Effect of bank levy introduction on bank risk-taking

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Research Article

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Abstract

Risk-taking by financial institutions is widely regarded as the one of the causes of the global financial crisis. To reduce the probability of crises and internalize the costs of financial institution distress, policymakers have introduced bank levies (BLs). In this study, we evaluate the effects of the Hungarian and German BLs on the risk-taking behavior of financial institutions. We compare two totally different BL designs. The results unambiguously demonstrate that a BL on assets has a negative impact on the financial sector's stability. The results of analyzing the influence that introducing BLs has had on the German financial sector demonstrate that BLs on liabilities decrease credit risk. An improved understanding of the determinants of the risk of EU financial institutions is very important for regulators and supervisors interested in benchmarking and validation issues related to the new EU banking regulation.

Key Messages

- The reduction in risk-taking behavior depends on the size and type of financial institution.
- Bank levies on assets negatively affect financial sector stability.
- Bank levies on liabilities decrease credit risk.

1. Introduction

Excessive risk-taking by financial institutions is widely regarded as the one of the causes of the global financial crisis in 2007-2008 (Devereux et al., 2013). Crises significantly increase public debt, aggravating the risk of public sector default (Reinhart & Rogoff, 2013). Furthermore, recessions triggered by debt crises are particularly severe and long-lasting (Taylor, 2012). To reduce the probability and cost of future crises and internalize the costs of financial institution distress, policymakers have introduced some new instruments. One of these were bank levies (BLs) that were introduced to limit credit activity risks of financial institutions (Claessens, Keen, & Pazarbasioglu, 2010).

BLs are a new topic in the academic literature. Although the concept has been constantly evolving, its main purpose has remained the same: to curb banks' risk-taking by taxing the highest-risk activities. There is little extant literature exploring the role of bank levies. Several questions remain open: Do BLs fulfil their role? Which BL format is the most effective from the point of view of regulators and in the context of the role BLs are expected to fulfil? Which BL structure is the most harmful for the banking sector? Answering these questions, which are still intensely debated, is crucial.

However, academic literature has not yet provided any satisfactory answers. Therefore, we contribute to the very timely, but still quite limited, literature on BL regulation. Scholars tend to concentrate on particular aspects of BLs instead of the concept itself. More specifically, they look at the effects of introducing BLs in individual countries, often analyzing data with a limited time span. For example, Perotti and Suarez (2011) explore the extent to which a Pigouvian tax can help internalize banks' contributions to the systemic risk associated with short-term funding. They find that a tax is superior to quantity-based regulation (e.g., funding ratios) if banks differ in lending opportunities, but inferior if they differ in charter values and risk-taking incentives. Devereux et al. (2015) both theoretically and empirically examine how banks adjust their capital structures and risk-taking in response to a levy on liabilities. They find banks indeed reduce their leverage, but also increase risk-taking measured by the average risk weight. The latter is due to a mechanical effect, as more equity increases a bank's maximum risk-weighted assets and subsequently raises asset risk instead of size. Schweikhard and Wahrenburg (2013) simulate the amount of (hypothetical) levy payments during the financial crisis and compare them to the funding benefit of systemically important banks due to government guarantees. They find that levies lead to a partial internalization of systemic risk. The existing evidence is mostly at the country level; for example, Buch et al. (2014) analyze the incidence of the German bank levy. Using a difference-in-differences approach to explore the variation between large banks that are taxed and small banks that are not, they find no evidence to confirm any impact on an average bank's loan volume or lending and deposit rates. However, they find banks with large market shares tend to decrease loan volume and deposit rates and increase lending rates. Using the Hungarian banking sector to test their hypothesis, Capelle-Blancard and Havrylchyk's (2013) study is the sole paper that

explores tax levies on assets, and their interest primarily lies in the impact of taxes on bank intermediation costs. Moreover, their analysis covers a very short period—between March 2008 and September 2012—and, consequently, their conclusions cannot be generalized.

In fact, a review of the above literature shows little is known about the effect of BLs on institutions' risk-taking behaviors in the cases of two different BL models. Therefore, we argue this study may significantly contribute to the existing body of knowledge about the BL concept. The finance sector is one of the most important sectors in an economy and plays several key roles (Philippon, 2011). It facilitates the flow of funds from savers to borrowers and provides a safe and efficient payment mechanism that facilitates the exchange of goods and services. It also provides insurance, both in the form of diversification and risk management (Burman et al., 2016). Problems within the financial sector can immediately translate into a general economic crisis. Assessing the impact of BLs on the banking sector's functioning may, therefore, prove valuable for regulators, politicians, and society as a whole; after all, the financial sector is an economic growth driver in most countries.

In this study, we evaluate the effects of the Hungarian and German BLs implemented in 2010 and 2011, respectively, on the risk-taking behavior of financial institutions. We compare two totally different BL designs. The German BL is designed to increase as a bank's total liabilities increase, with selected positions excluded from total liabilities (Buch, Hilberg, & Tonzer, 2016). Hungary adopted a BL that is conceptually quite different from the German design. In Hungary, the BL was assessed on total assets net of inter-bank lending (Devereux, Johannesen, & Vella, 2015).

