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Interactions between bank levies and corporate taxes: How is the bank leverage affected?

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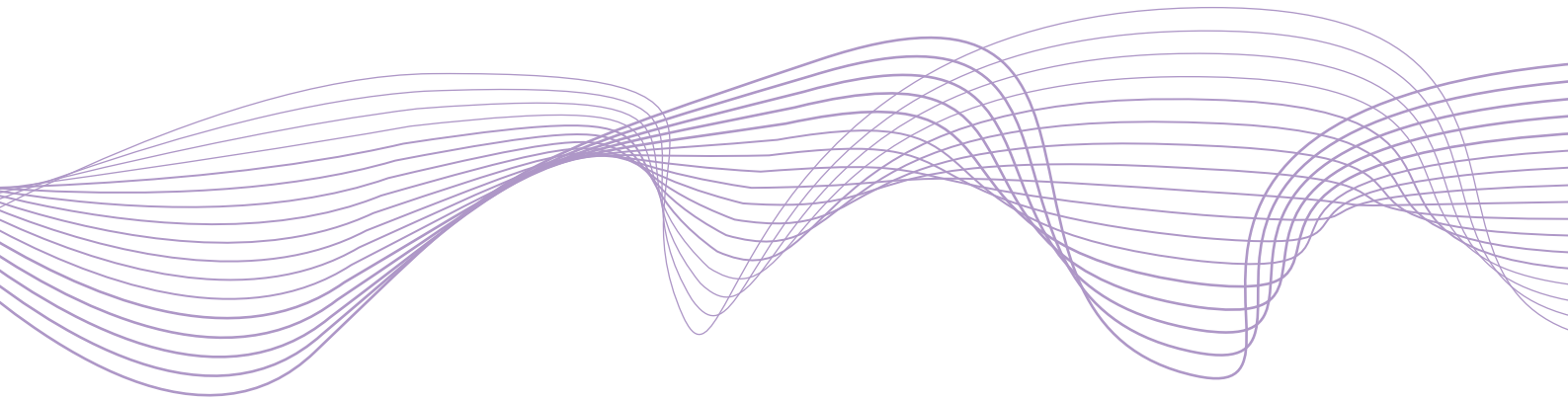

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Abstract

Regulatory bank levies set incentives for banks to reduce leverage. At the same time, corporate income taxation makes funding through debt more attractive. In this paper, we explore how regulatory levies affect bank capital structure, depending on corporate income taxation. Based on bank balance sheet data from 2006 to 2014 for a panel of EU-banks, our analysis yields three main results: The introduction of bank levies leads to lower leverage as liabilities become more expensive. This effect is weaker the more elevated corporate income taxes are. In countries charging very high corporate income taxes, the incentives of bank levies to reduce leverage turn ineffective. Thus, bank levies can counteract the debt bias of taxation only partially.

JEL Classification: G21, G28, L51

Keywords: Bank levies, debt bias of taxation, bank capital structure

1 Motivation

Regulatory bank levies provide incentives for banks to reduce leverage, as they are typically designed as a tax on liabilities. At the same time, corporate income taxation makes funding through debt more attractive, because interest on debt is tax-deductible in most countries while return on equity is not. In this paper, we ask how effective regulatory bank levies are in reducing bank leverage, depending on the corporate income tax (CIT) rate. Moreover, we study how the design of bank levies affects their impact upon leverage. As the European Banking Union also uses bank levies to finance the Single Resolution Fund, evidence regarding the impact of bank levies on bank behavior conditional on the corporate tax environment contributes to the assessment of such regulatory reforms.

The literature shows that corporate income taxes affect bank capital structure (De Mooij and Keen, 2016) and that banks exposed to regulatory levies strengthen capitalization (Célérier et al., 2018; Devereux et al., 2015). However, empirical evidence on the interaction effects between regulatory and corporate taxes is so far missing. Against the background of the evaluation of changes in banking regulations and potential interactions between different policy interventions (FSB, 2017), this paper aims at filling this gap. Our goal is to investigate what role regulatory bank levies play in counteracting the debt bias of taxation. A better understanding of the impact of bank levies on bank capital structure, depending on corporate taxation, is crucial given that the debt bias of taxation is shown to not only increase leverage of both non-financial and financial firms, but also the probability of systemic banking crises (De Mooij et al., 2013).

In the aftermath of the global financial crisis, many European countries introduced regulatory levies, the goal being to internalize banks' contribution to systemic risk. On the one hand, bank levies are aimed at establishing funds to finance the restructuring and resolution of banks in distress. On the other hand, banks' funding composition

should be influenced by taxing non-deposit liabilities of banks, thereby setting an incentive for lower leverage and funding risk. Given the opposite incentives for higher bank leverage that result from corporate taxation, the goal of this paper is to better understand the interaction effects between regulatory and corporate taxes, thus understanding the consequences for the effectiveness of bank levies as a tool to increase financial stability through a less risky bank capital structure.

Using bank-level balance sheet data for EU-countries over the 2006 – 2014 period, we investigate how bank leverage is affected by the introduction of regulatory levies, depending on CIT rates. The regression analysis yields three key insights. First, we confirm findings from previous literature (Célérier et al., 2018; Devereux et al., 2015) that the direct effect of bank levies on leverage is negative and statistically significant. Banks in countries where a levy is introduced, such that debt funding becomes more expensive, show lower leverage than banks that are not subject to a levy. Second, higher CIT rates mitigate the leverage-reducing effect of bank levies. In countries with higher CIT rates, an introduction of a bank levy reduces leverage less than in countries with lower tax rates. Third, and lastly, for the most elevated CIT rates, the positive incentives of bank levies on capitalization are not large enough to counteract the debt bias of taxation. Indeed, the effect of a bank levy turns statistically insignificant in high-corporate income tax countries, such that the goal of fostering financial stability through lower leverage cannot be fulfilled by the regulatory tax.

Our analysis bridges and, thus, contributes to two strands of the literature. A first set of related studies deals with the implications of the introduction of regulatory bank levies since the global financial crisis. Exploiting variation in bank levies in the European Union (EU) across countries, banks and time, Devereux et al. (2015) present empirical evidence that banks exposed to regulatory levies increase their equity ratio, thus reducing funding risk. At the same time, portfolio risk is shown to increase. Concentrating on different bank-level outcome variables, Buch et al. (2016) show that loan supply and deposit rates were, on average, not significantly affected by the in-

troduction of the bank levy in Germany. However, the most affected banks reduced loan supply and deposit rates while raising lending rates. An increase in lending rates is also found after the introduction of the Hungarian levy by Capelle-Blancard and Havrylchyk (2017). For a sample of EU banks, Kogler (2018) finds that banks pass the levies through to customers via higher lending rates while keeping deposit rates constant. This effect is weaker for the well-capitalized banks that are less exposed to the levies.[1] Our analysis differs from these studies as we focus, besides the direct impact of levies on bank leverage, on the interactions between bank levies and the CIT.

A second strand of literature investigates the relationship between corporate income taxation and leverage. As summarized in a meta-study by Feld et al. (2013), the design of the corporate tax system is an important determinant of non-financial firms' capital structure. Typically, tax systems incentivize leveraging since interest paid on debt is tax-deductible whereas the return on equity is not. To lower their tax burden, firms tilt their capital structure more toward debt than they would in the absence of this tax preference for debt. The positive effect of the CIT on leverage is well established in the literature.[2] Findings by Heider and Ljungqvist (2015) suggest asymmetric effects of tax rates on leverage: U.S. firms' leverage responds to tax increases, but not to tax cuts.

As banks face different funding decisions than non-financial firms and are subject to regulatory capital requirements, they were typically excluded from the analysis of capital structures pre-crisis. Yet, Gropp and Heider (2010) show that, as long as banks hold more capital than required by regulation, the drivers of capital structure are similar for financial and non-financial firms. Still, banks tend to be more leveraged than non-financial firms. Berg and Gider (2017) find that this difference is largely

[1] Kogler (2018) discusses theoretically the interaction effects between corporate taxation and levies for the pass-through of bank levies to customers in terms of lending rate increases. If the levy payment is not tax deductible, as in Germany or the UK, the pass-through is expected to be stronger than in countries where the levy payment can be deducted so that double taxation is prevented.

