



# Taxing banks: An evaluation of the German bank levy



Claudia M. Buch<sup>a</sup>, Björn Hilberg<sup>a</sup>, Lena Tonzer<sup>b,\*</sup>

<sup>a</sup> Deutsche Bundesbank, Wilhelm-Epstein-Straße 14, 60431 Frankfurt am Main, Germany

<sup>b</sup> European University Institute, Economics Department, Villa San Paolo, Via della Piazzuola 43, 50133 Florence, Italy

## ARTICLE INFO

### Article history:

Received 21 May 2015

Accepted 23 July 2016

Available online 5 August 2016

### JEL codes:

G21

G28

C21

### Keywords:

Bank levy

Bank lending

Interest rates

German banks

## ABSTRACT

Bank distress can have severe negative consequences for the stability of the financial system. Regimes for the restructuring and resolution of banks, financed by bank levies, aim at reducing these costs. This paper evaluates the German bank levy, which has been implemented since 2011. Our analysis offers three main insights. First, revenues raised through the levy were lower than expected. Second, the bulk of the payments were contributed by large commercial banks and by the central institutions of savings banks and credit unions. Third, for those banks, which were affected by the levy, we find evidence for a reduction in lending and higher deposit rates.

© 2016 Elsevier B.V. All rights reserved.

## 1. Introduction

Bank distress can have severe negative consequences, not just for the stability of the financial system but also for the real economy and for public finances. On average, systemic banking crises have imposed fiscal costs of 7% of gross domestic product, and output has fallen by 23% compared to long-run trends (Laeven and Valencia 2013). Banking crises increase public debt significantly, aggravating the risk of public sector default (Reinhart and Rogoff 2011, 2013). In order to reduce the probability of banking crises and to internalize the costs of bank distress, policymakers imposed various changes to the regulatory framework. For example, regimes for restructuring and resolution of banks have been established. They rely on fiscal backstops and bank levies, which aim at internalizing systemic risk and to finance restructuring funds (IMF 2010; Perotti and Suarez 2011; Shin 2010).

In this paper, we assess the effects of the German bank levy, which has been implemented since 2011 as part of the German Bank Restructuring Act. The levy applies to all credit institutions with a German banking license, and it is managed by the Federal Agency for Financial Market Stabilisation. The tax base for the levy is calculated by taking banks' total liabilities and

deducting equity and retail deposits. Banks are exempt from paying the tax if their contribution-relevant liabilities are less than €300 million. For contribution-relevant liabilities exceeding €300 million, tax payments are increasing progressively but are capped at 20% of profits. The levy has the objectives to generate resources for a restructuring fund and to internalize banks' contributions to systemic risk.

Our analysis on the effects of the levy on bank behavior is based on a difference-in-difference approach which exploits two features of the levy. First, while the Restructuring Fund Act was passed in December 2010, the specific terms of the levy were not known until the Restructuring Fund Regulation was actually passed in July 2011. Second, the levy was imposed in 2011, but it was applied retrospectively to banks' balance sheets of 2010. This implies that banks could not adapt their behavior before the introduction of the levy. We exploit this exogenous policy change from the perspective of the individual bank to distinguish the behavior of banks that paid the tax (the treated banks) from those that did not (the control group), and we focus on differences in banks' behavior before (2008–2010) versus after (2011) the introduction of the levy. This allows isolating the effect of the levy.

In analyzing the effects of the German bank levy, we focus on two main questions. First, what is the tax burden on different types of banks? The aim of the bank levy is to internalize banks' contributions to systemic risk. Larger banks, riskier banks, and banks with a high share of wholesale funding are thus supposed to pay higher levies. We find that the bank levies indeed correlate strongly with the size of banks. The largest commercial

\* Corresponding author. Present address: Halle Institute for Economic Research, Kleine Maerkerstrasse 8, 06180 Halle (Saale), Germany.

E-mail addresses: [claudia.buch@bundesbank.de](mailto:claudia.buch@bundesbank.de) (C.M. Buch), [bjorn.hilberg@bundesbank.de](mailto:bjorn.hilberg@bundesbank.de), [bjorn.hilberg@ecb.europa.eu](mailto:bjorn.hilberg@ecb.europa.eu) (B. Hilberg), [lena.tonzer@eui.eu](mailto:lena.tonzer@eui.eu), [lena.tonzer@iwh-halle.de](mailto:lena.tonzer@iwh-halle.de) (L. Tonzer).

banks and central institutions of savings banks and credit unions account for the bulk of the payments, whereas most smaller banks do not contribute to the levy at all. Other bank-specific features, such as the capital ratio, liquidity ratio, or the profitability of banks are only weakly correlated with the levy.

Second, we ask how the levy affects bank behavior. The design of the levy implies that banks' costs of wholesale funding increase. This provides incentives to adapt the business model towards equity and customer deposits. Given the short time span following the introduction of the levy that we can analyze, we cannot identify such structural shifts in banks' business models though. First and stylized evidence suggests that banks did not adapt their funding structure to reduce their amount of contribution-relevant liabilities in the short run.

While structural changes in banks' business models or funding structure evolve in the long-run, banks might respond to the levy already in the short-run. To analyze the short-run responses of banks to the levy, we use data on a subsample of German banks for which we have information about new loans, the interest rates on these new loans, and the interest rates paid on new deposits as provided by the *Deutsche Bundesbank*. Banks can respond to higher costs by increasing lending rates or reducing lending. Effects on deposit rates are not clear cut. On the one hand, lower deposit rates would help banks to increase their interest rate margins. On the other hand, higher deposit rates would create incentives to switch to deposit financing and thus to a source of funding exempted from the levy.

We find that banks affected by the levy tend to reduce their lending and to increase the interest rate on new deposits. This holds in particular for deposits obtained from non-financial firms, weaker evidence is found for deposits obtained from households. This finding suggests that banks try to attract funds which are not subject to the levy, especially in the firm sector, in which competition is likely to be higher. Hence, the result indicates that, in the longer run, banks' might change their business models to more retail based funding in order to pay lower taxes.

Our research contributes to four strands of literature. One strand of literature finds that banks pass higher taxes on to borrowers (Demirgüç-Kunt and Huizinga 1999, 2001, Albertazzi and Gambacorta 2010, Chiorazzo and Milani 2011). However, few empirical studies deal with regulatory taxes. One recent exception is the paper by Capelle-Blancard and Havrylchuk (2013) who analyze the Hungarian levy. The Hungarian levy differs from similar tax regimes because it is not imposed on positions on the liability but on the asset side of the balance sheet. Similar to our study, the authors use a difference-in-difference model to test whether larger banks respond differently than smaller banks to whom a lower tax rate is applied. Their results suggest that banks are able to pass a large fraction of the tax to customers, in particular to those with a low demand elasticity like households. Devereux et al. (2015) study the effect of bank levies introduced in European countries on the risk-taking behavior of banks. Our findings contribute to this literature by revealing a negative impact of the German bank levy on loan supply and a positive impact on deposit rates. We do not find strong evidence that banks pass the levy on to borrowers by increasing interest rates on new loans.

A second strand of literature contains policy proposals which focus on regulatory measures designed to internalize banks' contributions to systemic risk (IMF 2010). Perotti and Suarez (2009) propose a liquidity charge. Shin (2010) raises the idea of a tax on banks' non-core liabilities, which might reduce their reliance on short-term wholesale funding as a means to finance excessive balance sheet expansions during booms. Similarly, Hahm et al. (2013) establish a positive relationship between non-core liabilities and financial vulnerability. We find evidence that banks increase deposit rates as a response to the levy, which might reflect

the long-term objective to restructure funding sources toward retail funding.

A third strand of literature compares the effect of taxes on banks to alternative regulatory measures like capital and liquidity requirements from a theoretical point of view, e.g. Perotti and Suarez (2011) and De Nicolò et al. (2012). If we compare the design of the German bank levy with tax schemes discussed in the literature, we see that they all share the idea of targeting the liability side of banks' balance sheet and internalizing systemic risk due to excessive reliance on short-term wholesale funding.

A fourth strand of literature analyzes the relationship between bank levies and banks' contributions to systemic risk empirically. Schweikhard and Wahrenburg (2013) show that, within the German tax scheme, banks that contribute more to systemic risk pay higher taxes. Unlike our research, their analysis focuses on a selected sample of large banks and on the link between systemic risk measures and (hypothetical) tax payments in different regulatory regimes. Our objective instead is to evaluate the short-term effects of the German levy on banks' interest rate setting and lending behavior.

The paper is structured as follows. In the next section, we describe the design and legal background of the German bank levy. In Section 3, we introduce our data. Section 4 contains results from the calculation of the levy, the empirical model and the regression results. We conclude in Section 5.

## 2. German bank levy: design and legal background

The German bank levy was introduced in 2011 as part of a new regulatory framework for the restructuring and resolution of banks. It applies to all credit institutions with a banking license, as specified in the German Banking Act.<sup>1</sup> The levy finances the Restructuring Fund (*Restrukturierungsfonds*), which has a target size of €70 billion. The Restructuring Fund is managed by the Federal Agency for Financial Market Stabilisation (FMSA; *Bundesanstalt für Finanzmarktstabilisierung*), in association with the German Federal Ministry of Finance (*Bundesministerium der Finanzen*). These funds are earmarked as a financial backstop if the failure of a bank or parts thereof were to endanger the systemic stability of the banking system. Unlike a deposit insurance fund that insures depositors, the rescue fund is designed to intervene only if systemically important banks are in distress. In the first three years after the introduction of the bank levy in Germany (2011–2013), €1.8 billion have been collected. The yearly revenues vary between €520 million (in 2013) to €690 million (in 2012).<sup>2</sup> The bank levy collected between 2011 and 2013 accounts for 1.5% of operating income and 2.2% of total profits before taxes of German banks in this period.<sup>3</sup>

### 2.1. Timing of the legislation

To identify the effect of the bank levy on bank behavior, we use a difference-in-difference approach. This approach relies on the assumption that banks affected by the levy could not adjust their behavior prior to the introduction of the levy. For example, in anticipation of the tax, banks might have had incentives to restructure sources of funding in order to lower the tax base. If this would have been possible, the introduction of the levy would not qualify as an exogenous policy change. In this paper, we exploit two features in the timing of the legislation which help rule out related concerns.

<sup>1</sup> The Appendix provides details on which banks are subject to the regulation.

<sup>2</sup> See information published by the German Bundestag in Drucksache 17/12339, <http://dipbt.bundestag.de/dip21/btd/17/123/1712339.pdf>.

<sup>3</sup> The German bank levy is considered as non-interest expenses in the profit and loss accounts of banks.

