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**Spillovers of Banking Regulation:
The Effect of the German Bank Levy on
the Lending Rates of Regional Banks
and Their Local Competitors**

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Abstract

During the financial crisis numerous European governments decided to rescue domestic banks with public funds to prevent a collapse of the banking system. To internalize the public costs, bank levies have been introduced in many countries. This paper analyzes the German bank levy which was implemented from 2011 till 2014 and its effect on lending rates of regional banks. We examine not only if banks shift the cost of the levy to their customers' lending rates, but also whether there are spillovers to their local competitors. The German savings and cooperative banks are a perfect setting to study such effects as they only operate within well-defined regions, allowing us to identify their local competitors. Additionally, only some of them are subject to the levy due to a tax allowance. Further, with a market share of 42.8% in total, they are relevant. Firstly, we find that a bank that has to pay the bank levy raises its lending rate by about 0.14 percentage points. Secondly, we examine whether the increased lending rates of paying banks spill over to their local competitors. We find this indirect effect to be about one third of the size. Given an average lending rate of 4.96%, these effects are economically significant. Lastly, adverse effects of the levy on paying banks' loan supply growth are absorbed by their competitors to a certain extent.

JEL Classification: E43, G21, G28, R10

Keywords: Bank regulation; bank levy; regional spillover; lending rates

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1. Introduction

The high public costs of bank rescues have driven European politicians to implement policies to internalize the costs of banking crises. The direct fiscal costs of capital injections and asset reliefs in the banking sector are 4.6% of the GDP for European countries between 2008 and 2014 (European Commission, 2015). Laeven & Valencia (2013) estimate the fiscal costs of systematic banking crises to be 4.2% of GDP for advanced countries. In several European countries bank levies have been introduced which finance restructuring and resolution funds for credit institutions and investment firms with the objective to internalize the public fiscal costs of potential bank rescues (IMF, 2010; Perotti & Suarez, 2011). Bank levies work similar to a Pigouvian tax and usually target banks' balance sheet positions which are considered to be risky (Buch et al., 2016). Thereby, a levy also aims to reduce banks' risk positions. The German bank levy's tax base, for example, is calculated as total assets minus equity and customer deposits.¹ Therefore, bank levies increase the stability of an economy's banking sector by making risk taking for banks less worthwhile and by financing restructuring and resolution funds.

The question remains whether there are unwanted side effects. For instance, banks could shift the tax burden to customers by increasing their lending rates which in turn has a potential effect on growth. Slovik & Cournéde (2011) found that an increase of lending rates of 1% decreases annual GDP growth by 0.4% in the euro area. Using quarterly pre-Euro German nominal interest rates as an instrumental variable for other European countries' interest rates, di Giovanni et al. (2009) estimated that the causal effect of a 5% increase in interest rates is a contraction in annual real output growth of 2% to 3%. Exploring the connection between interest rates in major industrial countries and output growth in other countries, di Giovanni & Shambaugh (2008) showed that interest rates also have a contractionary effect on GDP growth in foreign countries. Next to the severe effects on GDP growth, there may also be spillover effects to competitors of levy paying banks. Aiyar et al. (2014b) found, for example, that there are spillovers of the UK bank-specific capital requirements to unregulated resident foreign branches. We want to tackle the question whether the German bank levy has such side effects. If, for example, banks which are not subject to the levy due to the levy's tax allowance adjust their lending rates due to spillover effects from their levy paying competitors, this would imply that also customers of non-targeted banks need to pay more for their loans.

As we want to study potential local spillovers, we concentrate on savings and cooperative banks which operate in well-defined regions. As these banks do not compete with other banks of the same banking group, we only need to identify which banks of the other banking group operate within their

¹Furthermore, the German bank levy taxes the derivative exposure of banks. However, we refrain from focusing on this part of the bank levy as no data are available for German savings and cooperative banks. Further, these banking groups are not very active in derivative trading.

region. For example, savings banks are usually bigger than cooperative banks and are often active only in a single county. On average they have three cooperative banks operating in the same county which we then define as their competitors. We use a freely available overview map² of the savings banks' regional markets and assign a cooperative banks as a competitor if it has branches within a savings bank's market. Cooperative banks provide locational information about their branches on their websites usually in a unified design. With respective market shares in loans to resident non-banks of 25.9% and 16.9% at the end of 2014, savings and cooperative banks are relevant for the German economy. We neglect other competitors such as big private banks which are active throughout Germany as we have no data about their regional operations. We assume, however, that this does not bias our estimates as it is unlikely that these banks, for example, have started to strengthen their operations in regions with levy paying regional banks since the introduction of the German bank levy.