[2] For an overview, see Bremus and Huber (2016). Another but less related strand of literature analyzes whether and how much corporate income taxes are shifted to customers (see e.g. Banerji et al. (2017) or Capelle-Blancard and Havrylchyk (2014)) and how securitization is affected by the CIT (Gong et al., 2015).

explained by lower asset side risk of banks due to diversification.

Regarding the role of CIT for bank capital structure, a small but growing literature concludes that the debt bias of taxation also affects financial firms. Comparing the tax sensitivity of banks' and non-banks' capital structure, Heckemeyer and de Mooij (2013) find similar values for both groups of firms. However, the tax sensitivity differs across firm size and leverage. While larger and capital-tight banks react less to tax changes, the relationship between tax rates and the size of non-banks is found to be U-shaped. De Mooij and Keen (2016) argue that capital buffers that are typically above regulatory capital requirements leave scope for taxes to affect bank leverage. Based on bank balance sheet data for 82 countries, they confirm that banks' reaction to taxation is, on average, similar to that of non-financial firms and that large banks are less tax-sensitive than small ones.[3] Related studies for the United States (Milonas, 2018; Schandlbauer, 2017) confirm a significant impact of tax changes on bank leverage, which differs across bank characteristics like capitalization and size. Using Italian data, Gambacorta et al. (2017) provide evidence that banks reduce leverage following tax reductions and that non-deposit liabilities decline more than deposits. Focusing on the capital structure of multinational banks, Gu et al. (2015) show that the debt bias of taxation also affects bank subsidiaries and that international tax differences lead to debt shifting to countries with high taxes.

Shifting the focus from CIT to the effects of bank levies and of "Allowances for Corporate Equity" (ACE), Célérier et al. (2018) find that tax reforms that make leverage more expensive increase bank capitalization, while simultaneously promoting lending. Regarding tax reforms, they exploit, on the one hand, that several countries have reduced the tax discrimination against equity by allowing for a deduction of a notional interest rate for equity through ACEs, while others have not. On the other hand, they also exploit the introduction of bank levies that increase the total cost of capital, since liabilities are taxed, thus becoming more expensive. In a similar vein, Schepens (2016)

[3]Hemmelgarn and Teichmann (2014) find smaller, but also statistically significant, effects of CIT-changes on bank leverage.

presents evidence that the capitalization of Belgian banks significantly increased after implementation of an ACE in 2006.

While the discussed studies analyze the effects of CIT and of regulatory taxes separately, we contribute to the literature by estimating the effects of introducing bank levies, depending on CIT rates. By examining the interaction effects between regulatory and corporate income taxes, we aim at gauging how far bank levies can counteract the debt bias of taxation. The remainder of the paper is structured as follows. In the following Section 2, we explain the theoretical link between bank leverage and taxes, both corporate income taxes and bank levies. Section 3 describes both the data used and its sources as well as our empirical model specification. We discuss the regression results and several robustness tests in Section 4, while Section 5 concludes and presents potential policy implications.

2 Bank leverage and taxes

Both corporate income taxes and bank levies are related to bank leverage. The expenses of bank levies that are designed as a tax on liabilities typically increase with the amount of wholesale funding and leverage:[4]

$$Bank\ levy\ expenses = Levy\ rate * (Total\ liabilities - Customer\ deposits - Equity) \tag{1}$$

Consequently, the cost of debt (or: leverage) increases, making debt funding less attractive. Bank levies target exclusively the financial sector, especially credit institutions. In the aftermath of the global financial crisis, bank levies were introduced as an instrument to establish resolution funds to finance the resolution and restructuring of banks in distress (e.g. Cyprus, Germany, Latvia, and Sweden). In addition, countries opting for a bank levy that taxes wholesale funding aimed at reducing systemic risk by

[4]See Appendix B for a detailed overview on which countries use wholesale liabilities as a tax base for their bank levy and Section 3.2 for more information on the data.

providing incentives for banks to shift from an over-reliance on short-term interbank financing to more stable funding sources such as customer deposits and equity capital (Kogler, 2018). Along these lines, Devereux et al. (2015) present a theoretical model of bank leverage, a tax on liabilities, and bank capital requirements where banks maximize the expected return to shareholders by choosing, among others, the optimal level of total debt (or leverage, as the amount of total assets is kept fixed for simplicity). In that framework, banks react to an increase in the tax on debt by reducing leverage. Similarly, in the model by Keen (2018), optimal leverage falls the higher the levy is, since the cost of leverage increases. These considerations lead to our first testable hypothesis:

Hypothesis 1: *A bank levy on debt incentivizes banks to reduce leverage.*

In contrast to bank levies, corporate income taxes are a general instrument targeting the non-financial as well as the financial sector. The main objective is to generate revenues for the public sector. Given that interest payments on debt are tax deductible, expenses due to corporate income taxes amount to

$$\begin{aligned} &CIT\ expenses = CIT\ rate * \\ &(Net\ income\ before\ taxes\ \&\ interest - Interest\ payments\ on\ debt). \end{aligned} \tag{2}$$

There is no explicit aim to target the behavior of taxed entities as concerns their capital structure. Nevertheless the empirical and theoretical literature documents that higher CIT rates set incentives for both non-financial firms and banks to increase leverage in order to lower tax expenses (Feld et al., 2013; Gropp and Heider, 2010; De Mooij and Keen, 2016; Langedijk et al., 2015). This debt bias of taxation results from the fact that interest rate costs for external debt are generally tax deductible, and thereby reduce the taxable net income of a company, whereas interest on equity is not.

As shown in the model of corporate income taxes and bank leverage presented by

De Mooij and Keen (2016), if banks optimally choose total debt in a world with capital requirements, they borrow up to the point where the expected costs of violating the capital requirement equals the tax advantage of debt. The model implies that higher tax rates result in banks increasing their optimal amount of debt. The marginal tax benefit of debt increases in the corporate income tax rate, thus increasing the optimal level of debt if tax rates rise. We can thus form the second hypothesis:

Hypothesis 2: *Bank leverage is higher the more elevated corporate income tax rates are.*

Due to opposing effects of corporate income tax rates and bank levies on leverage, the question arises of whether there is an interconnection between corporate income taxes, bank levies and bank leverage. If this is the case, it bears important policy implications. In particular, considering the case that the leverage-reducing effect of a bank levy taxing wholesale funding interacts reversely with the debt bias of taxation of the corporate income tax. In such a context, the effectiveness of the regulatory policy instrument cannot be guaranteed. Due to the hypothesized effects above, we suspect that the negative effect of bank levies on leverage can potentially be lowered conditional on the height of the corporate income tax:

Hypothesis 3: *The leverage-reducing effect of bank levies is counteracted by the size of the corporate income tax rate.*

In what follows, we empirically analyze the nexus between regulatory and corporate taxation and its effect on bank leverage.

3 Data and methodology

In order to shed light on the effect of bank levies on leverage, depending on the prevailing CIT, we construct a linked micro-macro dataset that connects bank balance sheet variables with country-level information on the introduction and design of bank

levies, as well as CIT rates. The baseline sample covers 2,771 banks in 27 EU-countries over the 2006 – 2014 period, which yields 10,774 bank-year observations. The sample period ends in 2014 because, since 2015, banks in EU member states participating in the European Banking Union must make levy contributions to the Single Resolution Fund. We next describe our dataset and some key features of the variables of interest, before discussing our estimation and identification strategy.