First, the Restructuring Fund Act came into force in December 2010. Specific details about the design of the bank levy are contained in the Restructuring Fund Regulation, which was passed in July 2011. The annual bank levy is calculated based on the banks' balance sheets and income statement of the immediately preceding accounting year. In our empirical approach, we exploit the fact that banks could not adjust their annual statements, i.e. those referring to the year 2010, when the levy was first introduced in 2011. The levy is thus an exogenous policy change from the point of view of the individual bank, and it is applied retrospectively.<sup>4</sup>

Second, the exact design of the levy has been the subject of a legislative debate during 2010. For the individual bank, there has been a substantial margin of uncertainty as to the outcome of this discussion. Hence, banks could not adjust activities *ex ante* in anticipation of a specific design. For example, it has been discussed whether savings banks should be exempt from the levy. The minimum threshold was thus lowered from €500 to €300 million, and the acceptability limit was raised from 15% to 20% of annual earnings. An additional issue in the debate was whether the regulation should be based on balance sheet quantities alone or whether risk weights should be applied.

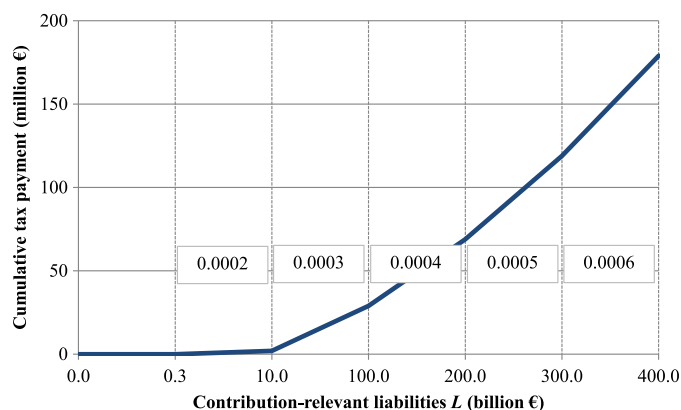
## 2.2. Calculating the bank levy

The actual design of the German bank levy aims at internalizing banks' contributions to systemic risk. Credit institutions with a market-based funding strategy and with a high volume of derivatives trading are charged more, smaller banks are charged less. Accordingly, the levy has two main components.

The first component of the bank levy imposes a tax on contribution-relevant liabilities. These consist of funding sources other than customer deposits and bank equity. This avoids the possibility that banks make contributions twice, with respect to the deposit insurance fund and the restructuring fund. Contribution-relevant liabilities are calculated as total liabilities minus positions like customer deposits and equity.<sup>5</sup> The levy increases progressively with the volume of a bank's contribution-relevant liabilities. If the resulting contribution-relevant sum is smaller than or equal to €300 million, no levy applies to this component of the tax. Contribution-relevant liabilities ( $L$ ) exceeding this value are subject to a progressive tax rate (Fig. 1).

The second component of the tax is based on derivatives. Contribution-relevant derivatives refer to the aggregate notional volume of derivatives listed in the appendix of the last annual accounts and specified in section 36 of the Credit Institution Accounting Regulation (*Kreditinstituts-Rechnungslegungsverordnung*). The accrued levy from this component results from the multiplication of this amount by a factor of 0.000003. This number may appear to be very small, but, as of December 2013, the notional volume of derivatives of German banks reporting to the BIS OTC Derivatives Statistics was €57 trillion.

The final contribution is the sum of the contribution-relevant liability positions, multiplied by the respective factors, and the amount referring to derivative exposures. Germany differs from most other European countries by imposing a cap on payments. The maximum levy to be paid is limited to 20% of the bank's annual earnings, which corresponds to an acceptability limit (*Zumutbarkeitsgrenze*). However, even if a credit institution has no



**Fig. 1.** Tax payments and contribution-relevant liabilities. This graph plots the cumulative tax payments (in million €) resulting from the multiplication of contribution-relevant liabilities (in billion €) in different tax brackets with the respective tax rate. The tax rate for contribution-relevant liabilities ( $L$ ) smaller than or equal to €300 million is 0. If a bank has contribution-relevant liabilities of more than €300 million, the amount exceeding this threshold is subject to the following progressive tax rate: 0.0002 (€300 million <  $L$  ≤ €10 billion), 0.0003 (€10 billion <  $L$  ≤ €100 billion), 0.0004 (€100 billion <  $L$  ≤ €200 billion), 0.0005 (€200 billion <  $L$  ≤ €300 billion), and 0.0006 ( $L$  > €300 billion). Source: Restructuring Fund Regulation, own calculations.

annual surplus and irrespective of the acceptability limit, a minimum contribution has to be paid. The minimum contribution (*Mindestbeitrag*) corresponds to 5% of the calculated annual contribution. Hence, if banks hit the acceptability limit, the levy is no flat tax but proportional to either annual earnings or the regularly calculated amount of their levy payments.

## 3. Data

To analyze the questions of which banks have been affected most by the levy and how this has affected their behavior, we use data provided by the *Deutsche Bundesbank* on banks' balance sheets, income statements, and prudential indicators for the years 2008–2011. This time window allows analyzing the behavior of banks before (2008–2010) and after (2011) the introduction of the levy. All data are annual.

### 3.1. Data on bank loans and interest rates

In the short run, the most important channel of adjustment to the introduction of the bank levy is a reduction in loans and an increase in interest rate spreads to compensate for higher funding costs. The effect on deposit rates is not clear a priori. On the one hand, higher deposit rates might attract new customer deposits and funds exempted from the tax. Higher deposit rates can thus reflect banks' incentives to change their funding structure and to reduce the amount of contribution-relevant liabilities in the long run. On the other hand, lower deposit rates would compensate for higher funding costs through the levy.

To focus on banks' short-term adjustment, we use information for a sub-sample of banks covered in the interest rate statistics for monetary financial institutions (MFI interest rate statistics). For these approximately 200 banks, this data set provides information about the quantity of new loans, the interest rate charged across new loans, and interest rates paid for new deposits. Our main regression results are thus based on a (balanced) sample of banks having reported to the MFI interest rate statistics since 2003. Hence, the sample of banks is constant over time, and we cannot model a possible selection effect. The results are robust to the addition of approximately 40 banks which have been

<sup>4</sup> The bank levy is part of the German Bank Restructuring Act implemented as a response to the experiences made during the recent financial crisis. Thus, while the levy can be interpreted as an exogenous policy change from the perspective of the individual bank, it might not be exogenous with respect to the state of the banking system as a whole. Our unit of analysis, however, is the individual bank.

<sup>5</sup> See the [supplementary materials](#) for details on the calculation of contribution-relevant liabilities.

**Table 1**  
Summary statistics for loan volumes and interest rates.

	(1) Full sample (7174 bank-year observations)		(2) Reporting banks in MFI interest rate statistics (625 bank-year observations)	
	Mean	Std. dev.	Mean	Std. dev.
<i>Loan volume</i>				
New loans (log, k €)			13.16	2.25
Loans (log, k €)	12.47	1.66	15.35	1.27
Loans/assets (ratio)	0.55	0.16	0.56	0.17
Loans (YoY change in %)	0.04	0.21	0.03	0.09
New loans HH (log, k €)			10.46	2.02
New loans F (log, k €)			12.89	2.54
<i>Loan rates (%)</i>				
All maturities			3.87	1.40
Short-term			3.47	1.65
Medium-term			4.65	1.26
Long-term			4.66	1.28
All maturities HH			5.77	1.52
All maturities F			3.49	1.08
<i>Deposit rates (%)</i>				
All maturities			1.82	1.01
Overnight			0.84	0.66
Short-term			1.64	1.06
Medium-term			2.48	1.03
All maturities HH			1.93	1.01
All maturities F			1.60	1.02

The table shows summary statistics for the loan volume, loan rate, and deposit rate variables. Descriptive statistics based on the full sample include all observations from 2008–2011 for all banks in our data set; those based on the subsample of banks reporting within the scope of the MFI interest rate statistics include all observations from this period for banks reporting from 2003 onward. The dependent variable is either newly granted loans (“New loans,” log thousand €) or the volume of existing loans (“Loans,” log thousand €). “Loans” consists of loans to customers excluding interbank loans. “Loans/assets” gives the total loan stock over total assets. “Loans (YoY change in %)” denotes the year-on-year change in the total loan stock. “New loans HH (F)” refers to new consumer loans provided to households (non-financial firms). The loan and deposit rates (%) are end-of-year volume-weighted interest rates. Data on loan rates are available for three maturity brackets. Short-term loan rates are fixed for a maximum of one year. Medium-term loan rates are fixed for at least one year and up to a maximum of five years. Long-term loan rates are fixed for at least five years. “All maturities” is a weighted average of loan rates across the three maturity buckets. It can be broken down by sector: “All maturities HH (F)” refers to loan rates applying to households (non-financial firms). Deposit rates are available for three maturity brackets. Overnight deposit rates are paid for deposits with an overnight maturity. Short-term deposit rates are fixed for a maximum of one year. Medium-term deposit rates are fixed for at least one year. “All maturities” is a weighted average of deposit rates across the three different maturity buckets available. It can be broken down by sector: “All maturities HH (F)” refers to deposit rates applying to households (non-financial firms). For more details, see the description in the Data Appendix. Source: Deutsche Bundesbank, Monthly Balance Sheet Statistics and MFI interest rate statistics, own calculations.

required to report since 2010.<sup>6</sup> To detect possible differences between the MFI banks and the German banking system as a whole, we provide the following descriptive statistics for each group separately.

To assess the impact of the levy on loans, we use: (1) log of new loans from the MFI interest rate statistics, (2) log of total loans (stocks from the balance sheet statistics), (3) total loans scaled by total assets, and (4) log changes in the stock of loans. Interest rate data on new loans are available for all new loans issued by banks, as well as for loans with short-term (less than 1 year), medium-term (1–5 years), and long-term (over 5 years) maturity. In addition, we have interest rate data on new deposits for all newly received deposits, disaggregated by maturity (i.e., overnight, short-term (less than 1 year) or medium-term (over 1 year) deposits). Data on new loans and new loan or deposit rates can in addition be broken down by sector (households and non-financial firms).<sup>7</sup>

Table 1 contains summary statistics for these variables. The banks in the MFI sample show significantly higher mean log of loans of €15.35 thousand, versus €12.47 thousand for the full sample. The results obtained from the MFI interest rate statistics are thus representative of larger banks in the market. Nevertheless, the two groups of banks are similar in other structural characteristics: The ratio of loans to total assets is almost identical (55%), as is the average annual growth rate of loans. Table 2 contains a comparison of key bank characteristics, such as capital and liquidity ratios or profitability, and shows similar patterns across the different samples of banks.

### 3.2. Data used to calculate the bank levy

The FMSA collects bank levies and therefore has data on payments by each bank. However, these data are not available to external researchers; they also do not contain information about banks' balance sheets and prudential indicators. We thus combine information on the rules governing how to calculate the levy with high-quality information on banks' balance sheets and income statements from the Deutsche Bundesbank. Contribution-relevant liabilities can be calculated directly from the balance sheets reported to the Bundesbank. To obtain information on derivatives positions, we resort to the OTC derivatives statistics, which show the derivatives positions of banks reporting to the Bank for International Settlements (BIS). This enables

<sup>6</sup> For a detailed description of the bank selection procedure and the changes made to the MFI interest rate statistics in June 2010, see the Deutsche Bundesbank's Monthly Reports (January 2004, pp. 45–59; June 2011, pp. 45–57) (Deutsche Bundesbank 2004, 2011).