The German bank levy was implemented into law in 2011. In general, it applies to all German banks. The tax base, defined as contribution-relevant liabilities, is calculated as a bank's total liabilities minus equity and customer deposits. Banks are exempted from the levy if their tax base is below €300 million. The tax rate increases progressively for tax bases above this limit. Furthermore, there is a minimum charge of 5% of the calculated annual contribution even if a bank has no surplus and a cap of 20% of annual net income. In 2015 it was replaced by the European bank levy. About half of the savings banks and 5% of the cooperative banks had to pay the bank levy. The others were exempted as their contribution-relevant liabilities were below the €300 million tax allowance threshold. Therefore, about 23% of the savings banks and 75% of the cooperative banks had a levy paying competitor. We use this information to estimate whether banks that had to pay the bank levy beginning with 2011 adjust their lending rates. To examine if there were also spillover effects to local competitors, we incorporate a dummy variable which captures whether a competitor was paying the bank levy. A bank could have taken advantage of the increased lending rates of its competitor and raised its own rates to maximize profits. For customers of a non-paying bank, this would imply that they were indirectly affected by the German bank levy and for customers of a paying bank with paying competitors that the effect was strengthened.

Our contribution to the literature is to show that banking regulations have spillovers to banks which are not actually targeted by the legislature. Literature on spillovers of regulations, such as Aiyar et al. (2014a) and Aiyar et al. (2014b), already exists. They use the UK bank-specific capital requirements to study the transmission effects of lending to foreign countries and the spillovers to unregulated resident foreign branches, respectively. Also, the German and other European bank levies have already been examined in several papers. Buch et al. (2016) find that German banks decreased their loan volumes and increased their deposit rates in 2011 if they were subject to the

²Available online: http://de.wikipedia.org/wiki/Liste_der_Sparkassen_in_Deutschland

bank levy. They use a difference-in-difference approach which uses banks which were not subject to the levy as the control group. Devereux et al. (2015) find that European banks which are exposed to a bank levy increase their equity financing and at the same time the riskiness of their assets using bank-level data from Bankscope for European banks of the 2004-2012 period. They shift the risk from the liability side of their balance sheets to the asset side. Kogler (2016) present a Monti-Klein model that predicts that banks shift the burden of a bank levy to borrowers by raising lending rates. Then, he shows that this prediction can be verified using a data set from the 2007-2013 period for European banks similar to Devereux et al. (2015). However, our paper is the first to study spillover effects of bank levies from levy paying banks to local competitors.

The outline of this work is as follows: Firstly, an introduction to the German banking system, the German bank levy and the data used is given. Secondly, the empirical methodology and evidence are presented with an additional chapter on the robustness of our results. Lastly, we conclude our results.

2. The German Banking System

2.1. Savings and Cooperative Banks

In Germany the banking system consists of three pillars. The three banking groups - private, savings and cooperative banks - compete with each other. Private banks are usually described as profit-maximizing while savings and cooperative banks are legally bound to also pursue social and welfare-enhancing goals. Furthermore, the latter two banking groups are more focused on traditional banking business models such as lending. Savings and cooperative banks are by law or by articles of association, respectively, bound to operate only within specific regions. Of the private banks only some can be specified as regional banks with a focus on traditional banking business models. In 2011 there were 426 savings banks, about 1,100 cooperative banks and 218 private banks operating in Germany. The savings and cooperative banks had a market share in loans to resident non-banks in the end of 2014 of 25.9% and 16.9%, respectively, according to Bundesbank data.

The savings banks sector is structured in three levels. At the highest level there is a nation-wide association, the *Deutscher Sparkassen- und Giroverband*, which is responsible for the representation of savings banks in the public and in politics. At the federal level there are several *Landesbanken* which act as central banks which manage liquidity and take operative task as cross-country lending for the individual savings banks (Gropp et al., 2014). Lastly, savings banks operate autonomously from the *Landesbanken*, but are to a certain extent under the control of the county governments. For example, counties have the right to be represented in the board of directors and the loan committee which decides over large and risky loans (Englmaier & Stowasser, 2013).

Cooperative banks are owned by their members. Each of their customers can buy partnership shares. They have two banks which act as their central banks, comparable to the *Landesbanken*, and

a federal association, the *Bundesverband der Deutschen Volksbanken und Raiffeisenbanken*. Both banking groups have their own insurance fund to guarantee deposits. In case of a potential default, banks usually merge with a healthy neighboring bank of the same group (Koetter & Dam, 2012). The main clientele for both banking groups are private customers and local businesses (Hakenes & Schnabel, 2011; Hakenes et al., 2015). In particular, these banks are the main lenders for SMEs which have a share of about 40% of the business volume and employ two thirds of the German working force. A more detailed overview about the cooperative and savings banks groups can be found in Englmaier & Stowasser (2013).