The analysis covers the panel structure data of 47 Hungarian financial institutions with unconsolidated financial statements and 292 German financial institutions with unconsolidated financial statements across 2005-2015. To evaluate the impact of levies on financial institution risk-taking behavior, our empirical methodology is a fixed-effects estimation, as suggested by the Hausman test, with standard errors clustered at the institution level. As measures of financial institution risk, we use the Z-score and credit risk, measured as the loan loss provision to asset ratio (LLP). In a robustness check, we use ROE volatility as the dependent variable. An important research question is whether BLs are able to reduce bank riskiness. Moreover, what BL design will reduce financial institutions' risk-taking behavior? Does the type of institution also matter?

The results unambiguously demonstrate that the BL on assets applied in Hungary has a negative impact. The Hungarian BL is found to increase a bank's LLP ratio compared to the period before its introduction. Moreover, smaller financial institutions seem most affected. In small commercial banks, the LLP ratio increased the most. The results of analyzing the influence of the BL introduction on the German financial sector demonstrate that the BL on liabilities decreased the LLP ratio. The effect of the BL on liabilities is similar to the effect of a Pigouvian tax and usually targets bank balance sheet positions that are considered risky.

The remainder of the paper is organized as follows. The next section presents a literature review, Hungarian and German BL designs, and describes the hypotheses development. In the third section, the data and methodology applied are discussed. Section four presents summary statistics, and section five contains the empirical results. The last section concludes the paper.

2. Literature Review And Hypothesis Development

2.1 The structure of bank levies in Europe

A BL is a tax on specific elements of financial institution balance sheets and takes many forms. The most common levy design, adopted by 11 countries (Austria, Belgium, Cyprus, Germany, the Netherlands, Latvia, Portugal, Romania, Slovakia, Sweden, and the UK) taxes some measure of bank liabilities. While the levies are conceptually similar, they vary across several dimensions. First, most of the levies are assessed on total liabilities net of the bank's own funds and customer deposits guaranteed under a deposit insurance scheme. However, two countries (Cyprus and Portugal) include insured deposits in the levy base. Second, the majority of levies treat short-term and long-term liabilities symmetrically, but two countries (the Netherlands and the UK) apply reduced rates to liabilities with maturities exceeding one year. Third, a flat rate is applied in most of the levies, yet four countries (Austria, Germany, the Netherlands, and the UK) have a progressive rate structure, where

small banks are taxed at lower rates than large banks or, in some cases, not taxed at all. Finally, unlike other countries, the UK has adopted rules that narrow the taxable base: most notably, they allow for netting gross assets and liabilities against the same counterpart and grant a deduction for highly liquid assets (Devereux et al., 2015).

Four countries (France, Hungary, Slovenia, and Poland) have adopted BLs that are conceptually quite different from the design described above. In France, the taxable base is the minimum amount of capital necessary to comply with regulatory requirements. In Hungary, the BL is calculated on total assets (net of inter-bank lending). In Slovenia, the taxable base is total assets with no deductions; however, the levy is not due if either the level of lending to the non-financial sector or the growth in lending to the non-financial sector exceed a threshold (Devereux et al., 2015). In Poland, the BL is calculated on total assets. Table 1 below presents the extent to which BL models are applied in some European countries:

2.1.1 The BL in Hungary

In particular, the Hungarian financial sector deserves special consideration, as this country decided to introduce a tax on assets. This form of taxation in Hungary was agreed upon in July 2010. The tax originated not only from a desire to recover some of the budget money allocated to saving the financial sector, but also the need to quickly improve Hungary's economic situation and explore new sources of financing the state budget. The statistics for 2009 confirm significant economic problems in Hungary, such as the GDP recession (OECD, 2016).

Hungary was one of the first countries to implement a BL based on assets of credit institutions (commercial and cooperative banks). Unlike other countries, Hungary and later, Poland decided to tax the asset side of financial institutions' balance sheets. The levy applies to all financial institutions, even those operating at a loss. More importantly, assets—with the exception of interbank positions—are the basis for levy calculation. At the time the tax was introduced, it was presented as a temporary measure, and hence, the tax base was fixed at the amount of assets in 2009. The levy is set at 0.15% of the tax base for small financial institutions (those with assets below 50 billion forints (around 185 million EUR)) and 0.53% of the tax base for larger institutions. This means the ratio of total tax paid by large financial institutions more than tripled from 0.15% of total assets to 0.53% (Capelle-Blancard & Havrylchyk, 2017).

2.1.2. The BL in Germany

Germany introduced a progressive BL in 2011 in the wake of the financial crisis; its purpose was to create a restructuring fund with a target value of EUR 70 billion, that is, roughly equal to the public support granted to financial institutions between 2008 and 2013 (EUR 64 billion). Entities subject to the BL are financial institutions holding a German banking license (Sullivan & Cromwell, 2011). As only systemic financial institutions were rescued there, smaller financial institutions benefit from a tax allowance (Buch et al., 2016), which means the BL rate for large financial institutions, large savings financial institutions, and other large financial institutions is higher (Buch, Tonzer, & Weigert, 2017). However, Haskamp (2016) observes spill-over effects of the BL from levy-paying financial institutions to financial institutions in the German financial sector that are not obligated to pay the BL. He claims an increase in the lending rates of the financial institutions paying the BL causes an increase in the lending rates of institutions exempt from the BL.