3.1 Bank-level data

Annual balance sheet and income statements for banks in 27 EU member states were obtained from Bankscope by Bureau van Dijk for the 2006 – 2014 period.[5] In order to clean the data from misreporting and outliers, we apply several standard screens. We eliminate bank observations if negative values of equity, assets, and loans are reported or when the loans-to-assets or the equity-to-assets ratio exceeds one. Further, only banks with at least three observations across the sample period are kept. Following De Mooij and Keen (2016) and Kogler (2018), we consider unconsolidated accounts that end at national borders and to which national tax rates and in general also regulatory bank levies apply. That is, we include observations with Bankscope consolidation codes U1 (unconsolidated statement with no consolidated companion) and U2 (unconsolidated statement with a consolidated companion). In terms of bank business models, our baseline sample includes bank holdings and holding companies, commercial banks, cooperative banks, and savings banks. In order to prevent outliers from affecting our results, we winsorize all bank-level variables at the top and bottom 1%-percentile.

Following the banking literature, our dependent variable, leverage of bank i in year t, is defined as liabilities divided by total assets (Berg and Gider, 2017; Gropp and Heider, 2010; Gu et al., 2015). Figure 1 illustrates that at the sample median, leverage has followed a slight upward trend between 2007 and 2013, with the highly leveraged banks

[5] We do not cover all 28 EU-countries as Croatian banks do not report all control variables included in the regression equation and, therefore, drop out of the sample.

(75th percentile) showing a rather stable leverage ratio, while leverage trended upwards for lower-leverage banks (25th percentile). The standard bank-level control variables that gauge bank size, profitability, and risk are also sourced from Bankscope. Appendix A provides a detailed data description of all variables used in the regression analysis. Table 1 reports summary statistics for our baseline regression sample. The sample mean of bank leverage, as measured by total liabilities to total assets, is 90%, varying between 8.5 and 98%. Regarding the unconditional correlations between the bank-level variables included in the regression model below, Table 2 reveals that leverage is higher for larger banks and lower for more profitable and more risky banks in our sample.

3.2 Country-level data

Information on bank levies for our sample period, like the year of the introduction and the tax base, is taken from Devereux et al. (2015) and double-checked with the ECB's Macroprudential Policies Evaluation Database by Budnik and Kleibl (2018). We also verify whether countries have implemented a bank levy in those years not covered by Devereux et al. (2015). Detailed information on the data source by country is provided in Appendix B.

In our baseline regressions, we include 27 EU-countries and construct a dichotomous variable that equals one if a bank levy is in place in a given country and year, and zero otherwise. Appendix B contains detailed information on the countries that implemented the levy, the implementation year, and the tax base. The majority of countries implemented a levy in 2011, while others adopted it earlier or later. As shown in Table 3, prior to 2009, no banks included in our sample were subject to a levy, whereas in 2011, about one-third of the banks had to pay levies. The share of affected banks increased to 73% at the end of our sample period. The timing is in line with the start of policy discussion about the implementation of levies to finance restructuring funds and internalize banks' contribution to systemic risk after the financial crisis (IMF, 2010).

Among the 17 countries that have introduced a bank levy within our sample period,

the majority implemented the levy design as suggested by the IMF (2010), namely as a tax on liabilities (i.e. total assets less equity) minus deposits. With this levy design, all non-deposit liabilities are taxed, thus making leverage more expensive. Appendix B reveals that there are, however, seven European countries that chose different levy designs.[6] In Hungary and Slovenia, for example, the levy is paid on total assets, whereas in France the minimum equity requirement is used as the tax base. Given the heterogeneity of the design of levies and the resulting differences in incentives set for capital structure, we restrict the "treatment group" in further regression exercises to the countries that impose the standard "liabilities minus deposits (L – D)" design.[7]

Information on corporate income taxes is obtained from the Oxford Centre of Business Taxation.[8] The corporate income tax rate for country c in year t is computed as the sum of the federal tax rate and the local tax rate taking into account surcharge and deductibility of local taxes. As shown by the summary statistics in Table 1, while the average CIT in our sample is 30%, the range of tax rates varies quite substantially between 10% (Bulgaria, Cyprus) and 40% (Spain). This variation is useful in the following empirical analysis as it helps identify the differential effects of regulatory bank levies depending on the existing CIT. Correlation coefficients (Table 2) show weakly positive relationships between banks' liabilities to assets and both the bank levy dummy variable and the CIT rate.

Further country-level control variables, like GDP growth and inflation or regulatory variables, come from the International Financial Statistics and from Barth et al. (2013).

[6] Poland only implemented a levy in 2016.

[7] See Kogler (2018) for a description of different levy designs in Europe.

[8] `https://www.sbs.ox.ac.uk/faculty-research/tax/publications/data`; missing information for Latvia, Lithuania, Malta and Cyprus is added from Devereux et al. (2015) and KPMG (2014).

3.3 Regression model

In order to analyze how the introduction of bank levies affects bank capital structure, depending on the prevailing CIT, we estimate the following regression equation

$$\begin{aligned} LA_{ict} = \alpha_i + \gamma_t + \beta_1 Levy_{ct} + \beta_2 CIT_{ct} + \beta_3 Levy_{ct} * CIT_{ct} \\ + \beta_4 X_{ict-1} + \beta_5 Y_{ct} + \epsilon_{ict} \end{aligned} \tag{3}$$

using a panel fixed-effects estimator. The dependent variable, bank leverage of bank i in country c at time t, is defined as the ratio of liabilities (total assets minus equity) to total assets (LA_{ict}). The main explanatory variables of interest are $Levy_{ct}$, a dummy variable that equals one if a bank levy is in place in country c at time t, and CIT_{ct}, the corporate income tax rate in country c at time t. Capturing bank levies by a country-specific dummy variable is a very crude proxy and ignores that some countries implement different levy designs and exclude, for example, small banks from the levy. Thus, in Section 4.2, we assess in more detail the role of the levy design and, in further robustness tests, we restrict the sample to include only larger banks.

Based on theoretical considerations and empirical results from previous literature, we expect the direct effect of a bank levy on leverage, β_1, to be negative, whereas the direct effect of CIT, β_2, is supposed to be positive. The total effect of bank levies on leverage, depending on the CIT, is given by $\beta_1 + \beta_3 * CIT$. To investigate how effective bank levies are at counteracting the debt bias of taxation, our coefficient of interest is β_3, i.e. the interaction effect between the bank levy and the corporate income tax rate. Supposed that leverage is lower for banks that are affected by a levy relative to banks that are not ($\beta_1 < 0$), then the larger and positive β_3 is, the more the leverage-reducing effect from the levy is mitigated with higher CIT rates.

The vector X_{ict-1} contains bank characteristics, all lagged by one year to account for potential simultaneity concerns.[9] Following the literature, we include the log of total

[9] Due to the fact that we lag the control variables by one period, our estimation covers the dependent variable for the years 2006-2014 and links it to bank-level control variables based on 2005-2013.

assets (in million USD) and the square of the log of total assets to control for bank size, the return on assets (in %) to measure profitability, and the ratio of non-performing loans to gross loans (in %) as a measure of bank risk. The term Y_{ct} summarizes annual GDP growth, inflation, and regulatory variables, that is, country-level controls. Common time trends in the data are accounted for by including yearly time dummies (γ_t). To control for unobserved time-invariant bank characteristics, all regression models include a set of bank fixed effects (α_i). Thereby, we can test whether banks subject to a levy changed their leverage compared to banks not affected by a levy with similar bank-level and country-level characteristics. Robust standard errors are clustered at the bank level.

For our identification of effects, we exploit variation in the introduction of bank levies across countries and time. Importantly, during our sample period, changes in bank capital regulation, like the stepwise implementation of Basel III that started in 2013, also affected the choice of bank capital structure. As we control for observed and unobserved bank and country characteristics, it is nevertheless reasonable to suppose that two otherwise similar banks – one located in an EU-country that introduced a levy and the other located in an EU country without levies – are affected similarly by regulatory and institutional changes at the EU-level.[10] Furthermore, as we outline below, most changes become only effective after 2014. To control for the fact that existing regulatory standards are enforced differently across EU-countries and that differences in the strength of moral hazards can impact leverage, we add two variables reflecting banking regulation in country c at time t, namely supervisory forbearance discretion and various factors mitigating moral hazard. Potential concerns about endogeneity are discussed in Section 4.3.