<sup>7</sup> The data are taken from the Deutsche Bundesbank, MFI interest rate statistics and Monthly Balance Sheet Statistics, 2008–2011. These data will be available in the future for replication purposes through the Research Data and Service Centre (RDSC) of the Deutsche Bundesbank.



**Table 2**  
Summary statistics for banking variables.

	(1) Full sample (7174 bank-year observations)		(2) Reporting banks in MFI interest rate statistics (625 bank-year observations)	
	Mean	Std. dev.	Mean	Std. dev.
<i>Bank levy variables</i>				
Bank levy (0/1)	0.06	0.23	0.23	0.42
Bank levy <sub>high</sub> (0/1)	0.00	0.07	0.05	0.21
<i>Banking variables</i>				
Log total assets	6.24	1.53	9.09	1.33
Tier 1 capital ratio	13.6%	0.07	12.1%	0.04
NPL ratio	4.4%	0.03	3.6%	0.02
Cost-to-income ratio	81.8%	0.08	83.7%	0.08
RoA	0.5%	0.00	0.3%	0.00
Liquidity ratio	5.9%	0.05	3.6%	0.02

This table shows summary statistics for variables related to the bank levy used in subsequent regressions and other bank-specific variables, such as banks' log of total assets (million €) and the CAMEL variables (i.e., Tier 1 capital ratio, NPL ratio, cost-to-income ratio, RoA, liquidity ratio). Descriptive statistics are based on the full sample and the subsample of banks reporting within the scope of the MFI interest rate statistics, over the period 2008–2011. The dummy variable *Bank levy* (0/1) is equal to 1 if in 2011 the bank had contribution-relevant liabilities higher than €300 million. The dummy variable *Bank levy<sub>high</sub>* (0/1) is equal to 1 if in 2011 the bank had contribution-relevant liabilities of more than €10 billion. *Log total assets* denote the log of bank assets in million €. *Tier 1 capital ratio* is Tier 1 capital over risk-weighted assets. *NPL ratio* is non-performing loans over gross loan volume. *Cost-to-income ratio* relates the cost (excluding extraordinary items) to the revenues (excluding extraordinary items). *RoA* measures the earnings before tax relative to total assets. *Liquidity ratio* measures the liquidity held by a bank over total assets. For more details, see the description in the Data Appendix. Source: Deutsche Bundesbank, Monthly Balance Sheet Statistics and Income Statements, own calculations.

us to calculate banks' contributions with a sufficient degree of precision.<sup>8</sup>

### 3.3. Bank-level control variables

We calculate the bank-level control variables on the basis of the CAMEL rating system employed by U.S. regulators to assess a bank's overall health.<sup>9</sup> Capital adequacy (C) is measured through Tier 1 capital relative to risk-weighted assets (*Tier 1 capital ratio*). The quality of a bank's asset portfolio (A) is captured through non-performing loans relative to the size of its overall loan portfolio (*non-performing loans* or *NPL-ratio*).<sup>10</sup> Management quality (M) is proxied through the *cost-to-income ratio*. Earnings (E) and thus profitability are proxied through return on assets (*RoA*). Liquidity (L) is liquid assets over total assets held, where liquidity is cash plus central bank balances plus claims with banks repayable on demand plus securities eligible as collateral at central banks (*liquidity ratio*). In addition, we control for bank size by including the logarithm of *total assets*.

Table 2 contains summary statistics for these variables for the whole sample period. To winsorize the CAMEL variables, we replace the highest and lowest 1% of observations with the respective thresholds. For the cost-to-income ratio, only the highest 1% of all observations are replaced. Banks with missing values for total assets are excluded from the sample. Information on the subset of banks in the MFI interest rate statistics appears in the right panel of Table 2. The main difference between the two samples of banks is that the MFI banks are larger, with a mean of log of assets of €9.09 million, compared with €6.24 million for the full sample.

<sup>8</sup> For a detailed description on the data used to calculate the levy and sources for deviations of the calculated levy from the actual levy, see the [supplementary materials](#).

<sup>9</sup> Since the late 1990s, the CAMEL rating system was expanded to control also for systemic risk factors. These are mainly derived from stock market data. Due to data availability, we rely on the initial definition and control for systemic risk at the country-level by including time fixed effects.

<sup>10</sup> Before 2009, only loans to the non-financial private sector with specific provisions were considered; after 2009, loans to both the financial and non-financial private sectors were included.

## 4. Results

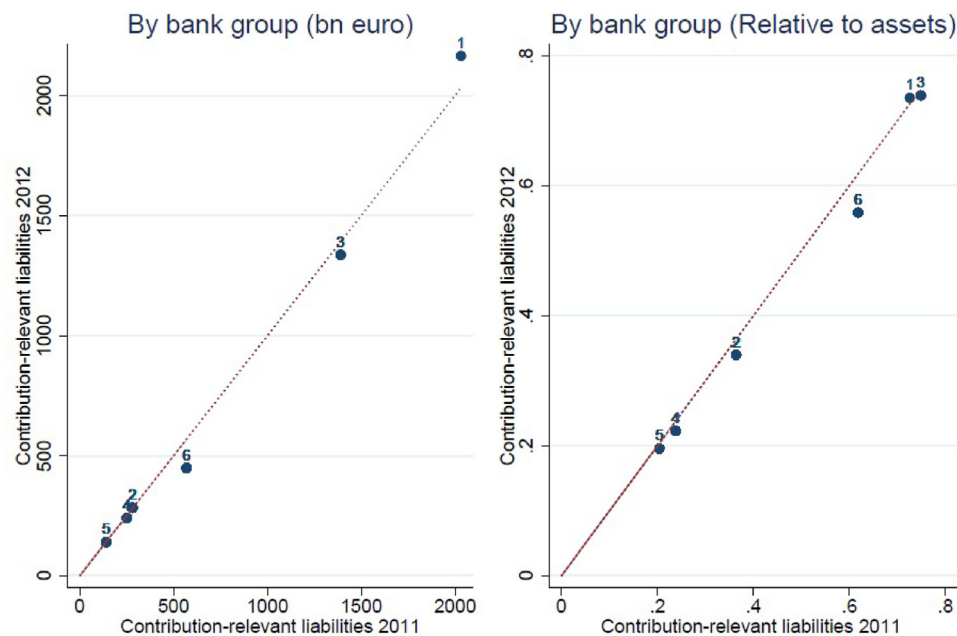
### 4.1. Descriptive analysis

Calculating the first and major component of the levy, contribution-relevant liabilities, shows that the majority of German banks (77% of all banks) have contribution-relevant liabilities smaller than €300 million. This implies that they do not have to make levy payments. This applies mostly to the smaller banks, like credit unions, which have a strong depositor base (see also Table A1 in the [supplementary materials](#)). Quantitatively, the average effect of the contribution arising from derivatives is of minor importance for the average German bank. Ignoring the bounds affecting the payments and considering only banks reporting to the BIS, we find that almost 90% of the total bank levy is attributable to contribution-relevant liabilities.

In Fig. 2, we investigate whether there are indications that the bank levy induced adjustment in banks' business models, in particular the funding structure. Fig. 2 plots the contribution-relevant liabilities for 2011 against those of 2012, by bank group. In the left panel, we find that the amount of contribution-relevant liabilities barely changed across years. Hence, banks did not adjust their balance sheets. Inspecting the contribution-relevant liabilities relative to total assets in the right panel of Fig. 2 yields similar results. This is not surprising, considering that most banks had contribution-relevant liabilities below the €300 million threshold, which exempted them from payments. However, even for large commercial banks (bank group 1) or central institutions of savings banks and credit unions (bank group 3), there are no visible adjustments.

In addition, we performed Kolmogorov-Smirnov tests to compare the distribution of each non-contribution relevant position (e.g., customer deposits or equity) underlying the computation of the bank levy for 2011 and 2012. These unreported tests show that the bank levy had no significant effect on the balance sheet structure.

Table 3 shows the results from calculating the bank levy. Column 1 of Table 3 shows that the total revenue of the bank levy in 2011 across all contributing banks amounted to €529 million. The average contributing bank pays about €1.3 million. The large



1: Large commercial banks 2: Other commercial banks 3: Central institutions (savings banks & credit unions) 4: Savings banks 5: Credit unions 6: Mortgage banks

**Fig. 2.** Contribution-relevant liabilities, 2011 versus 2012. This graph plots contribution-relevant liabilities for the year 2011 against those of 2012. On the left, data from all banks included in the sample are aggregated to obtain contribution-relevant liabilities by bank group (in billion €). On the right, contribution-relevant liabilities by bank group are scaled by total assets of the respective bank group. Source: *Deutsche Bundesbank*, monthly balance sheet statistics, own calculations.

**Table 3**

Revenue from the bank levy in 2011 by bank group.

	(1) Full sample (1803 bank-year observations)			(2) MFI sample (165 bank-year observations)		
	Total levy (million €)	Average levy (million €)	Number of contributing banks	Total levy (million €)	Average levy (million €)	Number of contributing banks
Large commercial banks	210.5	52.6	4	210.5	52.6	4
Other commercial banks	31.5	0.4	74	17.9	1.1	17
Central institutions	206.3	17.2	12	206.3	17.2	12
Savings banks	29.3	0.1	223	19.6	0.3	67
Credit unions	10.0	0.1	72	8.6	0.3	27
Mortgage banks	41.5	1.5	28	40.6	2.1	19
Total	529.1	1.3	413	503.5	3.4	146

In this table, we report the total contribution made by all banks in the sample (total levy, in million €), the average payment (average levy, in million €), and the corresponding number of contributing banks, which surpass the €300 million threshold and pay at least the minimum contribution of 5% of the computed bank levy (Columns 1–3). Columns 4–6 depict the same information for the subsample of banks reporting within the scope of the MFI interest rate statistics. All numbers refer to the contribution year 2011, so the balance sheet data come from 2010, and are reported for the full sample and by bank group. Source: *Deutsche Bundesbank*, Monthly Balance Sheet Statistics and MFI interest rate statistics, own calculations.

commercial banks as well as the central institutions of savings banks and credit unions are the largest contributors. Together, their contributions account for more than 79% of total revenues from the bank levy; the share increases to more than 82% for the subsample of MFI banks. The majority of German banks pay no levy at all, though.

Of the 1803 banks in our data set, only 81 were subject to the acceptability limit in 2011. These banks distinguish themselves from the other contributing banks mainly by lower levels of profitability. The acceptability limit constitutes the upper bound for a bank's contribution. Were we to ignore the acceptability limit, the total contribution across all banks would have been €1.9 billion, or more than four times higher.