The calculation of the German BL is based on contribution-relevant liabilities from the previous year's balance sheet. The German BL is designed to increase with banks' total liabilities (and, thus, with bank leverage), from which selected positions (e.g., equity and retail deposits) are deducted, as is the amount of derivative exposure. Contribution-relevant liabilities are all liabilities according to the annual statement of the previous financial year ending before March 1 of the contribution year, less (1) liabilities to customers, excluding liabilities issued as bearer securities; (2) profit participation rights with a maturity of more than two years; (3) reserve funds for general banking risk; and (4) equity (Buch et al., 2016).

Therefore, contribution-relevant liabilities in 2011 are based on an institution's 2010 balance sheet. They are calculated as total liabilities minus the bank's equity and customer deposits. Deposits are exempted, as financial institutions are already paying to cover deposit insurance for them. Contribution-relevant liabilities are taxed at a rate that increases progressively. In the case

of liabilities between EUR 300 million and EUR 10 billion, the rate is 0.0002 (EUR 300 million < contribution-relevant liabilities ≤ EUR 10 billion). In the case of contribution-relevant liabilities exceeding EUR 10 billion, the rate increases to 0.0003.

2.2 Hypotheses development

2.2.1. Does the Hungarian BL increase the risk of future credit losses?

The main aim of introducing a BL was to change the incentives of bank management and owners to contribute to systemic risk. However, researchers and experts have also noticed BLs have a negative impact, as they may increase financial transaction costs, reduce the number of transactions, and lower transaction values; this may negatively affect bank liquidity and result in wider interest spreads and higher volatility, as well as higher prices for banking services. On the other hand, researchers have proven that BLs might not decrease the number of bank operations because BL costs might be shifted to customers and/or some financial transactions might be transferred to countries where such taxes do not exist (Albertazzi & Gambacorta, 2010; Huizinga, Voget, & Wagner, 2012).

However, the Hungarian credit market is characterized by low customer mobility due to the lack of transparency among various financial services, lack of positive information sharing, and high closing charges when borrowers decide to repay their loans early (Havrylchyk, 2012). In addition, during the period analyzed, Hungarian financial institutions were allowed to unilaterally modify interest rates on outstanding household loans. This prevents borrower mobility, as it becomes pointless to switch to another financial institution to obtain a lower interest rate, given that the new financial institutions has the right to unilaterally raise the rate in the future (Havrylchyk, 2012). This confers significant market power to banks and allows them to shift taxes not only to new loans, but also to outstanding claims (Capelle-Blancard & Havrylchyk, 2017). Furthermore, previous researchers have proven that BLs do not decrease bank profitability because costs are shifted to customers or financial transactions are transferred to countries where such taxes do not exist (Albertazzi & Gambacorta, 2010; Huizinga et al., 2012).

In this study, we argue that Hungarian institutions have less flexibility to pass tax costs on to customers, as they are at higher risk of losing their clients and market share (Berger, Miller, Petersen, Rajan, & Stein, 2005). Therefore, higher costs, low customer mobility, and greater willingness to lend to riskier borrowers might translate into increased credit risk. Moreover, if the BL on assets causes a move to riskier borrowers as higher quality clients become rarer, credit risk is magnified (Blundell-Wignall, Atkinson, & Roulet, 2018). Therefore, we formulate the following hypothesis:

H1: The introduction of a BL in Hungary increases risky activities as credit institutions do not have the flexibility to pass on BL costs. Therefore, willingness to lend to riskier borrowers should increase. More specifically, we argue that LLPs should increase after the introduction of a BL and Z-scores should decrease.

2.2.2. Does the German BL discourage risky behavior of financial institutions?

Buch et. al. (2016) were among the first to examine and provide evidence of the German BL's impact on the financial sector. They find that, compared to unaffected financial institutions, financial institutions affected by the BL reduced loan supply. They also conclude that financial institutions tend to increase deposit rates, probably to attract customer deposits, which are deducted from the tax base. In more recent research, Reiter (2018) shows that institutions affected by BLs significantly decrease their contribution-relevant liabilities. Institutions are replacing contribution-relevant liabilities by non-affected funding (equity and customer deposits), which may help affected financial institutions avoid the BL and decrease risky activities.

Another study by Haskamp (2018) proves that levy-paying banks reduce their loan growth, while their competitors weaken this effect by augmenting their own loan supply. However, by raising the cost of borrowed funds, levies are designed to increase the financial sector's stability by inducing financial institutions to rely more on their own capital. At the same time, the latest research shows a levy on secured liabilities can prevent financial institutions from investing in gambling assets if the levy does not depend on the financial institutions' financial performance (Diemer, 2017).

In line with Devereux et al.'s (2015) argument, the first theoretical prediction may be that a levy on financial institutions' borrowing activities induces them to rely more on equity funding, but also to hold more risky assets. BLs on liabilities target bank balance sheet positions that are considered risky, such as funding sources other than customer deposits and bank equity (Buch et al. 2016). Moreover, many proponents argue that BLs on liabilities serve as a macro-prudential tool to discourage risky activities. Keen (2011) states that BLs might have a more purposive role in the area of corrective taxation. Policymakers assume that BLs on liabilities will prove to be a particularly effective tool for mitigating the risks associated with sudden reversals of foreign capital flows (Jiang, Li, & Shao, 2010). Moreover, levies on liabilities should clearly induce financial institutions to rely more on equity funding (Devereux et al., 2013); financial institutions with more equity funding might hold safer assets because of moral hazard problems caused by limited liability (Allen, Carletti, & Marquez, 2011). As in Germany, the tax is levied on volatile short-term funding, while stable funding, such as equity and deposits, is excluded. We formulate the following hypothesis:

H2: The introduction of a BL in Germany reduces risky activities because financial institutions are discouraged from entering into transactions with higher tax burdens. More specifically, we argue that LLPs should decrease after a BL is introduced and Z-Scores should increase.