[10]In robustness tests, we exclude the years after 2012 that are most likely to be influenced by regulatory changes or the announcement thereof. In addition, we add bank group-and-time fixed effects to control for different exposure of banks to changes in regulation depending on their capital ratio.

4 Regression results

This section discusses estimation results for the baseline sample including bank observations from EU-countries, using banks from those countries that introduced a levy as the treatment group and the remaining banks as the control group. We then limit the sample to countries with a more homogenous levy design, before testing the robustness of our findings with respect to additional changes in the sample composition.

4.1 Determinants of bank leverage

Table 4 reports the regression results from estimating Equation 3. Confirming previous findings from the literature, the results point to a negative effect of levies on bank leverage, while leverage is positively related to CIT rates. On the one hand, banks in countries that have introduced bank levies reduce leverage relative to other banks, given that most countries implement a levy scheme making debt funding more expensive. On the other hand, banks facing higher CIT rates have higher liabilities to assets ratios due to the debt bias of taxation. The estimated interaction effect between regulatory and corporate taxes, β_3, is positive: This finding suggests that if a country introduces a bank levy, higher CIT rates mitigate the leverage-reducing effect of the levy.

The estimated direct effect of the bank levy dummy in column (4) implies that for banks in countries with a bank levy in place, the liabilities to assets ratio is 4.5 percentage points lower than for the other banks, on average, if $CIT = 0$. Given the sample mean of 89.5%, this corresponds to a reduction in leverage of 5% at the sample mean. Regarding the coefficient on CIT, we find that an increase in the CIT rate of one standard deviation (5.1 pp) translates into an increase in leverage of 0.5 percentage points if no levy is in place ($Levy = 0$). When it comes to the total marginal effect of bank levies, depending on the CIT, the estimated coefficients suggest that at the sample mean of the CIT (30.2%), the introduction of a bank levy reduces bank leverage by only 0.4 percentage points. Thus, the introduction of a bank levy only

goes a small way in promoting a more stable bank capital structure in EU-countries with average CIT rates. For the countries with the lowest CIT rates in the sample (10%), the corresponding marginal effect amounts to -3.2 percentage points, whereas it is weakly positive for the maximum observed CIT rate (40.4%).

Figure 2a shows the whole range of marginal effects of bank levies on leverage, depending on CIT rates based on Table 4, column 4. It illustrates that the leverage-reducing effect of bank levies is most pronounced for banks in countries with low CIT rates. The higher the CIT rate, the smaller the favorable effect – from a regulatory perspective – of bank levies becomes. For the highest CIT rates in our sample, the sign of the effect changes. This positive but only weakly statistically significant marginal effect is mainly driven by the comparison of French and Spanish banks (subject to levies) with Italian banks (no levy). All three countries have high CIT rates and the positive effect of the levies is plausible, since the tax base in France and Spain is minimum equity requirements and deposits, respectively, rather than non-deposit liabilities. Thus, the baseline model points into an important direction for further analysis, namely that interaction effects between bank levies and CIT rates vary with the design of the bank levy.

The estimated coefficients on the control variables are in line with the related literature. Bank leverage increases with bank size, but this effect levels off and turns negative for the largest banks. Higher profitability allows banks to accumulate equity, such that leverage declines. Bank risk, as measured by the ratio of non-performing loans to gross loans, inflation, and institutions mitigating moral hazard, do not seem to systematically affect leverage, whereas leverage tends to be higher during booms but lower in countries where supervisors have less discretion if banks violate the laws (higher values of the variable "supervisory forbearance discretion").

4.2 The importance of the levy design

Since the design of bank levies differs across countries, in a next step, we split the regression sample according to the tax base of the levy. For those banks subject to a levy designed as a liabilities tax (L-D), theory predicts a negative link with leverage as a liabilities tax makes debt financing more expensive (Devereux et al., 2015). However, for banks affected by levies with a different tax base, like risk-weighted or total assets (Finland, Hungary, Slovenia), deposits (Cyprus, Ireland, Spain), or minimum capital requirements (France), the impact on leverage is not clear. To account for different levy regimes, we exclude, for example, bank observations of those countries that implemented a levy but did not design it as a liabilities tax over the whole sample period (compare also Appendix B).

The estimation results in Table 5 reveal that our baseline results are driven by banks subject to a levy in the form of a liabilities tax. The leverage-reducing direct effect of the bank levy becomes stronger when excluding countries with different tax bases that provide mixed incentives for bank capital structure (column 2). Further, the positive and significant effects of CIT and of the interaction term between the levy and CIT on leverage remain intact. In contrast, in countries where the levy design differs and is not focused on making debt funding more expensive, levies are ineffective at promoting a more stable bank capital structure, no matter how low or high the corporate tax rates are (columns 3 – 5).

Figure 2b illustrates the marginal effect of a levy on bank liabilities on leverage, depending on the corporate income tax rate. Compared to Figure 2a, the estimations exclude all countries implementing a levy with a tax base other than liabilities minus deposits. It confirms the previous finding that bank levies reduce leverage more, the lower CIT rates are and, hence, the lower the debt bias of taxation is. However, in countries with high CIT rates, bank levies are an ineffective tool for positively influencing capitalization. Their marginal effect is statistically insignificant in these cases. Thus, the leverage-reducing effect of bank levies is more pronounced for the L-D

design, i.e. for pure liabilities taxes.

In terms of economic significance, the estimated effects of the levy for the L-D-sample are – unsurprisingly – a bit larger compared to the effects for the full sample including all levy types: Table 5, column 2 reveals that leverage is 5.6 percentage points lower in countries with a liabilities tax in place. For those countries with the lowest CIT rates in the sample (10%), a levy leads to a reduction in leverage of 4.3 percentage points, whereas under the highest CIT rates (37%), a tax on liabilities still somewhat mitigates leverage (-0.6 percentage points relative to banks not subject to a levy). Thus, when comparing the results from Tables 4 and 5, it appears that bank levies that are designed as a tax on liabilities are more efficient in incentivizing a more stable bank funding structure, even for higher CIT rates.

Overall, the estimation results point to a favorable effect of bank levies on capitalization and this is the more so, the smaller the debt bias of taxation. For very high CIT rates, the resulting incentives for debt financing exceed the incentives from the bank levy to reduce leverage, such that the overall effect of the levies turns insignificant in these countries. Not surprisingly, the strengths of the levy-effect and, hence, its effectiveness to foster financial stability through lower leverage depends on levy design.

4.3 Potential sources of endogeneity

Regarding potential endogeneity issues, one could be concerned about reverse causality, meaning that high bank leverage drives the introduction of bank levies. However, this would imply a positive link between leverage and the introduction of bank levies, whereas we find a negative relationship between the two variables. Thus, our estimates would be biased downwards, such that they reflect a conservative estimate of the effect of levies on leverage if we do not fully control for reverse causality. Additionally, many countries did not primarily aim at influencing bank capital structure with the introduction of bank levies, but rather at filling bank resolution and restructuring funds. Lastly, we consider leverage at the bank level but control for the introduction

of the levy at the country level. This approach lowers concerns about reverse causality as individual banks might not drive the outcome of the regulatory process.

A further concern could be related to anticipation effects. For example, anticipating the introduction of bank levies, banks might, pre-introduction, lower leverage ratios in order to reduce regulatory costs. However, as bank levies were introduced quickly in most countries after first political discussion (see Section 3.2) and partially refer to balance sheets of years preceding the introduction (see e.g. Buch et al. (2016), Devereux et al. (2015)), it is unlikely that banks already adjusted their capital structure before the introduction. Again, such anticipatory adjustments would rather bias our results downwards because we would underestimate the full decline in leverage.