2.2. The German Bank Levy

The German bank levy was introduced in 2011 in the wake of experiences during the financial crisis. The taxes generated by the levy are used to finance a restructuring fund, *Restrukturierungsfonds*, which can be used to rescue systematic banks to ensure the stability of the banking system in crisis times. As only systematic banks are rescued, there is a tax allowance to relieve smaller banks from the tax burden. Therefore, only about half of the savings banks and 5% of the cooperative banks must pay the bank levy (Buch et al., 2016). We use this feature to study the direct effects of the bank levy as well as the spillover effect to competitors.

Next, we present how a bank's contribution to the *Restrukturierungsfonds* is calculated. The aim of the bank levy was to penalize risk taking and to internalize banks' systematic risk. The levy's calculation is based on the contribution-relevant liabilities of the previous year's balance sheet. Therefore, the contribution-relevant liabilities in 2011 are based on the 2010 balance sheet. They are calculated as total liabilities minus a bank's equity and customer deposits. Equity enters the equation negatively to avoid increasing the burden of building up equity. Deposits are exempted as banks are already paying for them to cover deposit insurance. The contribution-relevant liabilities are then taxed with a rate which increases progressively for liabilities over the threshold of the tax allowance of €300 million. In general one can say that banks exempted from the levy are small. The rate is 0.0002 until the next threshold of €10 billion is reached where the rate increases to 0.0003. No savings or cooperative banks reach the next threshold of €100 billion. Furthermore, two more rules apply to the tax. Firstly, a bank does not need to pay more than 20% of its annual earnings. Secondly, even if a bank does not have an annual surplus, a minimum contribution of 5% of the calculated annual contribution has to be paid. For more details we refer to Buch et al. (2016).

3. Data, Statistics and Figures

We have obtained unconsolidated financial data for 1,453 German savings and cooperative banks from Bankscope. The period covered is 2007 till 2014 such that we have pre-bank levy years as

well as the 2011-2014 period where the German bank levy was in place. In 2015 it was replaced by the European bank levy. For our time period Bankscope includes nearly all German savings and cooperative banks. For earlier years the coverage is more limited (Englmaier & Stowasser, 2013). Furthermore, Bankscope includes information about whether a bank is a commercial, savings, cooperative or other bank. Nevertheless, we had to correct this information for some banks. Most of the banks of our sample are active for the complete sample as a big merger wave had already happened in the 1990s and early 2000s (Koetter, 2008; Schmieder et al., 2010; Behr & Heid, 2011). Still, we account for mergers in our estimations by including a dummy which is equal to one in the merger and post-merger years. We used information from Bankscope to identify merging banks and also double checked our data by looking at unusual growth rates of total assets or loans.³ Also, our results do not change if we exclude all banks from our sample that merged in the 2007-2014 period.

Following Hasan et al. (2009) and Belke et al. (2016), the Bankscope database allows us to map banks to one of the 38 NUTS2 regions of Germany.⁴ Bankscope contains information about the city and zip code of banks' headquarters. Some data entries were corrected after double checking with banks' websites. For most of the banks in our sample it is possible to match a bank to a NUTS2 region by using zip codes. In all other cases the matching was done by city names. In 2011 a region included on average 48 savings and cooperative banks. Then, we used this information to merge the bank-level data with the regional data which we obtained from Eurostat. Koetter & Wedow (2010) analyzed whether German banks operate across multiple NUTS2 regions. Their approach was to check whether a bank's branches are located in the same *Raumordnungsregion*⁵ which are smaller than NUTS2 regions. Using Bundesbank data they found that 93% of all cooperative banks' branches and 97% of the savings banks' branches lie into the same *Raumordnungsregion*. Therefore, we conclude that our approach to map banks to NUTS2 regions is applicable.

In the next part of our data collection, the assignment of competitors, we go even more into detail. We want to assign a bank to be a competitor of another bank only if they compete directly with each other. More specifically, we analyze if two banks have branches in the same markets. Therefore, we do not define two banks as competitors only because they operate in the same NUTS2 region. For example, most savings banks are active in a single county and cooperative banks operate often in even smaller markets. For savings banks there is a freely available map which shows the market in which each savings bank is active. For each cooperative bank we needed to check the bank's website to obtain information about where their branches are. Cooperative banks' websites are usually organized in the same way and always contain information about branch location - in almost each case on a map. Then, if a cooperative bank's branch is within a savings banks market

³For savings banks there is a complete list of mergers available at German Wikipedia.

⁴A NUTS2 region has a population between 800,000 and 3 million persons and usually includes several counties. We use the 2010 NUTS version.

⁵These are aggregations of NUTS3 regions. They are created based on economic interdependencies between districts.

we define them as competitors. This allows us to calculate not only whether a bank pays the German bank levy, but also to identify if at least one of their competitors pays the levy, too. We use the “at least one competitor” specification to get a dummy variable which is easier to interpret.⁶ We also check the robustness of our later results, as our competitor mapping approach can be prone to errors despite double checking. To do this, we also calculate the mean of the mean of the “at least one competitor” variable for each banking group, NUTS2 region and year combination. We then take this ratio of competitors paying the levy as an explanatory variable.