Because we calculate, rather than observe, the payments by each bank, the quality of our approximation method is crucial. In Table 4, we compare the results from our calculation of the bank levy with numbers from official government sources. There

**Table 4**

Revenues from the bank levy.

	(1) Data set, total levy		(3) Official data, total levy	
	(million €)	(% of total)	(million €)	(% of total)
All commercial banks	242	45.7	256	44.1
Central institutions	206	39.0	246	42.4
Savings banks	29	5.5	28	4.8
Credit unions	10	1.9	8	1.3
Mortgage banks	42	7.8	43	7.4
Total	529	100	581	100

This table compares the total contribution made by all banks in the sample (total levy, in million €) with numbers from official sources. Columns 1 and 2 refer to all banks that surpass the €300 million threshold and pay at least the minimum contribution of 5% of the computed bank levy, based on our own calculations and using data from the Monthly Balance Sheet Statistics collected by the *Deutsche Bundesbank*. Columns 3 and 4 contain the information published on p. 20 in Drucksache 17/12,339 (German Bundestag, Answer by Parliamentary State Secretary Steffen Kampeter dated February 12, 2012).

**Table 5**  
Correlations between the bank levy and bank characteristics.

	(1) Total assets (million €)	(2) Customer deposits/ total liabilities	(3) Loans/customer deposits	(4) Tier 1 capital ratio	(5) Liquidity ratio	(6) RoA	(7) NPL ratio
(a) Full sample (1803 bank-year observations)							
Large commercial banks	0.59	−0.73	0.66	0.73	−0.51	0.27	−0.27
Other commercial banks	0.69	−0.09	0.06	−0.12	−0.13	−0.05	−0.08
Central institutions	0.54	0.04	0.07	0.09	−0.22	0.38	0.24
Savings banks	0.93	−0.22	0.17	−0.19	−0.10	−0.10	−0.08
Credit unions	0.84	−0.17	0.16	−0.06	−0.07	−0.07	−0.04
Mortgage banks	0.71	−0.56	0.39	−0.23	−0.12	−0.24	−0.09
Total	0.79	−0.22	0.06	0.01	−0.03	−0.07	−0.02
(b) Reporting banks in MFI interest rate statistics (165 bank-year observations)							
Large commercial banks	0.59	−0.73	0.66	0.73	−0.51	0.27	−0.27
Other commercial banks	0.58	−0.07	0.11	−0.17	−0.33	−0.05	−0.22
Central institutions	0.54	0.04	0.07	0.09	−0.22	0.38	0.24
Savings banks	0.93	−0.42	0.29	−0.43	−0.09	−0.48	−0.01
Credit unions	0.93	−0.50	0.35	−0.23	−0.31	−0.26	−0.04
Mortgage banks	0.74	−0.63	0.38	−0.34	0.09	−0.41	−0.01
Total	0.78	−0.43	0.10	0.10	−0.05	−0.17	0.00

This table shows the correlation between various bank characteristics and the contribution to be made in 2011. The correlations are based on the contributed bank levy in 2011 (in million €) and bank characteristics as of 2010 as the tax payment results from balance sheet positions of the annual account corresponding to the year preceding the contribution year, or 2010. Results are reported for all banks in the sample as well as for the subsample of banks reporting to the MFI interest rate statistics. Source: Deutsche Bundesbank, Monthly Balance Sheet Statistics and Income Statements, own calculations.

are some deviations in the absolute contributions for the group of commercial banks and central institutions of the savings bank sector. Yet, the *relative* contributions of each bank group to the total revenues of the bank levy are close to the official numbers.

The bank levy is intended to be disproportionately for banks that presumably impose negative externalities on financial stability. Larger banks and more interconnected banks tend to be systematically more important (Arinaminpathy et al. 2012; Drehmann and Tarashev 2011, 2013; Freixas and Rochet 2013; Haldane 2012). Table 5 thus relates the bank levy to bank size and other characteristics that might influence bank stability. Owing to the tax's design, we observe a positive relationship between bank size and tax payments. This is in line with the finding of Schweikhard and Wahrenburg (2013).

The correlations by bank group reveal that the high correlation with bank size is driven by savings banks and credit unions. The correlations are lower for large commercial banks or central institutions of savings banks and credit unions, for which the levy is more likely to be capped by the acceptability limit. Considering the share of funding through customer deposits, we find a negative relationship with tax payments. This reflects the design of the levy as customer deposits constitute a non-contribution-relevant balance sheet position and the objective of the bank levy is to tax market-based funding and, implicitly, leverage. For all other variables, the correlations are small. The patterns are similar across the full sample and the MFI sample.<sup>11</sup>

## 4.2. Regression results

Did German banks reduce the amount of (newly issued) loans to the private sector after the introduction of the bank levy? Did treated and non-treated banks adjust loan and deposit rates differently? To answer these questions, we analyze whether key activities of banks changed after the implementation of the levy in 2011, and we compare treated and non-treated banks. We employ a difference-in-difference approach to exploit the variation over two dimensions: the time before and after the introduction of the bank levy, and banks that had to pay and those that did not.

### 4.2.1. Baseline empirical model

Our baseline regression equation is given by:

$$y_{it} = \alpha_i + \gamma_t + \delta * \text{Charged Bank} * \text{After 2010} + \beta' x_{it-1} + \varepsilon_{it} \quad (1)$$

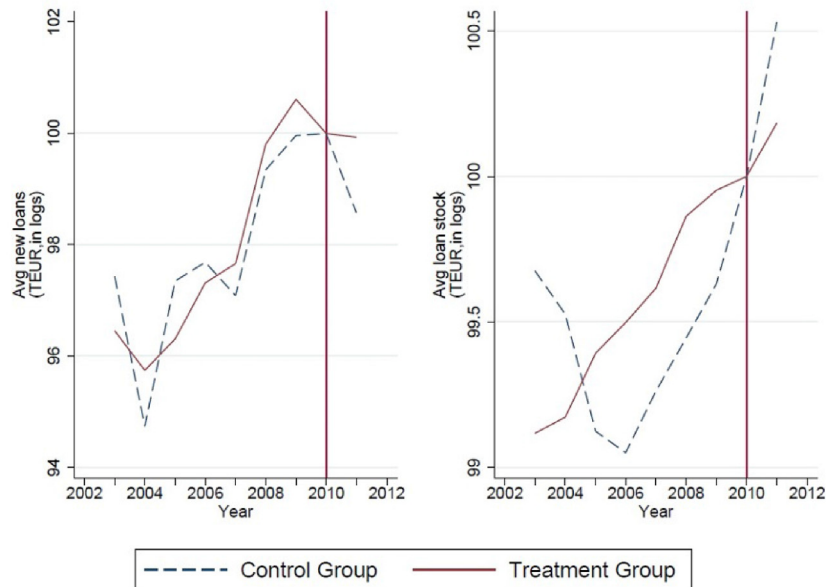
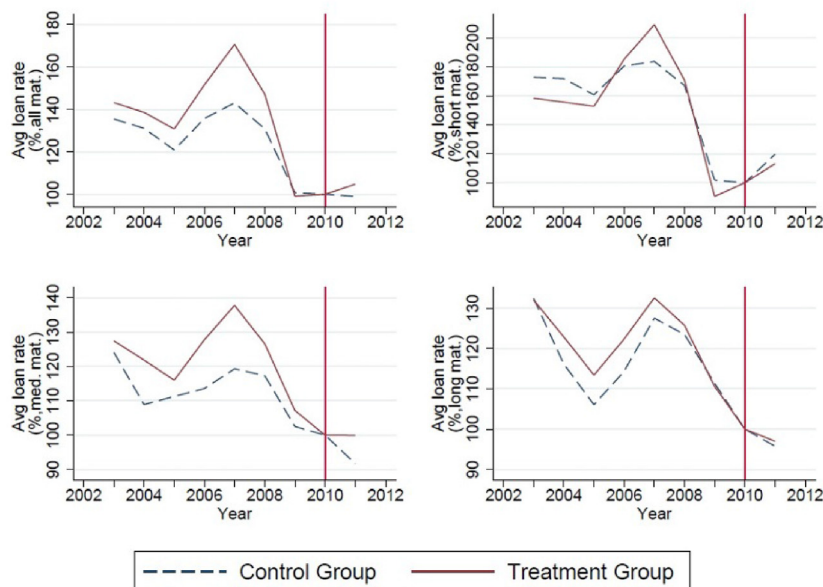
where the dependent variable  $y_{it}$  refers to bank loans or bank interest rates. We include time-invariant bank fixed effects ( $\alpha_i$ );  $\gamma_t$  captures time effects common to all banks. *Charged Bank* is an indicator variable, equal to 1 if the bank is subject to the tax (if it has contribution-relevant liabilities higher than €300 million) and 0 otherwise. *After 2010* is an indicator variable taking a value of 1 after the regulatory change (2011) and 0 otherwise (2008–2010). We define  $x_{it-1}$  as a vector of controls for time-varying bank characteristics, lagged by one period to avoid simultaneity. The coefficient of interest is  $\delta$ . It reveals whether banks subject to the tax changed their behavior significantly after the regulatory change compared with banks that fall below the contribution threshold.<sup>12</sup>

The difference-in-difference approach modeled in Eq. (1) requires two conditions to be fulfilled. First, the introduction of the bank levy should not have been anticipated by the banks. Otherwise, they could have adjusted their balance sheets *before* the introduction of the tax to pay smaller contributions or to evade the tax entirely. We exploit the uncertainty surrounding the implementation of the tax, in terms of the banks that would be covered and the precise specification of the tax payments. In addition, the levy was applied retrospectively to banks' balance sheets (Section 2.1).

Second, we must assume that differences in the means between the control and the treatment group would have remained constant *without* this regulatory change. In the absence of the “treatment”, the trend between the two groups should have remained the same. Hence, any differences in the behavior of banks in the control versus treatment group should be due solely to the tax. This common trends assumption cannot be tested; however, according to Fig. 3, before the introduction of the levy, the loan volumes and interest rates of banks in both control and treatment group evolved similarly in the period underlying our regression analysis (2008–2011), which supports the common trend assumption. Furthermore, banks in the control and the treatment group

<sup>11</sup> We have also related the bank levy to further variables capturing banks' riskiness like the Zscore but did not find any relevant correlation suggesting that the regulator's choice of the design of the tax is the key driver of levy payments.

<sup>12</sup> The fact that only banks with contribution-relevant liabilities have to make payments as well as the progressivity of the tax rate could be exploited in a regression discontinuity design. We do not make use of this because we have too few observations in a reasonable distance around the thresholds.