Finally, with respect to confounding factors that influenced bank capital structure at the same time as levies, we control for a large set of potential candidates. Disruptions due to the financial crisis, the European sovereign debt crisis, and expansionary monetary policy affecting all banks alike are captured by time fixed effects. Country-level macroeconomic developments, which obviously differed across the sample countries, and differences in the stance of regulation in the banking sector are controlled for by including a corresponding set of variables and country-level regulatory controls as described above.

As a response to the financial crisis, the regulatory framework has been reformed substantially with potential effects on banks' capital structure. However, our sample ends in 2014, whereas regulatory changes with respect to capital and liquidity requirements under Basel III were subsequently phased-in. Also, as concerns the establishment of the European Banking Union - one of the key regulatory changes in Europe after the financial and sovereign debt crisis - Koetter et al. (2018) show that many countries are delaying the implementation of the directives underlying the implementation of the European Banking Union into national law. Still, to control for shocks in the context of financial and regulatory reforms after the crisis that may affect specific bank groups differently, in robustness checks discussed in Section 4.4, we add interactions of bank

group and year fixed effects, where banks are categorized according to their capital ratio (Devereux et al., 2015; Kogler, 2018).

4.4 Robustness tests

We run several robustness checks in order to test the sensitivity of our results with respect to levy design, bank group-specific shocks and sample composition. Table 6 summarizes the main findings.

We first assess whether changes in the levy rate as well as the timing of the introduction of the levy impacts on our findings. Table 6 reveals that our baseline results (Table 4, column 4) are driven by banks in countries with an increasing levy rate over time (column 2)[11] and by banks that were subject to bank levies early on (2012 or earlier) (columns 2 and 6). When restricting the analysis to banks in countries that introduced the levy after 2011 or after 2012 only, the effects of the levy and of the CIT turn statistically insignificant (columns 3 and 5). This result might reflect that levies have been most effective in countries implementing them relatively quickly after first political discussions such that banks could not adjust *ex ante*.

Second, since adjustments in leverage due to changes in financial regulations or responses to the global financial crisis may have been heterogeneous across banks with different capitalization, we follow Devereux et al. (2015) and Kogler (2018) and account for bank group-specific time trends. For that goal, dummy variables are computed for each quartile of the equity ratio for the entire sample and are then interacted with year dummies. Adding these bank group-time fixed effects does not affect the sign or statistical significance of the baseline results, but reduces the size of the coefficient on the bank levy dummy as well as the coefficient on the interaction with the CIT rate (column 7).

[11] Sweden increased its levy rate in 2011 from 0.018% of non-deposit liabilities to 0.036%. Austria, Cyprus, France, Hungary, Latvia, and the United Kingdom have also increased their levy rate since introducing it (Budnik and Kleibl, 2018).

Appendix C provides additional estimations to test the sensitivity of our results with respect to the included banks, countries, and time. The latter point is especially important considering that our sample includes a non-crisis period, the financial and sovereign debt crisis episode and a period characterized by the re-regulation of the European banking sector with potentially different underlying dynamics in the banking system. When splitting the sample into different time periods to rule out that unobserved common factors drive our result, it appears that the results are statistically significant for the period after 2007 (column 2) and for different sub-periods excluding the year 2014 to control for the introduction of macroprudential policy measures (columns 3 and 4). Yet, the size of the estimated coefficients of the bank levy dummy and of the interaction term with CIT is smaller in more recent years when compared to the baseline result. This finding is in line with previous results suggesting that bank levies are most effective in reducing leverage depending on the CIT in countries implementing levies relatively early.

To test whether the composition of banks and countries matters for our results, we account for the fact that in many countries, smaller banks face exemptions from the levy; e.g. in Austria (balance sheet size smaller than 1 billion Euros) and Germany (tax base smaller than 300 million Euros). Similarly, positions within entities belonging to a bank holding company often face a special levy treatment. These banks might thus have no or different incentives to adjust their capital structure in order to lower levy payments. Excluding bank holding companies (column 5) or small banks with assets below the 25th percentile (column 6) leaves the key mechanism unaffected, even though the direct effect of the CIT rate turns statistically insignificant. This is also the case when restricting the sample to Euro area countries,[12] and thus reducing confounding factors due to a different stance of monetary policy, in column 7 – probably because the variation in CIT rates is significantly smaller among these countries than for the entire EU.

[12]The Euro area (EA) dummy varies across time and includes the 18 countries that joined the EA prior to 2015.

5 Conclusion

The goal of this paper is to analyze how the introduction of bank levies can reduce leverage of European banks, depending on the prevailing corporate income tax (CIT) rate. While corporate income taxes introduce a debt bias, bank levies can have opposite effects on banks' capital structure if, for example, equity is excluded from the tax base. Given substantial changes in the regulatory framework in Europe, including the introduction of a European bank levy to finance the Single Resolution Fund, understanding such interaction effects among regulatory and corporate income taxes is of utmost importance.

Our analysis reveals that bank levies promote a more stable bank capital structure with potentially positive effects for financial stability. However, this favorable effect is weaker, the higher the CIT rate that a bank is subject to and, hence, the stronger the debt bias of taxation. For EU-countries charging very high CIT rates, the leverage-reducing effect of bank levies turns ineffective because the incentives to use debt financing that result from the CIT system outweigh the opposite incentives set by the levies. Thus, there are non-negligible interaction effects between regulatory taxes and corporate taxes that should be taken into consideration when thinking about the goals and effectiveness of changes in one tax or the other.

We also show that the effectiveness of the levies as a tool to decrease leverage depends crucially upon levy design. Again, the leverage-reducing effect of bank levies taxing liabilities weakens with a higher debt bias of taxation. Not surprisingly, bank levies that tax bank liabilities reduce leverage, whereas levies with different tax bases like total assets, deposits, or minimum equity requirements do not show systematic effects upon bank capital structure. The latter tax schemes, hence, tend to serve primarily the goal of filling resolution funds only. Our analysis reveals that, ceteris paribus, a reduction of systemic risk due to less wholesale financing and a better capital base is most likely in case bank levies target the liability side and are implemented in an

environment of limited debt bias of taxation.

This result has the important policy implication that financial regulators should also have an eye on the specific design of regulatory levies and the interaction with other taxation schemes. In a broader context, our results imply that before introducing new regulation to target a specific outcome in banks' behavior, regulators have to assess possible interaction effects with (non-)regulatory measures that are found to impact the targeted variable. Otherwise, regulatory effectiveness cannot be guaranteed.

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Figure 1: Evolution of bank leverage

This figure illustrates the evolution of bank leverage as measured by total liabilities to total assets for the sample median as well as the 25th and 75th percentile.

