset quality, management efficiency, earnings, liquidity, size, diversification and market share (please see Table 2 for definitions of these variables). In addition, a set of time dummies and bank specific fixed effects are included across all regressions in all panels. Robust standard errors clustered at the bank level are reported in parentheses. ***, **, *, indicate significance at the 1%, 5%, and 10% level respectively.

Table B3 Alternative Identification Strategy

Panel A: Regression Discontinuity							
	nim	nifm	mark-up	markdown	loanvol	coredepovol	noncoredepovol
TAX	0.048**	0.065***	-0.108***	-0.132***	-0.031***	0.009	-0.064***
	(0.020)	(0.022)	(0.027)	(0.023)	(0.011)	(0.021)	(0.014)
Control	YES	YES	YES	YES	YES	YES	YES
Polynomial (2)	YES	YES	YES	YES	YES	YES	YES
Observations	998	998	998	998	998	500	500

Panel B: Event Study						
Event window	Treated banks			Control banks		
	CAAR	adj-Patell	adj-BMP	CAAR	adj-Patell	adj-BMP
[-5, 5]	-11.18	-2.35 **	-3.29 ***	-2.16	-0.021	-0.75
[-5, -1]	-3.52	-1.11	-2.24 **	-1.17	-0.80	-1.07
[0, 5]	-7.66	-2.16 **	-2.58 ***	-0.98	-0.46	-0.33
No of banks	16			84		

Panel A presents results from a sharp regression discontinuity design taking advantage of the sharp cut-off at ¥5 trillion in deposits for banks to be taxed by the Tokyo authorities. TAX is a treatment indicator taking the value one for taxed banks and zero for non-taxed banks. The set of control variables include capital adequacy, asset quality, management efficiency, earnings, liquidity, size, diversification and market share (please see Table 2 for definitions of these variables). Panel B presents event study results. The event date considered in this analysis is February 7th, 2000, the day the Tokyo governor announced the plan to levy the Tokyo bank tax. CAAR denotes cumulative average abnormal returns. Both the adj-Patell statistic (Patell, 1976) and the adj-BMP statistic (Boehmer et al., 1991) are adjusted for cross-sectional correlation as recommended by Kolari and Pynnonen (2010). ***, **, *, indicate significance at the 1%, 5%, and 10% level respectively.

Table B4 The Bank Monitoring Channel – Robustness checks

Panel A: Bank based analysis - Fiscal year 1999		
	Local Portfolio	Distant Portfolio
Placebo-TAX	0.001	0.002
	(0.001)	(0.001)
Control variables	YES	YES
N	235	235
R^2	0.14	0.16
Panel B: Borrowers' cost of public debt – Placebo test		
	BPS	
$PlaceboTAX^{Bond}$	36.72	
	(25.47)	
Maturity	-0.001	
	(0.002)	
Amount	-3.228	
	(8.27)	
Size	275.444**	
	(125.34)	
Leverage	-70.577	
	(52.60)	
Other control variables	YES	
N	566	
R^2	0.739	
Panel C: Borrowers' market value – Placebo test		
	CAR[0,0]	CAR[0,3]	CAR[0,5]
$PlaceboTAX^{Stock}$	0.078	0.069	-0.059
	(0.089)	(0.090)	(0.109)
Size	0.017	0.011	0.074***
	(0.010)	(0.010)	(0.020)
Risk	0.114	0.066	0.206
	(0.206)	(0.213)	(0.281)
Access to finance	0.092	0.104	-0.093
	(0.066)	(0.067)	(0.057)
Other control variables	YES	YES	YES
N	928	928	928
R^2	0.115	0.120	0.091