**(a) Loan volumes****(b) Loan rates**

**Fig. 3.** Time trends in loan volumes, loan and deposit rates. This figure compares the average pattern of (a) newly issued loans and total lending, (b) loan rates, and (c) deposit rates for the sample of banks reporting to the MFI interest rate statistics over 2003–2011. The series are normalized (2010=100). *Control group* refers to banks with contribution-relevant liabilities smaller than or equal to €300 million. *Treatment group* contains banks that must pay taxes on their contribution-relevant liability positions. Panel (a) shows the average pattern for the log of newly issued loans (in thousand €) and the log of the total loan volume (in thousand €) for the control and the treatment group. Panel (b) refers to average interest rates (%) on new loans with different maturities. Panel (c) corresponds to average interest rates (%) on new deposits with different maturities. Source: Deutsche Bundesbank, MFI interest rate statistics and monthly balance sheet statistics, own calculations.

show ideally similar characteristics. A comparison of the explanatory variables for banks in the treated and control group revealed substantial homogeneity between the two groups. The only exception is the variable total assets as banks in the control group are, on average, smaller.<sup>13</sup>

The bank levy was introduced as part of the German Bank Restructuring Act (GBRA). The GBRA contains two additional elements besides the establishment of a restructuring fund that could affect banks differently and thus constitute confounding factors.

The Credit Institution Reorganization Act specifies how to proceed to recover and reorganize credit institutions in case of distress. The Amendments to the Banking Act introduce additional supervisory measures to deal with distressed banks. While the levy applies to all banks, the other measures are mostly activated in case a (systemically important) bank enters into serious distress. To control for remaining differences across the treated and control group as well as confounding factors that affected all banks similarly, our empirical model allows for time and bank fixed effects as well as bank-specific controls.

Tables 6–8 show the results for estimating Eq. (1) and pooling the data across all banks reporting to the MFI interest rate

<sup>13</sup> These tables can be obtained from the authors on request.



## (c) Deposit rates

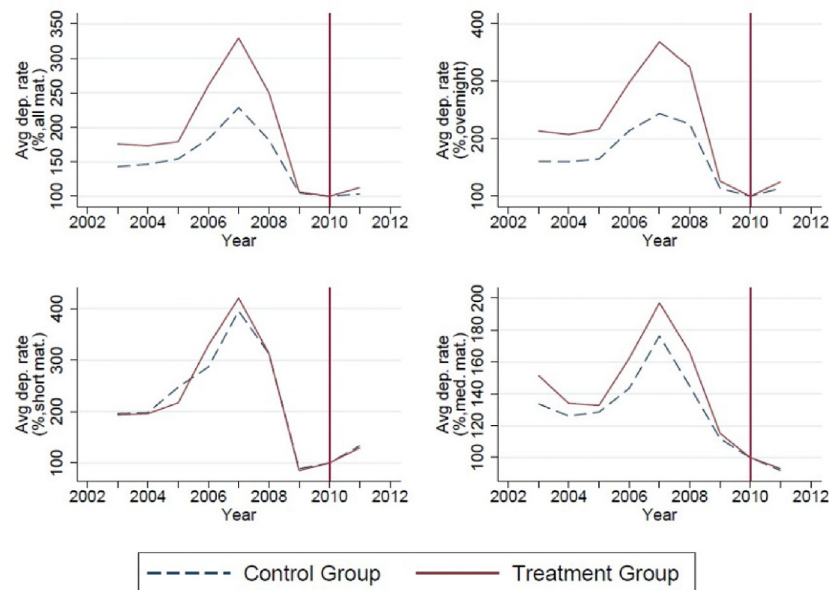


Fig. 3. Continued

**Table 6**  
Baseline regression results: loan volumes.

	(1) New loans (log)	(2) Loans (log)	(3) Loans/assets	(4) Loans (YoY change)	(5) New loans households (log)	(6) New loans firms (log)
Bank levy (0,1)	0.060 (0.173)	−0.061** (0.025)	−0.011 (0.010)	−0.019 (0.013)	0.299 (0.225)	0.099 (0.366)
Log total assets	−0.443 (1.541)	−0.907 (0.807)	−0.469*** (0.177)	−0.384 (0.845)	0.028 (2.748)	0.031 (2.340)
Log total assets <sup>2</sup>	0.061 (0.076)	0.067 (0.043)	0.023*** (0.009)	0.008 (0.042)	0.041 (0.136)	0.053 (0.112)
Tier 1 capital ratio	0.592 (1.842)	−0.492 (0.562)	−0.564*** (0.215)	−0.011 (0.521)	1.095 (5.367)	2.194 (2.066)
NPL ratio	−0.437 (0.734)	−0.243 (0.383)	−0.133 (0.153)	−0.411* (0.239)	−4.850** (2.293)	−0.034 (0.814)
Cost-to-income ratio	−1.136** (0.492)	−0.353*** (0.127)	−0.009 (0.084)	0.100 (0.190)	−1.354 (1.144)	−0.932 (0.603)
RoA	20.234 (16.052)	6.532** (2.674)	1.805* (1.011)	3.555 (2.160)	17.669 (19.418)	23.628 (19.441)
Liquidity ratio	−1.214 (1.405)	−0.030 (0.261)	0.402 (0.288)	−0.149 (0.363)	−0.372 (2.079)	0.029 (1.351)
Merger dummy	0.148 (0.101)	0.111** (0.048)	0.028 (0.018)	0.136*** (0.049)	0.577*** (0.201)	0.195 (0.119)
Constant	13.115 (8.064)	18.304*** (3.712)	2.957*** (0.921)	2.767 (4.312)	7.577 (14.408)	8.783 (12.211)
Observations	464	464	464	464	402	449
R <sup>2</sup>	0.067	0.426	0.275	0.194	0.191	0.061
Number of banks	162	162	162	162	141	159

This table shows the regression results of the estimation specified in Eq. (1). The estimations are based on the sample of banks that report to the MFI interest rate statistics and cover 2008–2011. The dependent variable is either newly granted loans (“New loans”) or the volume of existing loans (“Loans”). “New loans households (firms)” refers to new loans to households (to non-financial firms). The effect of the bank levy (“Bank levy (0/1)”) is the coefficient on the dummy “Charged Bank \* After2010,” equal to 1 in the year 2011 if the bank had contribution-relevant liabilities higher than €300 million. Total assets are expressed in million €. The independent variables comprise the CAMEL variables, as defined in Section 3.3, included with a lag. The merger dummy is equal to 1 if a merger took place in a given year and 0 otherwise. Time and bank fixed effects are included but not reported. The standard errors are robust to heteroskedasticity. \*, \*\*, \*\*\* indicate significance at the 10%, 5%, and 1% levels, respectively.

statistics. Wherever possible, data are broken down by sector (households, firms) and maturity. Table 6 shows the baseline regression results for loan volumes. The levy has a negative and significant effect, but only on the stock of loans.

How can we reconcile a negative effect of the levy on total loans with an insignificant impact on new loans? One explanation is that new loans (i.e. flows) are more volatile than total loans (i.e. stocks). Hence, even if the downward adjustment

in the levels of loans has been associated with a negative flow of new loans, this effect might not be statistically significant due to a high volatility of new loans. A second explanation is that the stock of loans would decline if loans that expire are not replaced by new loans. A downscaling of activities can thus occur even if the volume of new loans being issued does not change with the introduction of the levy and in comparison to the control group.

**Table 7**  
Baseline regression results: loan rates.

	(1) All maturities	(2) Short-term	(3) Medium-term	(4) Long-term	(5) All maturities households	(6) All maturities firms
Bank levy (0,1)	0.305 (0.198)	0.073 (0.263)	0.131 (0.285)	0.131 (0.187)	−0.123 (0.421)	0.313 (0.202)
Log total assets	4.468 (3.756)	6.705* (4.047)	−1.916 (3.677)	0.638 (2.715)	17.988*** (3.112)	4.828 (3.406)
Log total assets <sup>2</sup>	−0.215 (0.159)	−0.270 (0.164)	0.073 (0.176)	−0.054 (0.140)	−0.968*** (0.141)	−0.193 (0.133)
Tier 1 capital ratio	−0.383 (3.454)	−4.954 (3.133)	0.791 (4.532)	−0.238 (2.519)	−4.582 (6.588)	1.303 (2.346)
NPL ratio	−0.749 (2.444)	−0.628 (4.220)	−5.744 (4.133)	−1.577 (2.046)	−8.099 (4.995)	2.005 (2.152)
Cost-to-income ratio	0.637 (0.932)	0.654 (0.664)	−0.158 (1.376)	−2.235 (1.646)	1.119 (1.775)	0.724 (0.694)
RoA	−21.266 (27.847)	15.728 (21.307)	11.281 (32.578)	−34.000 (22.373)	−17.636 (46.460)	1.484 (19.382)
Liquidity ratio	−3.853* (2.270)	−1.534 (3.225)	−5.549* (3.086)	−1.968 (2.344)	−2.543 (3.085)	−25.619* (2.069)
Merger dummy	0.176 (0.246)	0.280 (0.189)	0.518 (0.366)	−0.090 (0.242)	0.034 (0.478)	0.139 (0.215)
Constant	−19.389 (21.569)	−35.484 (23.275)	16.377 (19.582)	5.719 (13.847)	−76.335*** (17.431)	−25.402 (20.291)
Observations	457	428	438	439	385	427
R <sup>2</sup>	0.057	0.271	0.094	0.248	0.107	0.089
Number of banks	160	150	155	156	137	154

This table shows the regression results of the estimation in Eq. (1). The estimations are based on the sample of banks that report to the MFI interest rate statistics and cover 2008–2011. The dependent variable is the interest rate charged on newly granted loans for different maturities and sectors: short-term: < 1 year; medium-term: ≥ 1 year and < 5 years; long-term: ≥ 5 years and < 10 years. The effect of the bank levy ("Bank levy (0/1)") is the coefficient on the dummy "Charged Bank \* After2010," which is equal to 1 in 2011 if the bank had contribution-relevant liabilities higher than €300 million. Total assets are expressed in million €. The independent variables comprise the CAMEL variables, defined in Section 3.3, included with a lag. The merger dummy is equal to 1 if a merger took place in a given year and 0 otherwise. Time and bank fixed effects are included but not reported. The standard errors are robust to heteroskedasticity. \*, \*\*, \*\*\* indicate significance at the 10%, 5%, and 1% levels, respectively.

Tables 7 and 8 show how banks adjust their pricing policies in response to the levy.<sup>14</sup> With regard to loan rates, there is no significant effect (Table 7). The picture for deposit rates looks different. Here, we find a positive and significant effect on deposits of firms (Table 8). Banks being affected more by the levy increase rates on newly received firm deposits as compared to the control group. If banks would aim at increasing their interest rate spreads, they would have to lower rather than to increase deposit rates. Our results are hence consistent with an interpretation of banks having the longer-run objective to shift their funding sources away from those funds affected by the levy towards funding sources not affected such as deposits.