3. Research Design

3.1 Sample and data collection

In our analysis, we use data from the OrbisFocus database, comprising all financial institutions during 2005-2015, which means both pre-BL years and post-BL years (when the German and Hungarian BLs are in place) are considered. Consequently, the sample consists of 2,133 observations (47 Hungarian financial institutions with unconsolidated financial statements and 292 German financial institutions with unconsolidated financial statements). Macroeconomic data were sourced from Central Banks' websites.

3.2 Methodology

We use a fixed effects estimator to run the regression. Moreover, the model choice under the current specification was dictated by Hausman's (1978) specification test. We refer to unconsolidated financial statements for all estimations because we argue the BL effect should be more evident in unconsolidated than consolidated statements, as conglomerate financial institutions might make some adjustments and shift activities among their entities to decrease the tax burden (Díaz, Olalla, & Azofra, 2004). Moreover, we are aware of other regulatory changes that occurred during the analyzed period and anomalies in the financial markets (Podgórski, 2018). Therefore, we also modify the standard errors in all regressions to be clustered at the institution level. Following Petersen (2009), we assume that clustered standard errors are unbiased as they account for the residual dependence created by the institution effect. The clustered standard errors correctly account for the dependence in the data common in panel datasets and produce unbiased estimates.

The regression equation is:

$$(1) \text{RISK}_{jt} = \beta_0 + \beta_1 \text{BL}_t + \beta_2 \text{Size}_{jt} + \beta_3 \text{LoanActivity}_{jt} + \beta_4 \text{Efficiency}_{jt} + \beta_5 \text{Loss}_{jt} + \beta_6 \text{Liquidity}_{jt} + \beta_7 \text{Capital ratio}_{jt} + \beta_8 \text{Inflation}_{jt} + \beta_9 \text{GDP growth}_{jt} + \varepsilon_j$$

To verify the hypotheses, the dependent variable (RISK) is measured as the loan loss provision to total assets ratio (LLP) as a proxy for credit risk, the Z-score ratio as a proxy for individual risk, and, in robustness tests, ROE volatility as a proxy for risky financial institution activities. BL is estimated as a dummy variable equal to one for all years BLs existed, and zero otherwise. Additionally, we use BLpaid as a simulated amount of BL payments each year.

Loan loss provisions are an important factor in banking, as they incorporate the credit risk of the principal and interest on loans extended by a financial institution (Abbas, Zaidi, Ahmad, & Ashraf, 2014). The Z-score is our second risk measure; it provides general information about a bank's financial soundness, and has been used in many previous studies (Altunbas, Binici, & Gambacorta, 2018; De Haan & Poghosyan, 2012; Houston, Lin, Lin, & Ma, 2010; Hryckiewicz, 2014; Laeven & Levine, 2009; Lapteacru, 2016). This ratio is predictive of the bankruptcy risk to which financial institutions are exposed. Its high accuracy has been demonstrated by empirical studies carried out in the Italian banking system (Altman, Danovi, & Falini, 2013) and the French banking system (Cihák & Hesse, 2008). A Z-score is estimated as the ratio of the sum of the bank's average capitalization to the standard deviation of return on assets. Z-scores are estimated as four-year moving averages.. Intuitively, the measure represents the number of standard deviations below the mean by which profits would have to fall to deplete equity capital (Boyd & De Nicolo, 2005; Hryckiewicz, 2014). A higher Z-score indicates a financial institution is further from default and, therefore, more stable (Delis & Staikouras, 2011).

Following Devereux et al. (2015), in a robustness check, we use ROE volatility as a proxy for risky financial institution activities. Increasing ROE volatility increases financial risk (Kwan, 1997). Moreover, higher ROE volatility indicates lower earnings quality (Minami & Wakatsuki, 2014). Following Devereux et al. (2013), we assume financial institutions that are more willing to take risk should, on average, experience more extreme outcomes. Therefore, assuming BLs reduce risk, financial institutions exposed to BLs should experience equity returns closer to reference level of ROE (Devereux et al., 2013). BL is estimated as a dummy variable equal to one for all years BLs when exist and zero otherwise.

In addition, we include a large set of control variables to ensure the BL effect is not influenced by other financial institution or country characteristics. The construction of all variables is explained in Table 2.

4. Summary Statistics

Table 3 presents summary statistics of the unconsolidated financial statements of Hungarian and German financial institutions for the entire sample period (2005-2015). Table 4 presents summary statistics of the unconsolidated financial statements of Hungarian and German financial institutions before the BL implementation (Hungary in 2005-2009 and Germany in 2005-2010), while Table 5 presents summary statistics on unconsolidated financial statements of Hungarian and German financial institutions after the BL implementation (Hungary in 2010- 2015 and Germany in 2011-2015).

Tables 4 and 5 allow us to compare the financial performance and risk-taking behavior between two periods: before and after the BL introduction, respectively.

The statistics presented in Tables 4 and 5 suggest the Z-score ratio increased in the Hungarian financial sector and decreased in German financial institutions after the BLs were introduced. However, the LLP in German financial institutions decreased after the BL introduction, which may mean financial institutions reduced their high-risk lending practices; we observe a similar trend in Hungary. ROE volatility increased in the Hungarian financial sector and decreased in German financial institutions after the BLs were introduced.