Panel A reports the results of ordinary least square (OLS) regressions using a sample of 126 Japanese banks spanning the period before the

introduction of the Tokyo bank tax. The dependent variables are the shares of the local portfolio, LP (loans granted to firms located in the same area code as the bank is located) and distant portfolio, DLP (loans granted to firms outside the area code where the bank is located) to the banks total loan portfolio. The main explanatory variable is Placebo-TAX, an indicator variable equal to one for banks affected by the Tokyo bank tax when it comes into effect and zero otherwise, but this time we falsely assume that this happens one year prior to the actual introduction. To control for potential heterogeneity between treated and control banks the lagged values of capital adequacy, asset quality, management efficiency, earnings, liquidity, market share, diversification and size (please see Table 2 for definitions of these variables) are included in the regressions as further control variables. In addition, a set of time dummies and bank specific fixed effects are included across both regressions. Panel B reports results on the effect of the Tokyo bank tax on the borrowers' cost of public debt using bonds issued during the period before the introduction of the Tokyo bank tax. The dependent variable, BPS, is the at-issue yield spread in basis points of the debt security over that of a corresponding Japanese government security of comparable maturity. The main explanatory variable is $PlaceboTAX^{Bond}$, an indicator variable equal to one if the two largest banks the firm is banking with (in terms of loans granted to the firm) are affected by the Tokyo bank tax when it comes into effect and zero otherwise, but this time we falsely assume that this happens one year prior to the actual introduction. *Maturity* is the number of years of the security until maturity. *Amount* is the natural logarithm of the size of bond issue. *Size* is the natural logarithm of issuing firm's total assets. *Leverage* is the ratio of total debt to total assets of the issuing firm. Other control variables include industry, prefecture, bank-type and Keiretsu affiliation dummies. Robust standard errors clustered at the firm level are reported in parentheses. Panel C reports coefficient estimates of OLS regressions of cumulative abnormal returns (CAR) for all listed Japanese firms included in the Japan Company Handbook (excluding banks) surrounding the announcement of the Tokyo bank tax, under the false assumption that the announcement of the tax occurred on January 7, 2000 instead of February 7, 2000. The event day 0 here is therefore January 7, 2000. The CAR is measured on the day of the announcement only, from day 0 to day 3, and from day 0 to day 5, as indicated. $PlaceboTAX^{Stock}$ denotes the treatment group dummy which takes the value of one if the two largest banks the firm is banking with (in terms of loans granted to the firm) are taxed and zero otherwise. *Market cap* is the natural logarithm of the firm's total market capitalization a month before the Tokyo bank tax announcement. *Risk* is the standard deviation of the firm's stock returns during the estimation period [-260,-20]. *Access to finance* is a dummy variable that equals one if the firm has issued at least one bond in the 3 years prior to the Tokyo tax bank announcement. Other control variables include industry, prefecture, bank-type and Keiretsu affiliation dummies. Robust standard errors clustered at the firm level are reported in parentheses. ***, **, *, indicate significance at the 1%, 5%, and 10% level respectively.

The Centre for Responsible Banking and Finance
CRBF Working Paper Series
School of Management, University of St Andrews
The Gateway, North Haugh,
St Andrews, Fife,
KY16 9RJ.
Scotland, United Kingdom
http://www.st-andrews.ac.uk/business/rbf/

Recent CRBF Working papers published in this Series

Fourth Quarter | 2017

17-014 **Arjan Trinks, Gbenga Ibikunle, Machiel Mulder, Bert Scholtens:** Greenhouse Gas Emissions Intensity and the Cost of Capital

17-013 **Yaoyao Fan, Kose John, Frank Hong Liu and Luqyan Tamanni:** The Financial and Social Performance of Islamic Microfinance Institutions: A Cross-Country Study

17-012 **Rónán Gallagher and Barry Quinn:** Regulatory Own Goals: The Unintended Consequences of Financial Regulation in Professional Football.

Third Quarter | 2017

17-011 **Ahmed Marhfor, Kais Bouslah and Bouchra M'Zali:** Corporate Social Responsibility and Stock Price Informativeness: Evidence from the Canadian Market.

17-010 **Ross Brown and Colin Mason:** Looking Inside the Spiky Bits: A Critical Review and Conceptualisation of Entrepreneurial Ecosystems.

17-009 **Pejman Abedifar, Paolo Giudici and Shatha Hashem:** Heterogeneous Market Structure and Systemic Risk: Evidence from Dual Banking Systems.

Second Quarter | 2017

17-008 **Alberto Montagnoli, Mirko Moro, Georgios A. Panos and Robert E. Wright:** Financial Literacy and Attitudes to Redistribution.

17-007 **Dimitris Chronopoulos, Anna Lucia Sobiech and John O. S. Wilson:** Future Issues in Bank Taxation.