Most control variables are insignificant and differences across banks are absorbed largely by the bank fixed effects. If anything, more profitable banks lend more. The higher the share of non-performing loans in the portfolio and the less efficiently a bank is managed, which implies a higher cost-to-income ratio, the lower are loans. Regarding interest rates, larger banks charge higher loan rates and pay lower deposit rates. The effect is non-linear, and it reverses for the largest banks.

In sum, the levy has negative effects on total loan supply and we find some evidence for an increase in deposit rates offered to firms. However, banks do not adjust their rates charged on new loans.

#### 4.2.2. Impact of the size of the bank levy

Given that the quality of difference-in-difference estimations depends on the comparability between control and treated banks, we refine our sample to cover only larger banks that have to pay the levy. This eliminates possible confounding factors such as other regulatory changes that affect small and large banks differently. We

now ask whether, within the group of banks that pay the levy, those that are charged more behave differently from those that are charged less. Like this, we test whether differences in the responses of banks to the levy are linked to the absolute size of the payment.

More specifically, we compare differences in the adjustment across banks that meet different thresholds for contribution-relevant positions. Thereby, we focus only on banks with contribution-relevant liabilities higher than €300 million. Otherwise, the identification is identical. The regression equation is now given by:

$$y_{it} = \alpha_i + \gamma_t + \delta * \text{Charged Bank}_{high} * \text{After 2010} + \beta'x_{it-1} + \varepsilon_{it} \quad (2)$$

Here though, our interest is in the coefficient  $\delta$  of the interaction term  $\text{Charged Bank}_{high} * \text{After 2010}$ , where  $\text{Charged Bank}_{high}$  is an indicator variable that takes a value of 1 if the bank meets the contribution threshold above €10 billion or 0 if the bank's contribution-relevant liabilities are higher than €300 million but smaller than or equal to €10 billion. Alternatively, we could control directly for the size of the tax payment. However, as we lack full information on the relevant positions to be taxed, doing so might cause a measurement bias.

The effects of the levy on loan volumes are shown in Table 9. We find a negative and significant impact of the levy on total loan supply: Banks with contribution-relevant liabilities of more than €10 billion provide relatively fewer loans than banks with liabilities below this threshold. The coefficient estimate for log loans (−0.063) indicates that loans increased, on average, by 6.1% less for banks subject to higher tax rates than for banks with low contribution-relevant liabilities.<sup>15</sup>

<sup>14</sup> Due to the level-log specification the coefficient on log(Total Assets) has to be divided by 100 to obtain the effect on the level of loan rates (Table 7) and deposit rates (Table 8).

<sup>15</sup> Following Halvorsen and Palmquist (1980), the percentage effect is  $(\exp(\delta) - 1) * 100$ .

**Table 8**

Baseline regression results: deposit rates.

	(1) All maturities	(2) Overnight	(3) Short-term	(4) Medium-term	(5) All maturities households	(6) All maturities firms
Bank levy (0,1)	0.153 (0.115)	0.023 (0.043)	−0.039 (0.155)	0.012 (0.127)	0.093 (0.161)	0.533** (0.265)
Log total assets	−5.255*** (1.720)	−0.460 (0.723)	−2.004 (1.359)	−1.347 (2.106)	−3.063 (2.059)	−2.443 (1.976)
Log total assets <sup>2</sup>	0.196*** (0.074)	0.028 (0.033)	0.064 (0.057)	0.068 (0.106)	0.101 (0.092)	0.074 (0.084)
Tier 1 capital ratio	0.145 (1.663)	1.062 (1.315)	−1.121 (1.724)	1.208 (2.397)	−0.239 (1.914)	−1.232 (1.850)
NPL ratio	2.587* (1.438)	7.574 (4.819)	0.144 (1.130)	0.386 (1.697)	2.067 (1.646)	−0.722 (1.335)
Cost-to-income ratio	−1.107** (0.540)	−0.467 (0.329)	−0.171 (0.409)	−0.871 (0.762)	−0.924 (0.616)	−0.187 (0.602)
RoA	−15.050 (15.702)	12.767* (6.649)	−19.555 (11.843)	−22.491 (22.014)	−12.678 (19.201)	−8.864 (12.170)
Liquidity ratio	0.616 (1.619)	−0.972 (0.683)	1.406 (2.258)	0.076 (1.684)	1.520 (1.788)	2.247 (1.826)
Merger dummy	−0.128 (0.141)	−0.114 (0.153)	−0.010 (0.099)	−0.138 (0.166)	−0.248* (0.142)	−0.146 (0.156)
Constant	33.360*** (9.798)	2.457 (4.438)	14.115* (7.850)	9.550 (10.633)	21.516* (11.355)	17.285 (11.300)
Observations	444	443	414	418	434	404
R <sup>2</sup>	0.126	0.380	0.405	0.185	0.059	0.250
Number of banks	156	152	143	153	152	148

This table shows the regression results of the estimation specified in Eq. (1). The estimations are based on the sample of banks that report to the MFI interest rate statistics and cover 2008–2011. The dependent variable is the interest rate paid for newly received deposits for different maturities and sectors: overnight, short-term: < 1 year; medium-term: ≥ 1 year. The effect of the bank levy ("Bank levy (0/1)") is the coefficient on the dummy "Charged Bank \* After2010," which is equal to 1 in 2011 if the bank had contribution-relevant liabilities higher than €300 million. Total assets are expressed in million €. The independent variables comprise the CAMEL variables, as defined in Section 3.3, included with a lag. The merger dummy is equal to 1 if a merger took place in a given year and 0 otherwise. Time and bank fixed effects are included but not reported. The standard errors are robust to heteroskedasticity. \*, \*\*, \*\*\* indicate significance at the 10%, 5%, and 1% levels, respectively.

**Table 9**

Regression results: size effect of bank levy on loan volumes.

	(1) New loans (log)	(2) Loans (log)	(3) Loans/assets	(4) Loans (YoY change)	(5) New loans households (log)	(6) New loans firms (log)
Bank levy <sub>high</sub> (0, 1)	0.042 (0.127)	−0.063*** (0.024)	−0.004 (0.010)	−0.013 (0.030)	−0.057 (0.241)	0.099 (0.137)
Log total assets	0.139 (1.806)	−0.519 (0.821)	−0.323 (0.210)	−0.643 (0.981)	0.263 (2.924)	−0.061 (2.167)
Log total assets <sup>2</sup>	0.034 (0.086)	0.048 (0.042)	0.016 (0.010)	0.019 (0.048)	0.033 (0.143)	0.053 (0.107)
Tier 1 capital ratio	0.245 (2.396)	−1.032** (0.470)	−0.757*** (0.245)	0.193 (0.661)	1.657 (6.863)	1.447 (2.444)
NPL ratio	−0.458 (0.711)	−0.087 (0.339)	−0.115 (0.168)	−0.420* (0.239)	−5.082** (2.339)	0.083 (0.789)
Cost-to-income ratio	−1.006* (0.590)	−0.322** (0.129)	−0.003 (0.078)	0.120 (0.219)	−1.488 (1.289)	−1.164* (0.628)
RoA	11.575 (15.696)	6.923** (2.714)	1.495 (1.029)	4.098* (2.392)	17.881 (20.391)	8.228 (17.572)
Liquidity ratio	−1.514 (1.515)	0.010 (0.270)	0.499 (0.304)	−0.225 (0.396)	−1.259 (2.392)	0.223 (1.304)
Merger dummy	0.157 (0.106)	0.099** (0.042)	0.028 (0.018)	0.129*** (0.049)	0.592*** (0.210)	0.187 (0.119)
Constant	10.157 (9.638)	16.534*** (3.965)	2.242** (1.129)	4.198 (5.018)	6.499 (15.199)	10.105 (11.123)
Observations	417	417	417	417	359	405
R <sup>2</sup>	0.068	0.463	0.305	0.203	0.186	0.076
Number of banks	145	145	145	145	126	142

This table shows the regression results of the estimation specified in Eq. (2). The estimations are based on the sample of banks that report to the MFI interest rate statistics and cover 2008–2011. The sample is restricted to MFI banks that had more than €300 million of contribution-relevant liabilities. The dependent variable is either newly granted loans ("New loans") or the volume of existing loans ("Loans"). "New loans households (firms)" refers to new loans to households (to non-financial firms). The effect of the bank levy ("Bank levy<sub>high</sub> (0/1)") is the coefficient on the dummy "Charged Bank<sub>high</sub> \* After2010," which is equal to 1 in 2011 if the bank had contribution-relevant liabilities higher than €10 billion and 0 if the bank's contribution-relevant liabilities were greater than €300 million but less than or equal to €10 billion. Total assets are expressed in million €. The independent variables comprise the CAMEL variables, as defined in Section 3.3, included with a lag. The merger dummy is equal to 1 if a merger took place in a given year and 0 otherwise. Time and bank fixed effects are included but not reported. The standard errors are robust to heteroskedasticity. \*, \*\*, \*\*\* indicate significance at the 10%, 5%, and 1% levels, respectively.

**Table 10**  
Regression results: size effect of bank levy on loan rates.

	(1) All maturities	(2) Short-term	(3) Medium-term	(4) Long-term	(5) All maturities, households	(6) All maturities, firms
Bank levy <sub>high</sub> (0,1)	0.030 (0.145)	−0.067 (0.138)	0.092 (0.235)	−0.159 (0.208)	−0.031 (0.362)	0.087 (0.121)
Log total assets	4.458 (4.718)	8.601* (4.357)	−5.757 (4.288)	−0.679 (3.215)	15.799*** (3.312)	5.475 (4.018)
Log total assets <sup>2</sup>	−0.219 (0.200)	−0.346* (0.180)	0.234 (0.193)	−0.006 (0.163)	−0.874*** (0.147)	−0.219 (0.159)
Tier 1 capital ratio	−2.433 (4.052)	−5.626* (3.277)	2.385 (5.239)	−0.799 (3.086)	−3.979 (6.828)	0.150 (2.580)
NPL ratio	−0.887 (2.582)	−0.160 (4.246)	−7.041* (3.930)	−1.403 (2.092)	−8.761* (4.999)	1.828 (2.287)
Cost-to-income ratio	0.764 (1.066)	0.877 (0.753)	0.217 (1.359)	−1.812 (1.707)	1.826 (1.987)	0.643 (0.810)
RoA	−22.708 (29.625)	14.687 (22.982)	15.873 (34.050)	−25.893 (23.992)	−19.103 (49.293)	−0.298 (20.149)
Liquidity ratio	−3.582 (2.456)	−2.664 (3.254)	−6.694** (3.381)	−1.415 (2.598)	−2.714 (3.209)	−3.616* (2.024)
Merger dummy	0.176 (0.259)	0.319 (0.211)	0.467 (0.369)	−0.140 (0.242)	0.015 (0.516)	0.180 (0.221)
Constant	−18.983 (26.987)	−46.792* (25.048)	37.424 (23.643)	13.317 (16.340)	−65.167*** (19.141)	−29.143 (23.711)
Observations	412	392	396	396	346	392
R <sup>2</sup>	0.060	0.286	0.116	0.244	0.118	0.102
Number of banks	143	136	139	141	122	138

This table shows the regression results of the estimation specified in Eq. (2). The estimations are based on the sample of banks that report to the MFI interest rate statistics and cover 2008–2011. The sample is restricted to MFI banks that had more than €300 million of contribution-relevant liabilities. The dependent variable is the interest rate charged on newly granted loans for different maturities and sectors: short-term: < 1 year; medium-term: ≥ 1 year and < 5 years; long-term: ≥ 5 years and < 10 years. The effect of the bank levy (“Bank levy<sub>high</sub> (0/1)”) is the coefficient on the dummy “Charged Bank<sub>high</sub> \* After2010,” which is equal to 1 in 2011 if the bank had contribution-relevant liabilities higher than €10 billion and 0 if its contribution-relevant liabilities were greater than €300 million but less than or equal to €10 billion. Total assets are expressed in million €. The independent variables comprise the CAMEL variables, as defined in Section 3.3, included with a lag. The merger dummy is equal to 1 if a merger took place in a given year and 0 otherwise. Time and bank fixed effects are included but not reported. The standard errors are robust to heteroskedasticity. \*, \*\*, \*\*\* indicate significance at the 10%, 5%, and 1% levels, respectively.