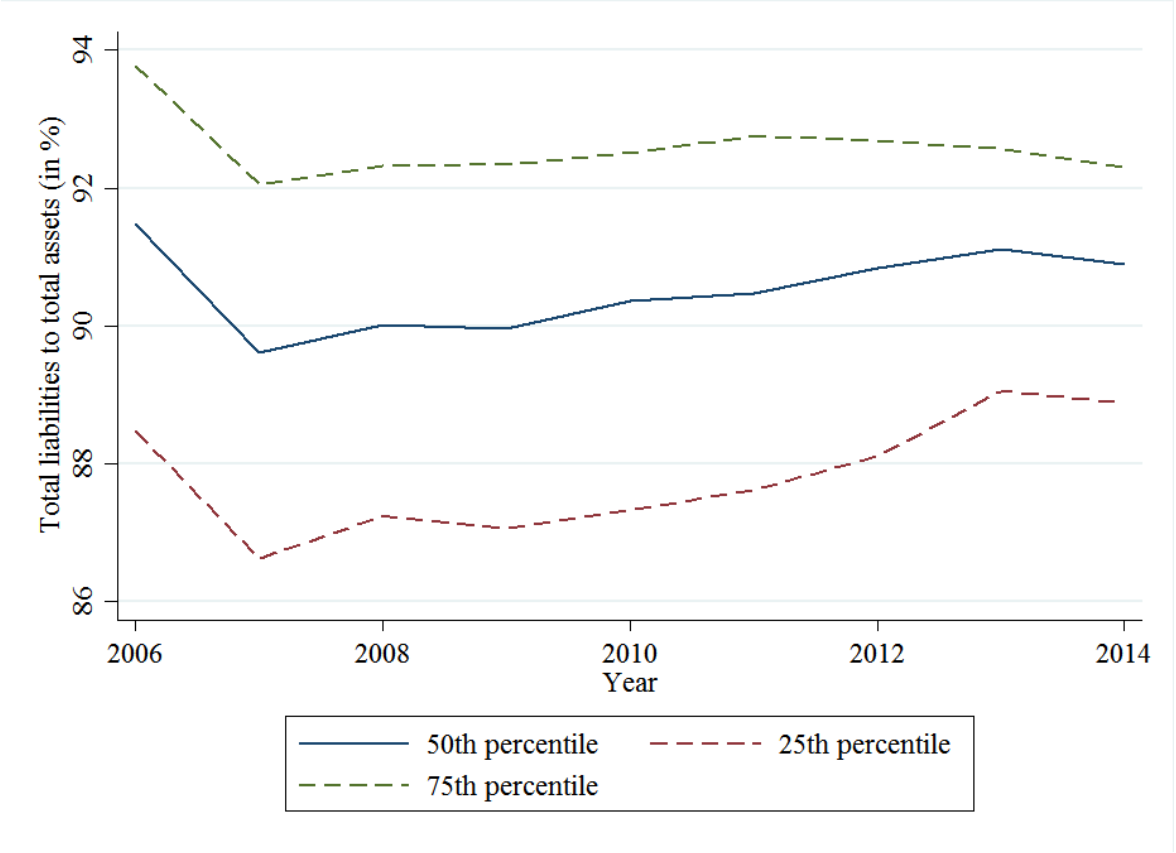
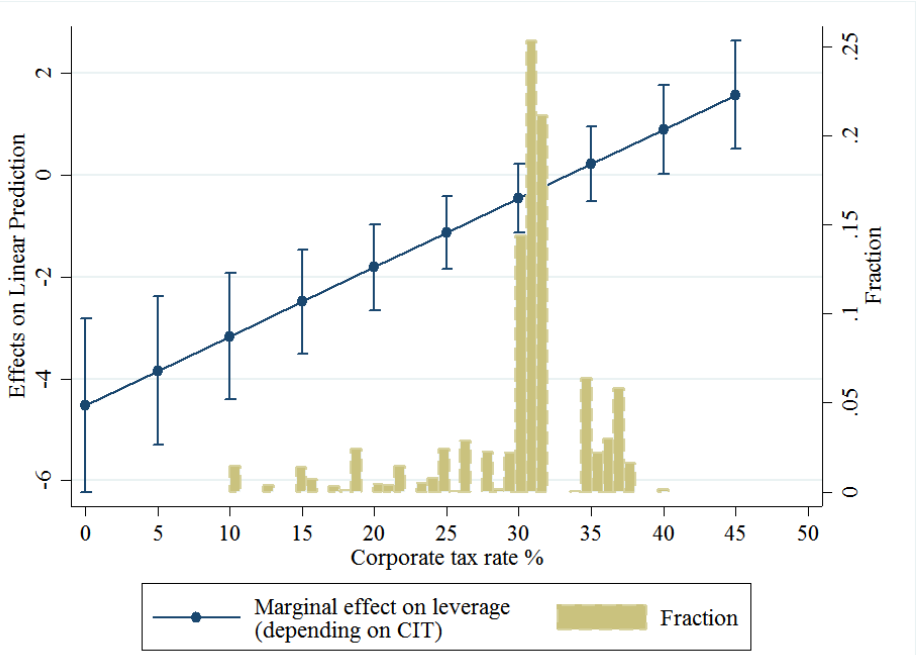


Figure 2: Marginal effects

This figure plots the marginal effects of levies (bank levy = 1 versus bank levy = 0) on bank leverage for the different observations of corporate income taxes (left hand side). On the right hand side, the fraction of observations for the histogram of corporate income taxes can be read. While subplot (a) shows the marginal effects for the entire country sample, subplot (b) summarizes the findings for the sample including countries where "liabilities minus deposits (L-D)" is the tax base of the levy. Source: Own calculations.

(a) Whole sample



(b) L-D sample

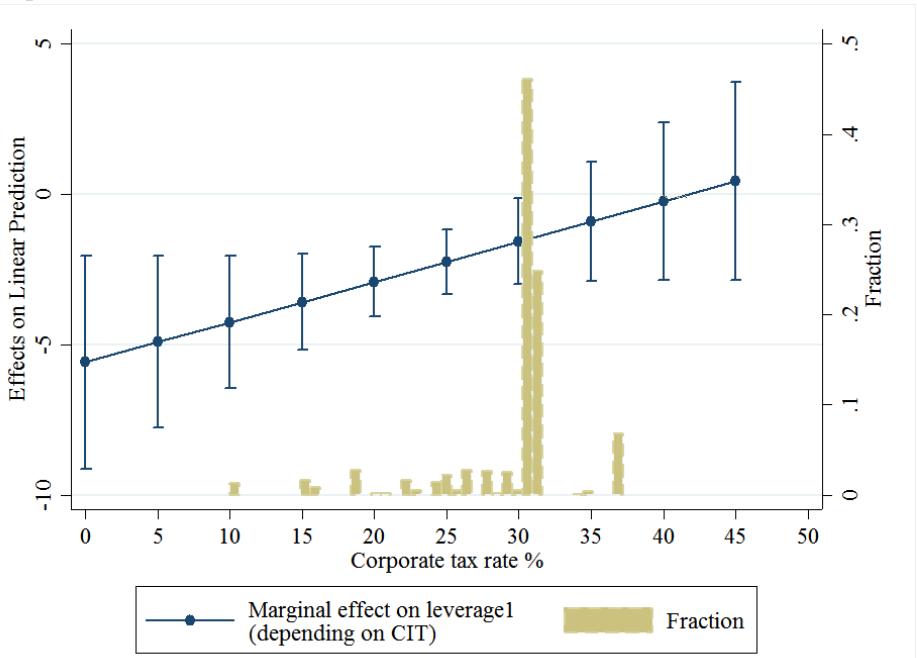


Table 1: Descriptive statistics

These descriptive statistics are based on the baseline regression sample (Table 4, column 1). The sample period spans 2006-2014. Source: See data description in appendix A.

	Obs	Mean	SD	Median	Min	Max
Bank-level variables						
Total liabilities to total assets (in %)	10,774	89.56	5.98	90.69	8.46	98.01
Lag of ln(total assets)	10,774	6.96	1.81	6.70	3.27	12.35
Lag of return on assets (in %)	10,774	0.75	1.07	0.78	-4.55	6.00
Lag of impaired loans (in %)	10,774	6.82	6.45	4.95	0.09	39.04
Country-level variables						
Bank levy (0/1 dummy)	10,774	0.42	0.49	0.00	0.00	1.00
Corporate tax rate (in %)	10,774	30.17	5.11	30.94	10.00	40.36
GDP growth (in %)	10,774	0.11	2.44	0.59	-14.81	11.62
Inflation (in %)	10,774	1.78	1.27	1.60	-1.71	15.24
Supervisory forbearance discretion (0-4)	10,774	1.31	1.03	1.00	0.00	4.00
Factors mitigating moral hazard (0-4)	10,774	1.79	0.55	2.00	0.00	3.00

Table 2: Cross-correlations

This table shows correlation coefficients between the variables used in the regression models. The sample period spans 2006-2014. Source: See data description in appendix A.