Additionally, we obtained bank-level data such as total assets, loans, equity ratio, interest income over average loans and others to calculate the contribution-relevant liabilities and to get control variables. Regional data consists of GDP and population growth. Descriptive statistics for these variables and our hand-collected competitor data can be found in Table 1. It can be seen that savings and cooperative banks are similar in their characteristics and business models. Both are very active in lending as their loans to non-banks over assets ratio is high. Further, savings banks seem to be a little more risk averse as their interest charged over average loans and loan impairment ratio is slightly lower while their ratio of mortgage loans over all loans is higher. The biggest difference is that savings banks are generally larger than their cooperative counterparts. To give also a graphical overview, we present important variables aggregated over NUTS2 regions in Figure 1. It can be seen that the southern regions of Germany are economically more prosperous while the eastern part still lags behind. This finding is partly correlated with banks’ profitability. In this regard the southern banks are more prosperous but also the northern part is relatively profitable. The average interest banks charge for a loan is higher in the eastern part than in others. Our competitor data shows that banks in city counties as Berlin usually have to pay the bank levy as they are big in size. For other regions no easy regional classifications can be made. The ratio of banks for which at least one competitor pays the levy is high in the southwestern and northwestern part of Germany. Such regions are usually dominated by a big savings bank which operates in one or more counties. For example, most cooperative banks in the Weser-Ems area (DE94) face the Oldenburgische Landesbank as a competitor which is historically big in its area of operation.

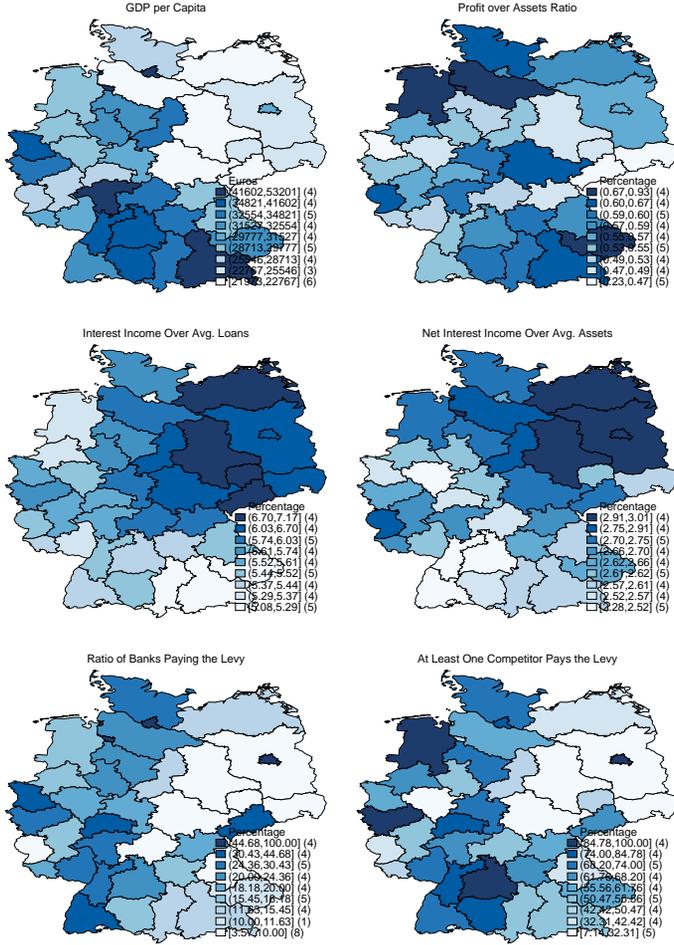
⁶If we specify the variable to be the ratio of competitors who are paying the banking levy, the variable is nearly binary anyway. Less than 5% of the observations are between zero and one. Still, our results are even stronger if we use the ratio specification of the variable.