On the other hand, efficiency and capital ratios decreased (increased) in Hungarian financial institutions (German financial institutions). After BL introduction, loan activity increased in Hungarian financial institutions and decreased in German financial institutions. Finally, liquidity decreased in the Hungarian and German financial sectors after BL introduction. Overall, the summary statistics seem to suggest the risk and financial ratios in Hungary tended to decrease more than those in Germany.

5. Results

5.1 Does the Hungarian BL increase the risk-taking behavior of credit institutions?

Table 6 presents the regression results for the entire sample, that is, including all credit institutions (commercial and cooperative banks) operating within the Hungarian financial system, as well as the results for commercial banks only.

The estimation results demonstrate that the BL on assets negatively affects the financial sector's stability. According to Table 6, the BL introduction increases the average bank's LLP ratio 1.318 percentage points, and these results are statistically significant. Therefore, higher costs, low customer mobility, and greater willingness to lend to high-risk borrowers might translate into higher credit risk in Hungarian credit institutions, which confirms the first hypothesis. However, this result is only significant when the entire sample is considered; the results seem to suggest that commercial banks are not affected. Commercial banks also differ from other credit institutions in terms of their business objectives, regulation, and ownership structures (Beck, Demirgüç-Kunt, & Peria, 2011). Commercial banks are, *inter alia*, required to diversify their assets and hold a minimum amount of assets in one particular sector and to hold a minimum level of capital or equity funds that must be contributed and monitored by the owners of a commercial bank (Schneider, 2001). Therefore, BL introduction might not affect commercial banks, as they are highly regulated (Hubbard, 2010).

Concerning other explanatory variables, we find that efficient financial institutions have lower LLPs and Z-scores. This might mean banks that are more efficient do not need to become involved in risky loans. However, as efficiency decreases, the Z-score also decreases. This result is consistent with Louzis et al.'s (2012) results, who prove that inefficient banks are more willing to take on additional risk. Moreover, we find that credit institution losses are negatively correlated with the Z-score and positively correlated with LLP in both samples. This result might indicate financial institutions with losses tend to be more likely to take risks due to profitability problems (Uhde & Heimeshoff, 2009). Additionally, we found that liquidity measures decrease financial institutions' LLPs. These results are not surprising, as research shows financial institutions holding highly liquid assets tend to have relatively lower risk indicators, since liquid assets are less risky (Kashyap, Rajan, & Stein, 2002). Moreover, capital ratios are positively correlated with the Z-score variable and negatively correlated with LLP; higher financial institution capital ratios decrease riskiness. Institutions with a capital surplus might not need to invest in risky assets (Osborne, Fuentès, & Milne, 2012). Finally, we find that an increase in inflation increases the LLP value, which is consistent with other studies, such as Arpa et al. (2001). They conclude that risk in the financial sector varies and is directly impacted by inflation.

As mentioned, the Hungarian tax authority decided to vary levy rates depending on institution size. Banks whose total assets exceed 50 billion forints (approximately 160 million EUR) are heavily taxed at the rate of 0.53%, whereas other credit institutions pay only 0.15%. Therefore, we test whether the effect of a BL on risk-taking is stronger in larger banks than in smaller banks. Table 7 presents the results.

According to Table 7, in smaller commercial banks, LLPs more than doubled. This result can be accounted for by the fact that larger banks, often operating as conglomerates, tend to shift their profits between different entities and locations to reduce their tax burden (Demirgüç-Kunt & Huizinga, 1999), while small commercial banks need to take on higher risk to reduce their tax burden. Furthermore, since financial institutions in Hungary are taxed at different rates depending on size, we argue smaller financial institutions have less flexibility to pass tax costs to customers, as they are at higher risk than larger entities of losing their clients or market share (Berger et al., 2005).

As for the other explanatory variables, bank size has been found to be positively correlated with bigger banks' LLPs. The reason might be that, due to the moral-hazard problem, large banks are more willing than small entities to lend to unreliable clients, such as firms that do not keep formal financial records (Berger et al., 2005; Uhde & Heimeshoff, 2009). Common other reasons why larger banks have larger LLP might be the greater diversification they can achieve, allowing them to lend to riskier borrowers, and different mixes of loan products. Moreover, as in the previous estimation, we found the same significance and similar coefficients of efficiency, loss, and capital ratios with both dependent variables. However, more liquid commercial banks with total assets below 50 billion forints seem to increase LLPs. Inflation is positively correlated with LLP, which is consistent with previous studies (Arpa et al., 2001).

An interesting question is how risk-taking behavior changes after BL introduction in credit institutions that provide services beyond the scope of ordinary commercial banking, that is, credit institutions other than commercial banks. Table 8 presents the regression results for credit institutions other than commercial banks.

According to Table 8, BL introduction is found to increase a bank's LLP ratio by 1.152 percentage points. This result is consistent with the view that BLs on assets tend to increase financial sector risk, as researchers show the reform might not change loan supply, but increase financial institutions' willingness to lend to high-risk borrowers (Carletti, De Marco, Ioannidou, & Sette, 2018). Therefore, the BL on assets might increase credit risk in the Hungarian financial sector, which confirms the first hypothesis. With respect to the other explanatory variables, this estimation also shows a negative correlation between efficiency and LLP and the capital ratio and Z-score.