	Total liabilities to total assets (in %)	Bank levy (0/1 dummy)	Corporate tax rate (in %)	GDP growth (in %)	Inflation (in %)	Lag of ln(total assets)	Lag of return on assets (in %)	Lag of impaired loans (in %)	Supervisory forbearance discretion (0-4)	Factors mitigating moral hazard (0-4)
Total liabilities to total assets (in %)	1									
Bank levy (0/1 dummy)	0.05	1								
Corporate tax rate (in %)	0.06	0.00	1							
GDP growth (in %)	0.01	0.25	-0.06	1						
Inflation (in %)	-0.02	-0.25	-0.14	0.07	1					
Lag of ln(total assets)	0.23	-0.05	-0.01	0.05	0.02	1				
Lag of return on assets (in %)	-0.13	0.12	0.11	0.10	0.05	-0.05	1			
Lag of impaired loans (in %)	-0.13	-0.21	-0.2	-0.09	-0.04	-0.12	-0.33	1		
Supervisory forbearance discretion (0-4)	-0.16	-0.33	0.06	-0.06	0.05	0.16	-0.01	0.02	1	
Factors mitigating moral hazard (0-4)	0.16	-0.09	0.44	-0.09	-0.04	-0.03	0.04	0.02	-0.25	1

Table 3: Distribution of bank observations by years

This table presents the number and fraction of banks in the baseline sample that are subject to a levy and the ones that are not by sample year. Source: Own calculations.

	Number of bank observations			**Share of bank observations with levy**	
Year	without levy	with levy	total	by year	accumulated
2006	251	0	251	0%	0%
2007	754	0	754	0%	0%
2008	836	0	836	0%	0%
2009	894	59	953	6%	2%
2010	914	64	978	7%	3%
2011	674	353	1,027	34%	10%
2012	693	804	1,497	54%	20%
2013	667	1,546	2,213	70%	33%
2014	609	1,656	2,265	73%	42%
Total	6,292	4,482	10,774		

Table 4: Determinants of bank leverage

This table shows regression results based on the empirical specification of Equation (3) for a sample of European banks. The estimation period covers 2006-2014. The dependent variable is total liabilities relative to total assets (in %). Bank levy is a country-level dummy variable that is one if a bank levy is in place and zero otherwise. Corporate tax rate is a continuous variable, also defined at the country level. All models include bank-level and country-level controls, as well as bank and time fixed effects. Bank-level controls are included with a lag and standard errors are clustered at the bank level. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

	(1)	(2)	(3)	(4)
	Total liabilities to total assets$_t$			
Bank levy$_t$		-0.532	-0.750**	-4.520***
		(0.335)	(0.345)	(0.867)
Corporate tax rate$_t$			0.176***	0.097**
			(0.044)	(0.043)
Corporate tax rate$_t$ $*$ Bank levy$_t$				0.135***
				(0.027)
GDP growth$_t$	0.038	0.055	0.083**	0.102**
	(0.046)	(0.043)	(0.042)	(0.043)
Inflation$_t$	0.116	0.126*	0.117	0.047
	(0.075)	(0.076)	(0.077)	(0.074)
Ln total assets$_{t-1}$	6.940***	6.812***	7.239***	7.449***
	(1.886)	(1.854)	(1.878)	(1.885)
Ln total assets$^2_{t-1}$	-0.213**	-0.208**	-0.239**	-0.251**
	(0.107)	(0.105)	(0.106)	(0.107)
Return on assets$_{t-1}$	-0.290***	-0.285***	-0.283***	-0.290***
	(0.063)	(0.063)	(0.064)	(0.065)
Impaired loans$_{t-1}$	-0.011	-0.013	-0.011	-0.005
	(0.021)	(0.020)	(0.021)	(0.021)
Supervisory forbearance discretion$_t$	-0.387***	-0.286	-0.435**	-0.624***
	(0.145)	(0.191)	(0.185)	(0.194)
Factors mitigating moral hazard$_t$	0.461	0.399	0.384	0.372
	(0.375)	(0.355)	(0.359)	(0.344)
Time fixed effects	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes
Number of observations	10,774	10,774	10,774	10,774
R-squared	0.068	0.069	0.073	0.079
Number of banks	2,771	2,771	2,771	2,771

Table 5: Determinants of bank leverage, depending on levy design

This table shows regression results based on the empirical specification of Equation (3). The estimation period covers 2006-2014. The dependent variable is total liabilities relative to total assets (in %). Bank levy is a country-level dummy variable that is one if a bank levy is in place and zero otherwise. Corporate tax rate is a continuous variable, also defined at the country level. Column (1) repeats the baseline results from Table 4, column (4). Columns (2)-(5) show the estimates for subgroups with regard to the levy design. As indicated in the column header, the estimation sample covers countries with the respective levy tax base and countries that never implemented a levy. All models include bank-level and country-level controls, as well as bank and time fixed effects. Bank-level controls are included with a lag and standard errors are clustered at the bank level. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)
	Baseline	Tax base: L-D	Tax base: RWA or minimum equity requ.	Tax base: deposits	Tax base: total assets
Bank levy$_t$	-4.520***	-5.590***	-1.839	-1.293	3.356
	(0.867)	(1.807)	(4.261)	(1.297)	(6.93)
Corporate tax rate$_t$	0.097**	0.167***	-0.071	0.022	-0.174**
	(0.043)	(0.062)	(0.049)	(0.102)	(0.069)
Corporate tax rate$_t$ $*$ Bank levy$_t$	0.135***	0.134*	0.077	0.002	-0.169
	(0.027)	(0.074)	(0.125)	(0.04)	(0.35)
GDP growth$_t$	0.102**	0.122***	0.046	0.211**	0.056
	(0.043)	(0.045)	(0.035)	(0.088)	(0.039)
Inflation$_t$	0.047	0.075	0.197***	-0.332*	0.174**
	(0.074)	(0.067)	(0.075)	(0.193)	(0.074)
Ln total assets$_{t-1}$	7.449***	7.643***	6.484***	6.514***	6.462***
	(1.885)	(1.937)	(1.464)	(1.683)	(1.578)
Ln total assets$^2_{t-1}$	-0.251**	-0.233**	-0.221**	-0.198*	-0.196**
	(0.107)	(0.109)	(0.089)	(0.113)	(0.099)
Return on assets$_{t-1}$	-0.290***	-0.230***	-0.243***	-0.260***	-0.278***
	(0.065)	(0.066)	(0.07)	(0.078)	(0.076)
Impaired loans$_{t-1}$	-0.005	-0.011	0.028	0.015	0.014
	(0.021)	(0.022)	(0.022)	(0.024)	(0.022)
Supervisory forbearance discretion$_t$	-0.624***	-0.704***	-0.601***	-1.701***	-0.565***
	(0.194)	(0.181)	(0.19)	(0.481)	(0.184)
Factors mitigating moral hazard$_t$	0.372	0.623*	-0.008	-0.878	0.393
	(0.344)	(0.373)	(0.376)	(0.692)	(0.438)
Time fixed effects	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes
Number of observations	10,774	9,180	6,228	5,456	5,213
R-squared	0.079	0.158	0.174	0.096	0.214
Number of banks	2,771	2,451	1,018	938	851