Table 1: Descriptive Statistics of German Banking Groups between 2011 and 2014

	All Banks	Savings Banks	Cooperative Banks
<i>Dependent Variables</i>			
Interest income over avg. loans	4.95 (0.86)	4.77 (0.78)	5.03 (0.88)
Net interest income over avg. assets	2.52 (0.36)	2.34 (0.33)	2.61 (0.33)
<i>Bank Levy Variables</i>			
Fraction of banks paying the levy	19.60 (39.70)	48.51 (49.99)	5.88 (23.53)
Fraction of bank's with at least one competitor paying	59.31 (49.13)	23.27 (42.27)	76.25 (42.56)
Number of local competitors	1.76 (1.65)	2.73 (2.46)	1.31 (0.69)
<i>Regional Controls</i>			
GDP growth	1.57 (1.82)	1.46 (1.76)	1.63 (1.84)
Population growth	-0.26 (0.79)	-0.35 (0.81)	-0.21 (0.78)
<i>Bank-Level Controls</i>			
Total assets	1256.50 (2271.08)	2624.26 (3481.90)	613.82 (771.18)
Profits over assets	0.56 (0.28)	0.42 (0.22)	0.62 (0.28)
Equity over assets	8.37 (1.95)	8.24 (1.89)	8.43 (1.97)
Loan impairment ratio	-0.19 (1.16)	-0.38 (1.37)	-0.11 (1.03)
Mortgage loans ratio	41.83 (18.52)	47.51 (8.90)	39.15 (21.11)
Loans over assets	58.80 (12.82)	60.80 (13.08)	57.87 (12.58)
Loans over deposits	136.13 (48.42)	128.74 (47.50)	139.60 (48.47)
Observations	5149	1646	3503

Notes: The total assets variable is measured in millions of euros. All other variables are defined in percentage. GDP and population growth are measured on the NUTS2 level. Standard errors in parentheses.

Figure 1: The Economic and Banking Environment in German NUTS2 Regions



Notes: Regions shown are the German NUTS2 regions in 2011. The considered banks are savings and cooperative banks.

4. Empirical Evidence

4.1. Estimation Methodology

Our main empirical panel specification looks as follows:

$$y_{i,t} = \alpha + \beta_1 \text{Levy}_{i,t} + \beta_2 \text{Competitor Levy}_{i,t} + \delta X_{i,t} + \eta_i + \mu_t + \epsilon_{i,t} \quad (1)$$

with $y_{i,t}$ being the dependent variable for bank i in year t , the *Levy* variable capturing whether the bank has to pay the German bank levy and *Competitor Levy* whether at least one of the bank's competitors pays the levy. Further, we include bank-specific and regional controls in vector $X_{i,t}$ and time- and bank-fixed effects. The bank-specific controls are lagged by one period to avoid simultaneity problems. In most of our specifications the dependent variable is interest income on loans over average loans. With our data we cannot distinguish between new and old loans and we thus get a conservative estimation of the effects of the levy as banks most likely started to shift the burden of the tax to their customers' new loans when the levy was anticipated. Banks most likely could not anticipate their tax burden before 2011 as the details of the levy were still unclear in 2010, the first balance sheet year which was used for the calculation of the contribution-relevant liabilities (Buch et al., 2016; Kogler, 2016). In a robustness check we show that the coefficients go up the more years we leave out of the sample beginning with 2011. Later we also investigate whether there are effects of the levy variables on the volume of loans.

Devereux et al. (2015) and Kogler (2016) use three different proxies to estimate the effect of European banking levies. Their first proxy is a dummy variable which is equal to one if a levy is introduced in a country. The second one captures whether the bank was subject to the levy. The third represents the calculated marginal tax rate. As we only examine a single country and nearly all the banks in our sample are subject to the same marginal tax rate, we use only the second proxy.

Furthermore, Devereux et al. (2015) raised an endogeneity issue. Banks with contribution-relevant liabilities around the tax allowance threshold might reduce their liabilities to avoid the levy. This is not so much the issue for the beginning of our sample as it was unclear till the end of 2010 where this threshold would be set and which banking groups would be subject to it (Buch et al., 2016). We follow Devereux et al. (2015) and apply the methodology developed by Gruber & Saez (2002) for research on personal income taxation. We instrument the potentially endogenous tax variables of the examined banks (and their competitors) with dummies that capture whether a bank (or its competitors) would have been subject to the levy based on the relevant balance sheet items from the year before the introduction of the bank levy. These instruments are exogenous and strongly correlated with our actual levy variables.

The control variables used are the following: Firstly, we control for standard bank-level characteristics such as size measured by the log of total assets and profitability. Further, to include risk measures of the bank's business, we incorporate the equity over total assets ratio, the mortgage

loans over total loans ratio and the loan impairment ratio. To control for differing business models, we include the loans over assets and loans over deposits ratios as well as the mortgage loans over total customer loans ratio. Furthermore, we add regional growth rates of GDP and population on the NUTS2 level.

4.2. Results

We present our baseline results for Equation (1) in the left-hand side of Table 2 for a sample with all banks and with the two banking groups alone. Firstly, we concentrate on the control variables. Of the regional variables, only population growth is sometimes statistically significant. Additionally, the size and profitability of a bank only have a minor influence on loan price setting. The risk indicators equity over assets and the loan impairment ratio, however, clearly show that the more risk a bank takes, the higher the price of the loans. Of the business model variables only the loans over deposits variable is strongly significant. Banks that are more dependent on their banking sector's central banks to obtain funding for their credit operations increase their lending rates. This is most likely the case for our sample with still positive ECB interest rates because these central banks charge more for funding than customers do.