With regard to loan pricing, there is again no significant effect (Table 10). For deposit rates, we confirm that the effect on the structure of funding dominates (Table 11). Banks being affected more by the levy increase rates on newly received deposits compared to the control group. This holds in particular for deposits obtained from households. In contrast to the previous results, deposit rates paid to non-financial firms are not significant. If we exclude banks that have to make levy payments but are subject to the acceptability limit and thus a special tax treatment, also the rate paid to deposits held by firms is positive and significant. This suggests that banks subject to the acceptability limit may disturb our results. We thus report robustness tests of the baseline model (Eq. (1)) excluding banks for which the acceptability limit applies from the sample in Section 4.3.2. Results for Eq. (2) excluding those banks are available upon request.

#### 4.3. Robustness tests

We first analyze whether banks' responses to the levy are heterogeneous across banking groups or conditional on certain bank characteristics. Second, we verify the robustness of our results to changes in the methodology and sample composition. All robustness tests start from the model specified in Eq. (1) if not stated otherwise. The regression tables are reported in Tables B1–B6 in the supplementary materials.

##### 4.3.1. Heterogeneous effects of the bank levy

The response of banks' behavior might differ depending on the group of bank they belong to. For example, savings banks have a higher depositor base and thus a lower tax burden. Thus, we first include only commercial banks (panel a of Tables B1–B3). Second, we restrict the analysis to savings banks and credit unions including their central institutions (panel b of Tables B1–B3). This has,

in addition, the advantage that control and treated group become more homogeneous. The disadvantage is that the sample size decreases. For both types of banks, we confirm our results for the loan stock (Table B1) and the deposit rate (Table B3), while the qualitative effect is stronger for commercial banks.

To evaluate whether banks respond differently to the levy depending on their characteristics, we interact the bank levy dummy variable with a variable indicating whether a bank lies above or below the median value of the distribution of the regression sample. The indicator variable takes on a value of 1 if the bank's average size (profitability) over the sample period is larger than the median value of all banks in the sample, and 0 otherwise (panels c and d of Tables B1–B3). The coefficient of the interaction term tells whether affected banks that lie on average above the median value of all banks behave differently than affected banks that lie below. The results show that heterogeneities matter.

For loans as dependent variable, profitability causes significantly different effects and more profitable banks reduce lending by less: the bank levy dummy variable has a negative effect whereas this effect is mitigated for banks with on average higher profitability when looking at the interaction with the return on assets ratio (Table B1, panel d). The change in the loan stock becomes significant in the interaction models. For example, including an interaction between the indicator variable derived from the Tier 1 capital ratio and the bank levy dummy variable, the bank levy shows a negative effect on the change in the loan stock. This negative effect is, however, significantly mitigated for banks with an on average higher Tier 1 capital ratio.<sup>16</sup>

<sup>16</sup> For brevity, the results when the bank levy dummy variable is interacted with the control variables other than bank size and profitability are not reported but can be obtained upon request.



**Table 11**

Regression results: size effect of bank levy on deposit rates.

	(1) All maturities	(2) Overnight	(3) Short-term	(4) Medium-term	(5) All maturities, households	(6) All maturities, firms
Bank levy <sub>high</sub> (0,1)	0.193* (0.102)	−0.071 (0.067)	−0.029 (0.089)	−0.425 (0.289)	0.251** (0.117)	0.108 (0.104)
Log total assets	−5.424*** (1.947)	−0.185 (0.918)	−3.524** (1.450)	−3.546 (2.332)	−4.215** (1.970)	−3.847** (1.926)
Log total assets <sup>2</sup>	0.202** (0.081)	0.014 (0.037)	0.127** (0.060)	0.160 (0.114)	0.149* (0.085)	0.138* (0.078)
Tier 1 capital ratio	−1.141 (2.099)	0.625 (1.608)	−0.986 (2.038)	2.264 (3.074)	−2.188 (2.497)	−0.371 (1.544)
NPL ratio	2.022 (1.543)	8.046 (4.991)	0.019 (1.205)	1.060 (1.789)	1.817 (1.741)	−1.833 (1.399)
Cost-to-income ratio	−1.243** (0.561)	−0.499 (0.361)	−0.223 (0.411)	−0.416 (0.909)	−1.296* (0.709)	−0.206 (0.503)
RoA	−15.503 (16.380)	12.075* (7.163)	−17.769 (12.410)	−6.178 (24.098)	−13.524 (20.074)	−8.710 (11.965)
Liquidity ratio	0.473 (1.690)	−1.099 (0.768)	1.975 (2.422)	−1.325 (1.648)	1.717 (1.898)	1.538 (1.825)
Merger dummy	−0.105 (0.142)	−0.134 (0.163)	−0.030 (0.095)	−0.221 (0.171)	−0.255* (0.132)	−0.114 (0.160)
Constant	34.860*** (11.232)	1.112 (5.757)	23.106*** (8.393)	20.929* (11.988)	28.637** (11.313)	24.731** (11.285)
Observations	397	400	377	371	387	374
R <sup>2</sup>	0.142	0.398	0.421	0.195	0.086	0.301
Number of banks	139	137	130	136	135	135

This table shows the regression results of the estimation specified in Eq. (2). The estimations are based on the sample of banks that report to the MFI interest rate statistics and cover 2008–2011. The sample is restricted to MFI banks that had more than €300 million of contribution-relevant liabilities. The dependent variable is the interest rate paid for newly received deposits for different maturities and sectors: overnight, short-term: < 1 year; medium-term: ≥ 1 year. The effect of the bank levy ("Bank levy<sub>high</sub> (0/1)") is the coefficient on the dummy "Charged Bank<sub>high</sub> \* After2010," which is equal to 1 in 2011 if the bank had contribution-relevant liabilities higher than €10 billion and 0 if its contribution-relevant liabilities were greater than €300 million but less than or equal to €10 billion. Total assets are expressed in million €. The independent variables comprise the CAMEL variables, as defined in Section 3.3, included with a lag. The merger dummy is equal to 1 if a merger took place in a given year and 0 otherwise. Time and bank fixed effects are included but not reported. The standard errors are robust to heteroskedasticity. \*, \*\*, \*\*\* indicate significance at the 10%, 5%, and 1% levels, respectively.

Controlling for heterogeneities among affected banks also results into partially significant results for the loan rate (Table B2). Again affected banks' profitability plays a role; banks with an on average higher profitability increase the loan rate by less, probably because they have a higher buffer to compensate increased funding costs by the levy. Also, banks subject to the levy with an on average lower Tier 1 capital ratio increase their loan rates by more. In contrast, for the deposit rate, the differential effect is not significant (Table B3).

#### 4.3.2. Further robustness tests

To verify whether our results are driven by the selection of the sample period, treatment date, or outlier cases, we conduct a final set of robustness tests. Results for loans as the dependent variable are shown in Table B4, for the loan rate in Table B5, and for the deposit rate in Table B6.

**Sample period:** In panel (a), we reduce the sample period to include only the year before (2010) and after (2011) the introduction of the tax payment. In this specification, we do not include the control variables or fixed effects. Instead, we now introduce a dummy for whether a bank is treated or not and a dummy which equals 1 after the introduction of the tax and 0 otherwise. The results confirm a negative effect of the bank levy on banks' total loan supply (Table B4).

**Region-year fixed effects:** In our baseline model, we included year fixed effects capturing general macroeconomic conditions. To account for the fact that banks are exposed to different regional macroeconomic factors, we exploit that we know the region (*Bundesland*) in which a bank is located. Thus, in panel (b), we take the baseline model and add region-year fixed effects. Controlling for time-varying effects specific to the region in which the bank is located, we again find a significant and negative effect of the bank levy on lending (Table B4). Also, the significantly positive effect on deposit rates to non-financial firms remains robust (Table B6).

**Anticipation effects:** Given that discussions about the introduction of the levy started in 2010, we cannot completely rule out that banks adjusted already in 2010 because they anticipated the levy. Thus, in panel (c), we change the treatment date to 2010 yielding slightly more pronounced results. Now, not only the loan stock obtains a significant coefficient but also the change in the loan stock (Table B4). Also, we obtain a significant coefficient for the loan rate that firms have to pay (Table B5). For the deposit rate, the coefficient of the bank levy dummy variable has gained in magnitude (Table B6). This might point into the direction of anticipation effects.

**Acceptability limit:** Banks that hit the acceptability limit receive a special treatment. They either have to make contributions equal to 20% of their annual earnings, or if those are lower than the minimum contribution, they have to pay 5% of the regularly calculated levy. Especially those banks that hit the upper limit might be inclined to respond differently to the levy because the levy imposes considerable burden on them relative to their earnings. To verify whether these banks drive our results, we run regressions excluding them from the sample (panel d). It can be seen that the results remain robust, with increased significance, for the loan stock (Table B4). Additionally, there is slight evidence that banks affected by the levy have incentives to increase the loan rate more than unaffected banks after the policy change (Table B5). This would be in line with related papers that document that taxes are shifted to banks' borrowers (Capelle-Blancard and Havrylychuk 2013). Hence, excluding the banks that hit the upper limit strengthens the results, most likely because we exclude outlier cases.

**Marginal tax rate:** To make use of the progressive tax rate, in panel (e), we interact the difference-in-difference dummy variable with the marginal tax rate ranging from 0.00% to 0.06%.<sup>17</sup> We

<sup>17</sup> We thank Olena Havrylychuk for this suggestion.

exclude banks that hit the upper limit because they receive a special treatment. Using the marginal tax rate is similar to studies on the effects of corporate income taxation and has also been applied by [Devereux et al. \(2015\)](#). Results confirm the negative response of affected banks compared to unaffected banks for the stock of loans. Also, the positive effect for deposit rates can be confirmed, but now also for deposit rates capturing deposits of all maturities and deposits received from households.