5.2. Does the amount of paid levy matter? – Hungarian experience

In this section, we perform several tests to see if the amount of paid BLs in Hungary influences risk-taking measures. The tax base of the BL consists of assets of credit institutions excluding interbank assets, which are deducted to avoid double taxation. The levy is determined as 0.15% of the tax base for small credit institutions with assets under EUR 185 million (50 billion forints) and 0.53% of the tax base for large institutions. Table 9 presents the regression results.

The estimation results demonstrate that the increase in paid BLs in the financial sector negatively affects the financial sector's stability. According to Table 9, the increase in paid BLs is found to increase bank LLP ratios by 0.0671 percentage points in all financial institutions. This increase is especially seen in non-commercial institutions, and the results seem to suggest commercial banks are not affected.

Concerning other explanatory variables, we find efficient financial institutions have lower LLPs and Z-scores. This might mean banks that are more efficient do not need to become involved in risky loans. Moreover, we find credit institution losses are negatively correlated with the Z-score and positively correlated with LLP in both samples. This result might indicate financial institutions with losses tend to be more prone to risk-taking due to their profitability problem (Uhde & Heimeshoff, 2009). Additionally, we find that liquidity measures decrease financial institutions' LLPs. These results are not surprising, as research shows financial institutions holding highly liquid assets tend to have relatively lower risk indicators, since liquid assets are less risky (Kashyap et al., 2002). Moreover, capital ratios are positively correlated with the Z-score variable and negatively correlated with the LLP variable. Higher financial institution capital ratios decrease riskiness. Finally, we find increases in inflation increase the LLP value, consistent with other studies that conclude risk in the financial sector varies and is directly impacted by inflation (Arpa et al. 2001).

5.3. Robustness checks

In this section, we perform several robustness tests to ensure the validity of our results. Table 10 presents the regression results where the LLP and Z-score are replaced by ROE volatility. Therefore, assuming that levies reduce risk, financial institutions exposed to levies should experience equity returns closer to the average level of ROE volatility.

The estimation results demonstrate that the BL on assets negatively affects the financial sector's stability. According to Table 10, the BL introduction is found to increase a bank's ROE volatility ratio 5.255 times on average in all financial institutions, and these results are statistically significant. The results seem to suggest commercial banks with total assets below 50 billion forints are most affected, where the ROE volatility ratio increases more than eight times.

Concerning the other explanatory variables, we find efficient small commercial banks have lower ROE volatility ratios, and credit institution losses are positively correlated with ROE volatility ratios in all samples. Additionally, we find liquidity measures increase the ROE volatility ratios of financial institutions other than small commercial banks. Our findings support the evidence that BL introduction increases risk-taking by Hungarian credit institutions.

5.5. Does the German levy discourage financial institutions from engaging in high-risk activities?

In this section we present the results of analyses of the relationship between the BL and the German financial system. Table 11 presents the regression results for the entire sample, that is, all financial institutions operating in the German banking system, as well as those of commercial banks only.

The estimation results demonstrate that the BL positively affects the financial sector's stability. According to Table 11, the BL decreases a bank's LLP ratio by 0.648 percentage points in all financial institutions and by 0.364 percentage points in commercial banks. In accordance with Devereux et al.'s (2015) argument, the first theoretical prediction may be that a levy on financial institution borrowing induces financial institutions to rely more on equity funding. Moreover, Kopecky and VanHoose (2006) find the imposition of regulatory capital requirements has an initially ambiguous effect on aggregate loan quality, although once such requirements are in place, further increases in required capital ratios cause the overall credit quality in the banking system to increase. Therefore, the credit quality in the German banking system increases following the BL introduction.

As for the other explanatory variables, we find the size of a financial institution is positively correlated with its Z-score. Moreover, the efficiency ratio in the German financial sector is positively correlated with LLP. This might mean when German financial institutions become more efficient, they have more resources available for risky activities. Moreover, we find credit institution losses are negatively correlated with Z-scores and positively correlated with LLPs in both samples. This result might indicate financial institutions with losses tend to be more prone to risk-taking due to their profitability problem (Uhde & Heimeshoff, 2009). Finally, estimations show that GDP growth is positively correlated with LLP in the commercial bank sample and negatively correlated with the Z-score in the sample of all financial institutions. This might mean German financial institutions decide to invest in risky assets when the macroeconomic environment is in good condition.

As mentioned before, Germany introduced a progressive BL in the wake of the financial crisis, with the purpose of financing a restructuring fund. As only systemic financial institutions are rescued, a tax allowance was introduced to relieve smaller financial institutions from the tax burden (Buch et al., 2016). Consequently, large commercial banks and head institutions of savings banks and credit unions contributed the most (Buch et al., 2017). The German BL's calculation is based on contribution-relevant liabilities; the rate is 0.0002 until the following threshold of EUR 10 billion is reached, at which point the rate increases to 0.0003.

In Table 12, we compare the regression results of commercial banks with contribution-relevant liabilities below and equal to EUR 10 billion euro, and those exceeding EUR10 billion.

According to Table 12, LLPs decrease almost by 0.4 percentage points in commercial banks with contribution-relevant liabilities lower than EUR 10 billion. This might mean, following the BL introduction, banks decide to invest funds in more stable assets. Moreover, smaller banks tend to operate according to a more traditional business model, with a greater focus on lending activities (Köhler, 2012), and usually derive a greater share of their income from more stable provisions (Stiroh, 2004). Therefore, small banks have been shown to hold less risky assets (Schneider, 2001) and replace relevant liabilities with non-affected funding (e.g., equity) (Reiter, 2018).