The coefficients of our variables of main interest are positive and statistically significant. For example, the coefficient of the levy variable implies that a bank which is subject to the levy increases its average interest rate on its loans by 0.14 percentage points. Therefore, customers of these banks need to pay higher interest for their loans. The direct effect differs only slightly across banking groups and is comparable to Kogler (2016) who found a coefficient of about 0.15 using a sample including all German banking groups. Further, one can see that there are spillover effects at the local level. If at least one competitor of a bank is subject to the levy, the bank increases its loan rate by about one third of the direct effect. Thus, banks take advantage of the increased lending rates of their competitors and follow their increase to a certain extent. Further, this implies that customers of a non-paying bank are indirectly affected by the German bank levy if their bank's competitors are subject to it. Customers of paying banks are affected more strongly if their bank's competitors pay the levy as well. Given an average lending rate of 4.96% for the 2011-2014 sample, these effects are also economically significant. Therefore, one can conclude for customers of savings and cooperative banks - which are often households and SMEs - that they are less affected if their region incorporates mostly non-paying banks. Recalling the distribution of banks subject to the levy across German NUTS2 regions in Figure 1, it can be seen that the least prosperous and populated regions are affected less. This implies that the banking levy helps regions catch up, but also that the growth of successful regions is stalled.

On the right-hand side of Table 2 we present results for regressions which include interactions between size and year dummies to increase the comparability between paying and non-paying banks (Devereux et al., 2015; Kogler, 2016). The latter ones are usually smaller. For example, it is possible

that larger savings and cooperative banks were hit more strongly by the financial crisis and therefore behave differently. The size dummies are created for five size quantiles. Including these interactions, however, only slightly alters our results.

Table 2: Direct and Spillover Effects of the German Bank Levy on Banks' Lending Rates

	Baseline			Year * Size Dummies		
	All Banks	Savings Banks	Coop. Banks	All Banks	Savings Banks	Coop. Banks
Bank pays levy	0.137*** (0.026)	0.127*** (0.036)	0.102** (0.047)	0.143*** (0.039)	0.118** (0.048)	0.148** (0.059)
At least one competitor pays	0.040** (0.020)	0.071** (0.027)	0.055* (0.030)	0.037* (0.020)	0.072*** (0.028)	0.062** (0.031)
GDP growth	0.003 (0.002)	0.005 (0.003)	0.000 (0.003)	0.002 (0.002)	0.006* (0.003)	0.000 (0.003)
Population growth	0.016 (0.011)	0.033*** (0.015)	0.006 (0.014)	0.018* (0.011)	0.030* (0.016)	0.009 (0.014)
ln(Total assets)	-1.124 (1.678)	5.148*** (2.312)	1.790 (2.268)	-1.250 (1.837)	3.172 (2.536)	2.090 (2.619)
ln(Total assets) ²	0.007 (0.062)	-0.180** (0.080)	-0.110 (0.086)	0.010 (0.068)	-0.114 (0.088)	-0.125 (0.100)
Profits over assets	0.019 (0.030)	0.006 (0.059)	0.039 (0.037)	0.016 (0.029)	0.004 (0.058)	0.036 (0.035)
Equity over assets	-0.030*** (0.011)	-0.047*** (0.015)	-0.025* (0.015)	-0.031*** (0.011)	-0.045*** (0.015)	-0.025* (0.015)
Loan impairment ratio	0.011** (0.005)	0.016** (0.007)	0.012 (0.008)	0.010* (0.005)	0.017** (0.007)	0.013* (0.007)
Mortgage loans ratio	0.001 (0.001)	0.005*** (0.001)	-0.002 (0.002)	0.001 (0.001)	0.005*** (0.002)	-0.002 (0.002)
Loans over assets	-0.007* (0.004)	0.002 (0.005)	-0.007 (0.005)	-0.007* (0.004)	0.001 (0.005)	-0.007 (0.005)
Loans over deposits	0.007*** (0.001)	0.009*** (0.002)	0.007*** (0.002)	0.007*** (0.001)	0.008*** (0.002)	0.007*** (0.002)
Constant	17.601 (11.424)	-33.630** (16.939)	-0.735 (15.150)	21.872* (12.459)	-15.886 (18.530)	0.854 (17.335)
Merger dummies	Y	Y	Y	Y	Y	Y
Year dummies	Y	Y	Y	N	N	N
Year * size dummies	N	N	N	Y	Y	Y
Observations	7520	2470	5050	7520	2470	5050
Number of banks	1322	413	909	1322	413	909
Avg. obs. per bank	5.69	5.98	5.56	5.69	5.98	5.56
R2 overall	0.39	0.58	0.39	0.40	0.63	0.41

Notes: * p < 0.1, ** p < 0.05, *** p < 0.01. All monetary variables are in real values. The banks' balance sheet variables are lagged one period to avoid simultaneity. Clustered standard errors in parentheses.