**Longer sample period:** Using a longer sample period (2003–2011) yields insignificant results for the baseline model (Eq. (1)) as well as the results for deposit rates differed when including only banks above the €300 million threshold (Eq. (2)). However, we also found a negative and significant effect on the total loan volume based on the model specified in Eq. (2). This deviation in results might be due to the more heterogeneous time window including both a crisis and non-crisis period. Also, there is less support for a common trend (Fig. 3). Thus, we do not report these results but they are available upon request.

## 5. Conclusion

This paper assesses effects of the German bank levy on bank lending and interest rates. The levy has been introduced in 2011. It aims at internalizing the systemic risk of banks and financing a bank restructuring fund. Our results show that the majority of German banks (77% of the total number of banks) were exempt from paying the tax. The bulk of the tax payments comes from large commercial banks and central institutions of savings banks and credit unions. Due to the progressivity of the tax rate, larger banks have to pay more, but tax payments are capped at 20% of annual earnings. This aspect of regulation in connection with low earnings in the aftermath of the crisis might explain that overall proceeds from the tax have been small, accounting for only 4.85% of the banking system's profits before taxes in 2011.

Regarding the effects of the bank levy on bank behavior, we do not find evidence for changes in the provision of new loans. However, banks affected by the levy respond by increasing their total supply of loans less than non-affected banks and by increasing interest rates on new deposit more than banks which do not have to pay the levy. A similar result emerges if we compare banks with a high tax base to those with a low tax base. These results suggest that banks react to increased funding costs by the levy in two ways. First, they decrease their total stock of loans whereas the provision of new loans remains unaffected. Second, banks try to attract deposits which are not subject to the tax by increasing deposit rates.

Finally, the design of the levy implies that banks' costs of wholesale funding increase. Thus, banks might have incentives to adapt their business model towards more equity and retail funding. First evidence suggests that banks did not change their funding structure in any significant way. However, these structural changes might rather take place in the longer run. This provides interesting avenues for future research.

## Acknowledgments

The hospitality of the research center of the Deutsche Bundesbank and access to its bank-level data are gratefully acknowledged. The authors thank Tim Adam, Martin Brown, Manuel Buchholz, Elena Carletti, Christoph Memmel, Tommaso Oliviero, participants of workshops and seminars at the CEPR/Deutsche Bundesbank/University of Bonn Conference on Regulating Financial Intermediaries, the CESifo Area Conference on Macro, Money & International Finance, the CESifo Group Seminar, the Deutsche Bundesbank, the Frankfurt School of Finance & Management, the Freie Universität Berlin, the Labex ReFi, the University of Magdeburg.

Particularly, we want to thank two anonymous referees for helpful and constructive comments. All errors and inconsistencies are solely our own. The views expressed in this paper are those of the authors and do not necessarily represent those of the Deutsche Bundesbank or the Eurosystem.

## Data appendix

The empirical results in this paper are based on bank-level data obtained from the *Deutsche Bundesbank*. The data are confidential and can be used on the premises of the *Deutsche Bundesbank* only. We resort to information on banks' regulatory capital, bank lending, banks' balance sheets, and banks' profit and loss accounts. Variables and definitions are listed below. More details on the calculation of the bank levy are provided in the [supplementary materials](#).

### Banking groups

**MFI banks:** Group of banks required to report in the context of the MFI interest rate statistics.

**Central institutions:** Central institutions of savings banks and credit unions.

**Mortgage banks:** Mortgage banks and building societies.

### Information used to calculate the bank levy

**Banks affected by the levy:** The levy applies to all credit institutions with a banking license, as specified in the German Banking Act (*Kreditwesengesetz*). Bridge banks, defined as banks established by the FMSA to resolve banks in distress, and development banks (*Förderbanken*) such as the Reconstruction Loan Corporation (KfW) are excluded from the levy. Because the levy is computed on the basis of non-consolidated, single-entity accounts, domestic and foreign branches of German banks are subject to it. The levy also applies to any subsidiary of foreign banks located in Germany with a German banking license. Foreign subsidiaries of German banks are excluded from the regulation, unless they fall under the classification of the KWG and hold a German banking license. Branches of non-German banks are exempted from the regulation if they belong to credit institutions in the European Economic Area (KWG, section 53b). In contrast, branches and subsidiaries of non-German, non-EU banks pursuant to the KWG section 53c are charged. To avoid double taxation of foreign branches of German banks abroad, Germany signed bilateral agreements with individual countries (e.g., the United Kingdom). Bank levy payments made in Germany thus are deductible from similar payments made abroad.

**Contribution-relevant liabilities:** First tax base of the bank levy; net liabilities of a bank computed according to RStruktFV, to which the respective tax rates are applied to obtain the first component of the bank levy.

**Derivatives:** Second tax base of the bank levy; amount of derivatives held by a bank; for the calculation of the bank levy, the amount of OTC derivatives held by a bank and reported to the BIS is used as a proxy.

### Dependent variables

**Newly issued loans:** New loans granted to households and/ or non-financial firms, in thousand € unless indicated otherwise.

**Loan stock:** Loans to the private sector (households and firms) excluding interbank loans, in thousand € unless indicated otherwise.

**Loan rates:** Volume-weighted interest rates charged on newly issued loans to the private sector (households and/ or non-financial firms).

**Deposit rates:** Volume-weighted interest rates paid for newly received deposits from the private sector (households and/ or non-financial firms).

#### *Bank-level explanatory variables*

**Total assets:** Sum of on-balance sheet items, in million € unless indicated otherwise.

**Tier 1 capital ratio:** Tier 1 capital over risk-weighted assets.

**Non-performing loans (NPL) ratio:** Non-performing loans over gross loan volume, where gross loan volume before 2009 is given by the gross loan volume, and after 2009, it is the sum of the net loan volume plus specific loan loss provisions plus general loan loss provisions plus untaxed general loan loss provisions plus direct write-offs. Non-performing loans before 2009 is the gross loan volume with specific loan loss provisions (excluding loans to financial institutions); after 2009, it is the sum of loans with latent risks.

**Cost-to-income ratio:** Degree by which operating expenses are covered by operating income, where costs are operating expenses, and income is operating income.

**Return on assets:** After-tax profit including extraordinary items plus taxes paid to total assets.

**Liquidity ratio:** Liquid assets over total assets held, where liquidity is cash plus central bank balances plus claims with banks repayable on demand plus securities eligible as collateral at central banks.

**Merger dummy:** Dummy variable is equal to 1 if a merger took place in a given year during the sample period and 0 otherwise.

#### **Supplementary materials**

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.jbankfin.2016.07.010](https://doi.org/10.1016/j.jbankfin.2016.07.010).

#### **References**

- Albertazzi, U., Gambacorta, L., 2010. Bank profitability and taxation. *Journal of Banking & Finance* 34 (11), 2801–2810.
- Arinaminpathy, N., Kapadia, S., May, R., 2012. Size and complexity in model financial systems. *PNAS* 109 (45), 18338–18343.
- Capelle-Blancard, G., Havrylchyk, O. (2013). Incidence of Bank Levy and Bank Market Power. CEPII Working Paper 2013 – 21.
- Chiorazzo, V., Milani, C., 2011. The impact of taxation on bank profits: evidence from EU banks. *Journal of Banking & Finance* 35, 3202–3212.
- Demirgüç-Kunt, A., Huizinga, H., 1999. Determinants of commercial bank interest margins and profitability: some international evidence. *World Bank Economic Review* 13 (2), 379–408.
- Demirgüç-Kunt, A., Huizinga, H., 2001. The taxation of domestic and foreign banking. *Journal of Public Economics* 79, 429–453.
- De Nicolò, G., Gamba, A., Lucchetta, M., 2012. Capital Regulation, Liquidity Requirements and Taxation in a Dynamic Model Of Banking. Deutsche Bundesbank, Research Centre Discussion Papers 10/2012.
- Deutsche Bundesbank (2004). The New MFI Interest Rate Statistics—Methodology For Collecting The German Data. Deutsche Bundesbank Monthly Report (January 2004). Frankfurt a. M.
- Deutsche Bundesbank (2011). Extended MFI Interest Rate Statistics: Methodology and First Results. Deutsche Bundesbank Monthly Report (June 2011). Frankfurt a. M.
- Devereux, M., Johannesen, N., Vella, J. (2015). Can Taxes Tame the Banks? Evidence From the European Bank Levies. Saïd Business School RP 2015–5.
- Drehmann, M., Tarashev, N., 2011. Systemic Importance: Some Simple Indicators. BIS quarterly review, Bank for International Settlements, March.
- Drehmann, M., Tarashev, N., 2013. Measuring the systemic importance of interconnected banks. *Journal of Financial Intermediation* 22 (4), 586–607.
- Freixas, X., Rochet, J.-C., 2013. Taming systemically important financial institutions. *Journal of Money, Credit and Banking* 45 (1), 37–58.
- Hahn, J.-H., Shin, H.S., Shin, K., 2013. Noncore bank liabilities and financial vulnerability. *Journal of Money, Credit and Banking* 45 (1), 3–36.
- Haldane, A., 2012. On being the right size. In: Speech given at the Institute of Economic Affairs' 22nd Annual Series, The 2012 Beesley Lectures at the Institute of Directors, Pall Mall, October 2012.
- Halvorsen, R., Palmquist, R., 1980. The interpretation of dummy variables in semilogarithmic equations. *The American Economic Review* 70 (3), 474–475.
- International Monetary Fund (IMF), 2010. Financial Sector Taxation: The IMF's Report to the G20 and Background Material. IMF, Washington DC.
- Laeven, L., Valencia, F., 2013. Systemic banking crises database. IMF Economic Review 61, 225–270.
- Perotti, E., Suarez, J., 2009. Liquidity Insurance for Systemic Crises CEPR Policy Insight No. 31, February.
- Perotti, E., Suarez, J., 2011. A Pigovian approach to liquidity regulation. *International Journal of Central Banking* 7 (4), 3–41.
- Reinhart, C.M., Rogoff, K.S., 2011. From financial crash to debt crisis. *American Economic Review* 101, 1676–1706.
- Reinhart, C.M., Rogoff, K.S., 2013. Banking crises: an equal opportunity menace. *Journal of Banking & Finance* 37 (11), 4557–4573.
- Schweikhart, F.H., Wahrenburg, M., 2013. The internalization of systemic risk: an analysis of bank levy schemes. In: Presented at the EFA 2013 Meetings. Gothenburg.
- Shin, H.S., 2010. Non-Core Liabilities Tax as a Tool For Prudential Regulation. Policy Memo <http://www.princeton.edu/~hsshin/www/NonCoreLiabilitiesTax.pdf>.