Concerning the other explanatory variables, size is positively correlated with Z-scores in smaller financial institutions, and loan activity is positively correlated with bigger financial institutions. Moreover, the efficiency ratio in small financial institutions is also positively correlated with LLPs. This might mean when small commercial banks become more efficient, they have more resources available for risky activities. Moreover, we find credit institution losses are negatively correlated with Z-scores in smaller financial institutions. The capital ratio measures an institution's financial strength and should have an effect on the financial institution's risk-taking behavior (Tran, Lin, & Nguyen, 2016). Therefore, we note positive correlations between the capital ratios and Z-scores in both samples.

As with the Hungarian sample, we evaluate the risk-taking behavior of entities other than commercial bank financial institutions following the BL introduction. Table 13 presents the regression results.

According to Table 13, the BL decreases the LLP ratio by 0.564 percentage points. These correlations can be accounted for in the same manner as in the case of smaller commercial banks.

Concerning the other explanatory variables, size is negatively correlated with LLP. Moreover, we find losses of financial institutions other than commercial banks are negatively correlated with the Z-score. The capital ratio measures an institution's financial strength and should have an effect on its risk-taking behavior (Tran, Lin, & Nguyen, 2016). Therefore, we note a positive correlation between the capital ratio and Z-score and a negative correlation with LLP.

5.6. Does the amount of paid levy matter? - German experience

In this section, we perform several tests to see if the amount of paid BL in Germany influences risk-taking measures. Germany introduced a progressive BL in 2011. Larger banks, banks with a market-based funding strategy, and banks involved in derivatives trading faced a higher marginal levy. "Contribution-relevant liabilities" are total liabilities minus equity, customer deposits, profit participation rights, and reserve funds for general banking risk. Banks are exempted from the levy if their contribution-relevant liabilities are smaller than or equal to €300 million. Table 14 presents the regression results.

The estimation results demonstrate that the increase in financial sector paid BLs negatively affects its stability. According to Table 14, we find the LLP ratio decreases in non-commercial financial institutions as the paid BLs increase. On the other hand, the increase in paid BLs is found to decrease a bank's Z-score ratio 0.234 times in all financial institutions and it is significant. It shows, that with increase of amount of paid BL the Z-score decrease, therefore the risk of default increases.

Concerning the other explanatory variables, we find when we control for the value of paid BLs, efficient financial institutions have higher LLPs, while the results for credit institution losses are the same as in the previous estimations. Moreover, capital ratios are negatively correlated with the LLP variable. Higher financial institution capital ratios decrease riskiness. Finally, the estimations show GDP growth is negatively correlated with LLP and the Z-score.

5.7. Robustness checks

In this section, we perform several robustness tests to ensure the validity of our results. We present the regression results in which we replace the LLP and Z-score by ROE volatility. Therefore, assuming levies reduce risk, financial institutions exposed to levies should experience equity returns closer to the reference level volatility. Table 15 presents the regression results.

The estimation results demonstrate that the BL on liabilities positively affects the financial sector's stability. According to Table 15, the BL introduction is found to decrease a bank's ROE volatility ratio 6.773 times in commercial banks, and these results are statistically significant. The results seem to suggest commercial banks with contribution-relevant liabilities below and equal to EUR 10 billion are most affected; the BL introduction is found to decrease a bank's ROE volatility ratio seven times in these institutions.

Concerning the other explanatory variables, we find efficient small financial institutions have lower ROE volatility ratios. Moreover, we find inflation increases ROE volatility. Our findings support the evidence that BL introduction decreases risk-taking by German financial institutions.

6. Conclusions

Financial institution distress can have severely negative consequences not only for the financial system's stability, but also for the real economy and public finances. Therefore, financial stability and risk-taking are highly debated concepts. Proponents of BLs advocate that, first of all, they will curb speculative short-term and high-frequency trading, as they are regulatory

instruments that correct negative externalities stemming from financial sector activities, which include the effects of excessive risk-taking Claessens, et al. (2010).

In this study, we analyzed the impact of BLs on the stability of the German and Hungarian financial sectors. Although we agree that by regulating the financial system, governments strive to limit the negative consequences of financial crises and the probability of future economic downturns, our regression estimations show that the effect of BLs depends on their construction. The problem lies in deciding which regulatory instruments or combination of instruments will prove most effective in reducing risk, and how effectively they can be applied (Devereux et al., 2015). More specifically, our results demonstrate that reducing risk-taking behavior is contingent on institution size and type. The results also provide evidence that the BL on assets in the Hungarian financial sector negatively affects sector stability. Following the BL introduction in the Hungarian financial sector, financial institutions might be more willing to provide loans to high-risk borrowers (Carletti et al., 2018). Moreover, commercial banks that pay BLs at a lower rate and other small financial institutions seem to be most affected. The reason might be that larger financial institutions, often operating as conglomerates, tend to shift their profits between different entities and locations to reduce their tax burden (Demirgüç-Kunt & Huizinga, 1999), while small commercial banks take on higher risk to reduce their tax burden.