5. Robustness

5.1. Allocation of Competitors and the Design of the Competitor Paying Variable

The assignment of a bank to their competitors was done manually by checking whether a cooperative bank's branches are within the market of a savings bank. Even after double checking,

this can be prone to errors. Therefore, we calculate the variable “At least one competitor pays” across the NUTS2 level. To do this, we compute for each banking group, NUTS2 region and year combination the mean of the “At least one competitor” variable. Thus, for this estimation we rely only on the successful assignment of banks to a NUTS2 region, and that any potential remaining errors are random. In that case the coefficients are biased towards zero. The variable then measures, for instance, the effect of a higher ratio of levy paying savings banks within a NUTS2 region on a cooperative banks’ interest rate setting. In Table 3 it can be seen that the coefficients for the bank levy variables are still significantly positive. We refrain, however, from interpreting the substantially increased coefficient for the “At least one competitor pays” variable as it is not a bank-level measure anymore, but a NUTS2 level one.

Further, one could argue that our baseline definition of the “At least one competitor pays” variable is specified wrongly as it is a dummy variable, not a ratio. For robustness, we now use the “Ratio of competitors paying” variable instead which is calculated as the ratio of competitors paying the bank levy. Less than 5% of the observations are between zero and one. In Table 3 we can see that the results largely remain similar. Only for savings banks the coefficient for the ratio of competitors paying is considerably higher. This can be the case because they face 3 local competitors on average, while cooperative banks face only 1.2. Thus, the latter are largely unaffected by the changed definition of the variable.

Table 3: Redefining the Bank Levy Variables: On the NUTS2 Level and as a Ratio of Competitors

	NUTS2 Level			Ratio of Competitors Paying		
	All Banks	Savings Banks	Coop. Banks	All Banks	Savings Banks	Coop. Banks
Bank pays levy	0.157*** (0.028)	0.114*** (0.035)	0.089* (0.047)	0.148*** (0.027)	0.139*** (0.036)	0.110** (0.047)
At least one competitor pays	0.129*** (0.034)	0.320*** (0.068)	0.281*** (0.066)			
Ratio of competitors paying				0.052** (0.022)	0.118*** (0.036)	0.067** (0.031)
Controls	Y	Y	Y	Y	Y	Y
Merger dummies	Y	Y	Y	Y	Y	Y
Year dummies	Y	Y	Y	Y	Y	Y
Observations	7520	2470	5050	7486	2436	5050
Number of banks	1322	413	909	1319	410	909
Avg. obs. per bank	5.69	5.98	5.56	5.68	5.94	5.56
R2 overall	0.37	0.60	0.38	0.39	0.60	0.39

Notes: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. All monetary variables are in real values. The banks’ balance sheet variables are lagged one period to avoid simultaneity. The variable “At least one competitor pays” is calculated across NUTS2 regions. Thus, it measures for each banking group the mean of banks for which at least one competitor pays the levy. In contrast to the baseline “At least one competitor pays”, the “Ratio of competitors paying” is calculated as a ratio, not as a dummy. Clustered standard errors in parentheses.

5.2. Instrumental Variable Estimations

The German bank levy depends on the relevant balance sheet items to calculate the contribution-relevant liabilities. Therefore, the bank levy variables could be endogenous because banks react to the levy to reduce their tax exposition or to avoid it entirely by dropping below the tax allowance threshold. For the beginning of our sample this is less of an issue as it was unclear till the end of 2010 where the threshold would be set and which banking groups would be affected (Buch et al., 2016). Still, we address this issue by following Devereux et al. (2015) and instrument the potentially endogenous levy variables of the examined banks and their competitors with dummies that capture whether the bank (or its competitors) would have been subject to the levy based on the relevant balance sheet items from the year before the introduction of the bank levy. These instruments are exogenous and strongly correlated with our actual levy variables. The results in Table 4 show increased coefficients for the bank levy variables. This finding is similar to Devereux et al. (2015) and Kogler (2016). The results reassure us that we found a causal effect of the German bank levy on banks' and competitors' loan rate setting.

5.3. The Effects Over Time

In this chapter we want to investigate the effects of the German bank levy over time. Firstly, we cannot distinguish between new and old loans and thus we get a conservative estimate of the effects of the levy as banks most likely started to shift the burden of the tax to their customers when the levy was first anticipated. Secondly, it is interesting to see when competitors start to catch up in their loan setting as they do not know to which degree other banks will adjust their interest rates. Therefore, we estimate the regression again by successively dropping years from the sample after the introduction of the German bank levy in 2011. In Table 5 one can see that the coefficients of our variables of interest increase over time. Therefore, banks were initially hesitant to shift the burden towards their customers. They seem to have increased the rates solely for new loans. Further, competitors of paying banks only adjusted their loan rates slowly as well. This is likely to be the case as they did not know if and to what extent paying banks would adjust their loan rates after the introduction of the German bank levy.