Table 6: Robustness checks

This table shows regression results based on the empirical specification of Equation (3). The estimation period covers 2006-2014 if not indicated otherwise. The dependent variable is total liabilities relative to total assets (in %). Bank levy is a country-level dummy variable that is one if a bank levy is in place and zero otherwise. Corporate tax rate is a continuous variable, also defined at the country level. For comparison, the baseline results from Table 4 are reported in column (1). Column (2) restricts the sample to banks in countries increasing the levy rate over time, while columns (3)-(6) present results for subsamples of countries that introduced levies relatively early or later. In column (7), we add interactions of bank group and time fixed effects. Bank groups are based on the quartiles of bank equity ratios to the baseline model. All models include bank-level and country-level controls, as well as bank and time fixed effects. Bank-level controls are included with a lag and standard errors are clustered at the bank level. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Baseline	Increasing levy rate	Levy introduced after 2011	Levy introduced 2011 or earlier	Levy introduced after 2012	Levy introduced 2012 or earlier	With bank group-time FE
Bank levy$_t$	-4.520***	-6.984***	-0.991	-4.455***	-0.485	-4.429***	-1.848***
	(0.867)	(1.385)	(2.537)	(0.902)	(4.463)	(0.858)	(0.614)
Corporate tax rate$_t$	0.097**	0.108**	0.015	0.086*	0.010	0.087**	0.134***
	(0.043)	(0.044)	(0.090)	(0.044)	(0.111)	(0.043)	(0.039)
Corporate tax rate$_t$ * Bank levy$_t$	0.135***	0.204***	-0.002	0.121***	-0.017	0.121***	0.059***
	(0.027)	(0.039)	(0.075)	(0.027)	(0.126)	(0.026)	(0.019)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank group-time fixed effects	No	No	No	No	No	No	Yes
Number of observations	10,774	7,151	5,475	10,400	5,404	10,471	10,774
R-squared	0.068	0.157	0.093	0.127	0.093	0.126	0.238
Number of banks	2,771	1,196	940	2,660	925	2,675	2,771

Appendix A Data description

Variable	Description	Source
Bank-specific variables		
Total liabilities to total assets (in %)	Total liabilities relative to total assets	Bankscope
Ln total assets	Log of total assets (in US$ million)	Bankscope
Return on assets (in %)	Operating profit relative to average assets	Bankscope
Impaired loans (in %)	Impaired loans relative to gross loans	Bankscope
Country-specific variables		
Bank levy (0/1 dummy)	Dummy variable that is 1 if a bank levy is in place and 0 otherwise	Based on Devereux et al. (2015), ECB's Macroprudential Policies Evaluation Database by Budnik and Kleibl (2018), Kogler (2018), Twarowska (2016), Ernest and Young (2016)
Bank levy tax base: L-D (0/1 dummy)	Dummy variable that is 1 if the bank levy in place uses the difference of liabilities (=total assets - equity) and deposits as tax base to calculate the levy	
Bank levy tax base: deposit based (0/1 dummy)	Dummy variable that is 1 if the bank levy in place uses deposits as tax base to calculate the levy	
Bank levy tax base: RWA or minimum equity requirement (0/1 dummy)	Dummy variable that is 1 if the bank levy in place uses risk-weighted assets or minimum equity requirements as tax base to calculate the levy	
Bank levy tax base: total assets (0/1 dummy)	Dummy variable that is 1 if the bank levy in place uses total assets as tax base to calculate the levy	
Increasing levy rate (0/1 dummy)	Dummy variable that is 1 if the bank levy rate was increased after the introduction	ECB's Macroprudential Policies Evaluation Database by Budnik and Kleibl (2018)
Corporate tax rate (in %)	Sum of federal tax rate, local tax rate taking into account surcharge and deductibility of local taxes	Oxford University Centre for Business Taxation, KPMG (2014), Devereux et al. (2015)
GDP growth (in %)	Annual growth of GDP	International Financial Statistics, IMF
Inflation (in %)	Annual inflation rate	
Supervisory forbearance discretion (0-4)	Whether the supervisory authorities may engage in forbearance when confronted with violations of laws and regulation or other imprudent behavior (0-4, with higher values indicate less supervisory discretion)	Barth et al. (2013)
Factors mitigating moral hazard (0-4)	The degree to which moral hazard exists (0-4, higher values indicate greater mitigation of moral hazard)	Barth et al. (2013)
Euro area (0/1 dummy)	Dummy variable that is 1 if the country is a member state of the Euro area in a given year	

Appendix B Country sample and tax base

This table presents the country samples depending on the tax base applied for the levy. Countries in **bold font** are those that introduced a levy, while the other countries did not have a levy in place during our sample period (2006 – 2014). In the second column, the L-D sample is shown including only countries in which the tax base is "Liabilities (=total assets – equity) – deposits (L-D)" and countries without a levy. The third column shows the year when the levy was implemented. The broad definition of the tax base is indicated in the fourth column. The final column shows the source of the information in those cases we draw on information beyond the one provided in Devereux et al. (2015) and the ECB's Macroprudential Policies Evaluation Database by Budnik and Kleibl (2018).

Baseline sample	*L-D sample*	*Implementation*	*Tax base*	*Source (if additional to:* Devereux et al. (2015); Budnik and Kleibl (2018))
Austria	**Austria**	**2011**	**L-D**	
Belgium	**Belgium**	**2012**	**L-D**	
Bulgaria	Bulgaria	No levy	No levy	
Cyprus	-	**2011**	**Deposits**	
Czech Republic	Czech Republic	No levy	No levy	
Denmark	Denmark	No levy	No levy	
Estonia	Estonia	No levy	No levy	
Finland	-	**2013**	**Risk-weighted assets**	Twarowska (2016)
France	-	**2011**	**Minimum equity requirement**	
Germany	**Germany**	**2011**	**L-D**	
Greece	Greece	No levy	No levy	
Hungary	-	**2010**	**Total assets**	
Ireland	-	**2014**	**Deposits**	
Italy	Italy	No levy	No levy	
Latvia	**Latvia**	**2011**	**L-D**	
Luthuania	Luthuania	No levy	No levy	
Luxembourg	Luxembourg	No levy	No levy	
Malta	Malta	No levy	No levy	
Netherlands	**Netherlands**	**2012**	**L-D**	
Poland	Poland	No levy	No levy	
Portugal	**Portugal**	**2011**	**L-D**	
Romania	**Romania**	**2011**	**L-D**	
Slovakia	**Slovakia**	**2012**	**L-D**	
Slovenia	-	**2011**	**Total assets**	
Spain	-	**2014**	**Deposits**	http://www.elexica.com/en/legal-topics/tax/09-spain-new-tax-on-bank-deposits
Sweden	**Sweden**	**2009**	**L-D**	
United Kingdom	**United Kingdom**	**2011**	**L-D**	

Appendix C Additional robustness checks

This table shows regression results based on the empirical specification of Equation (3). The dependent variable is total liabilities relative to total assets (in %). Bank levy is a country-level dummy variable that is one if a bank levy is in place and zero otherwise. Corporate tax rate is a continuous variable, also defined at the country level. For column (1) and columns (5)-(7), the estimation period covers the years 2006-2014. Columns (2)-(4) show estimates for alternative sample periods. In column (5), all banks that are indicated by Bankscope as bank holdings and holding companies are excluded from the sample. Column (6) shows estimates for a sample that excludes banks with total assets below the 25th percentile of the baseline sample. The estimates shown in column (7) are based on banks in Euro area countries only. All models include bank-level and country-level controls, as well as bank and time fixed effects. Bank-level controls are included with a lag and standard errors are clustered at the bank level. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

	(1) Baseline	(2) after 2007	(3) until 2013	(4) 2010 - 2013	(5) w/o bank holdings	(6) excl. small banks	(7) Euro area countries
Bank levy$_t$	-4.520***	-2.911***	-4.462***	-1.852*	-4.547***	-3.888***	-3.490***
	(0.867)	(0.875)	(0.865)	(0.948)	(0.873)	(0.844)	(1.066)
Corporate tax rate$_t$	0.097**	0.322***	0.069	0.295**	0.098**	-0.001	-0.051
	(0.043)	(0.083)	(0.046)	(0.127)	(0.043)	(0.04)	(0.046)
Corporate tax rate$_t$ * Bank levy$_t$	0.135***	0.082***	0.141***	0.074***	0.136***	0.120***	0.135***
	(0.027)	(0.028)	(0.029)	(0.027)	(0.027)	(0.027)	(0.039)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	10,774	9,769	8,509	5,715	10,748	8,080	9,274
R-squared	0.068	0.072	0.081	0.045	0.079	0.066	0.067
Number of banks	2,771	2,727	2,581	2,464	2,765	2,106	2,470

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