To investigate the last issue in more detail, we take the change in the loan volume as the dependent variable. In detail, we use the change in log real loans to customers. We obtain a statistically significant negative effect for the levy on banks' lending rates. Thus, we can confirm the result of Buch et al. (2016) that banks which are subject to the levy decrease their loan supply. However, competitors are able to offset this effect to a certain extent. The positive spillover effect to competitors is about one third of the size of the negative direct effect. One line of explanation is that a competitor of a levy paying bank now faces an increased loan demand and takes it as private information that the other bank increased its loan rates. Using this private information, they increase their loan rate as well. Another line is a standard supply and demand argument.

Table 4: Instrumental Variable Estimations

	All Banks	Savings Banks	Coop. Banks
Bank pays levy	0.222*** (0.028)	0.221*** (0.037)	0.119** (0.060)
At least one competitor pays	0.097*** (0.030)	0.122*** (0.044)	0.133*** (0.048)
Controls	Y	Y	Y
Merger dummies	Y	Y	Y
Year dummies	Y	Y	Y
Observations	7477	2436	5041
Number of banks	1310	410	900
Avg. obs. per bank	5.71	5.94	5.60

Notes: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. All monetary variables are in real values. The banks' balance sheet variables are lagged one period to avoid simultaneity. Clustered standard errors in parentheses.

Table 5: The Effects of the Bank Levy Over Time

	Interest Rate Over Avg. Loans			Change in ln(Loans) to Customers		
	2012-2014	2013-2014	2014	2012-2014	2013-2014	2014
Bank pays levy	0.196*** (0.026)	0.216*** (0.030)	0.254*** (0.035)	-0.024*** (0.004)	-0.030*** (0.004)	-0.028*** (0.005)
At least one competitor pays	0.033 (0.023)	0.052* (0.027)	0.065** (0.032)	0.008*** (0.003)	0.011*** (0.004)	0.011*** (0.004)
Controls	Y	Y	Y	Y	Y	Y
Merger dummies	Y	Y	Y	Y	Y	Y
Year dummies	Y	Y	Y	Y	Y	Y
Observations	6253	4969	3694	6262	4977	3701
Number of banks	1322	1320	1320	1322	1320	1320
Avg. obs. per bank	4.73	3.76	2.80	4.74	3.77	2.80
R2 overall	0.47	0.50	0.56	0.02	0.03	0.02

Notes: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. All monetary variables are in real values. The banks' balance sheet variables are lagged one period to avoid simultaneity. Clustered standard errors in parentheses.

Overall loan supply is decreased because levy paying banks reduce their lending while demand stays constant. This increases the price for money which makes it more worthwhile for non-paying banks to enlarge their loan supply. Concluding, these estimations show that spillover effects increase the adverse effect of higher interest rates on the local economy, but dampen the negative effect of slower loan growth. In evaluating regulations one therefore has to take also spillover effects to non-targeted subjects into account to conceive the total effect.

6. Conclusion

While most studies analyzing regulations consider only direct effects to assess their impact on the economy, we also examine indirect spillover effects. This allows for a more thorough analysis of the total impact as well as the effect on economic agents who are not actually subjected to the regulation. In our case, we study the effects of the German bank levy which was introduced in 2011. We use bank-level data of savings and cooperative banks from Bankscope which are the perfect setting to study spillover effects. Firstly, both banking groups only operate within well-defined regions allowing us to identify their local competitors. Secondly, only some of these banks needed to pay the levy due to a tax allowance which is, roughly speaking, based on the size of the bank. Furthermore, they are relevant in respect to their total market share in Germany.

Confirming the findings of Kogler (2016), we find that banks subject to the bank levy increase their loan rates. Additionally, we show that there are spillover effects to their local competitors. This indirect effect is about one third of the size of the direct effect. Therefore, non-paying competitors catch up to their paying counterparts while paying competitors further increase their loan rates. For customers this either implies that they are affected by the levy although their bank is not subject to it or that the direct effect is strengthened by spillover effects. This result does not change if we use an instrumental variable approach to ensure causality.

Interestingly, we also find a direct effect on the growth of a bank's loan volume like Buch et al. (2016) as well as an indirect spillover effect which in this case has the opposite sign. Levy paying banks reduce their loan growth while their competitors weaken this effect by enlarging their own loan supply. Thus, spillovers affect the local economy differently. Firstly, the adverse effect of increased loan rates is increased. Secondly, the effect of the slowed loan growth of paying banks is dampened by their competitors. Therefore, policy makers need to take both amplifying as well as absorbing effects into account while implementing new regulations (Aiyar et al., 2014b).

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