As for the German financial sector, the estimation results are also consistent with expectations and the extant literature. Credit quality in the German banking system increases and LLPs decrease following the BL introduction. According to our results, commercial banks, which enjoy lower tax rates, and financial institutions other than commercial banks are most affected. However, by raising the cost of borrowed funds, levies are designed to increase the financial sector's stability, as they induce banks to rely more on their own capital. The BL on liabilities has an effect similar to the effect of a Pigouvian tax, and usually targets financial institution balance sheet positions that are considered high-risk (Buch et al. 2016). Thereby, a levy is intended to curb financial institution risk-taking activities, and this goal has been achieved in the German financial sector.

These results have important policy implications. First, research findings show that BLs on assets are associated with significantly higher risk in the financial sector. From a regulator's perspective, this result is worth stressing. This evidence contributes to the current debate on the potential effects of BLs on the financial sector's functioning in the future. Second, this result demonstrates that risk-taking is contingent on the type of BL and depends on the size of the entity in question. Therefore, it is in policymakers' interests to select and apply a set of mechanisms that will allow them to mitigate risk-taking behavior in the financial sector.

Declarations

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References

- Abbas, A., Zaidi, S. A. H., Ahmad, W., & Ashraf, R. (2014). Credit risk exposure and performance of banking sector of Pakistan. *Journal of Basic and Applied Sciences*, 4(3), 240–245.
- Albertazzi, U., & Gambacorta, L. (2010). Bank profitability and taxation. *Journal of Banking & Finance*, 34(11), 2801–2810.
- Allen, F., Carletti, E., & Marquez, R. (2011). Credit market competition and capital regulation. *The Review of Financial Studies*, 24(4), 983–1018.

- Altman, E. I., Danovi, A., & Falini, A. (2013). Z-Score Models' application to Italian companies subject to extraordinary administration. *Journal of Applied Finance*, 23(1), 128–137.
- Altunbas, Y., Binici, M., & Gambacorta, L. (2018). Macroprudential policy and bank risk. *Journal of International Money and Finance*, 81, 203–220.
- Arpa, M., Giulini, I., Ittner, A., & Pauer, F. (2001). The influence of macroeconomic developments on Austrian banks: implications for banking supervision. *BIS Papers*, 1, 91–116.
- Beck, T., Demirgüç-Kunt, A., & Peria, M. S. M. (2011). Bank financing for SMEs: Evidence across countries and bank ownership types. *Journal of Financial Services Research*, 39(1–2), 35–54.
- Berger, A. N., Miller, N. H., Petersen, M. A., Rajan, R. G., & Stein, J. C. (2005). Does function follow organizational form? Evidence from the lending practices of large and small banks. *Journal of Financial Economics*, 76(2), 237–269.
- Blundell-Wignall, A., Atkinson, P., & Roulet, C. (2018). The Determinants of the Riskiness of Banks BT - Globalisation and Finance at the Crossroads: The Financial Crisis, Regulatory Reform and the Future of Banking. In A. Blundell-Wignall, P. Atkinson, & C. Roulet (Eds.) (pp. 157–173). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-72676-2_6
- Boyd, J. H., & De Nicolo, G. (2005). The theory of bank risk taking and competition revisited. *The Journal of Finance*, 60(3), 1329–1343.
- Brunnermeier, M. K. (2009). Deciphering the Liquidity and Credit Crunch 2007–2008. *Journal of Economic Perspective*, 23(1), 77–100.
- Buch, C., Tonzer, L., & Weigert, B. (2017). Assessing the effects of regulatory bank levies. Retrieved March 6, 2018, from <https://voxeu.org/article/assessing-effects-regulatory-bank-levies>
- Buch, Hilberg, B., & Tonzer, L. (2016). Taxing banks: An evaluation of the German bank levy. *Journal of Banking and Finance*, 72(C), 52–66. <https://doi.org/10.1016/j.jbankfin.2016.07.010>
- Burman, L. E., Gale, W. G., Gault, S., Kim, B., Nunns, J., & Rosenthal, S. (2016). Financial Transaction Taxes in Theory and Practice. *National Tax Journal*, 69(03), 171–216.
- Capelle-Blancard, G., & Havrylchyk, O. (2017). Incidence of bank levy and bank market power. *Review of Finance*, 21(3), 1023–1046.
- Carletti, E., De Marco, F., Ioannidou, V., & Sette, E. (2018). Banks As Patient Lenders: Evidence from a Tax Reform. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3179491
- Chaudhry, S. M., Mullineux, A., & Agarwal, N. (2015). Balancing the regulation and taxation of banking. *International Review of Financial Analysis*, 42, 38–52. <https://doi.org/10.1016/j.irfa.2015.01.020>
- Cihak, M., & Hesse, H. (2007). Cooperative banks and financial stability. Retrieved from <https://www.imf.org/en/Publications/WP/Issues/2016/12/31/Cooperative-Banks-and-Financial-Stability-20141>
- Cihák, M. M., & Hesse, H. (2008). Islamic banks and financial stability: An empirical analysis. *IMF WP*, (8–16).
- Claessens, S., Keen, M., & Pazarbasioglu, C. (2010). *Financial sector taxation: The IMF's report to the G-20 and background material*. Washington.
- De Haan, J., & Poghosyan, T. (2012). Bank size, market concentration, and bank earnings volatility in the US. *Journal of International Financial Markets, Institutions and Money*, 22(1), 35–54.

- De Jonghe, O. (2010). Back to the basics in banking? A micro-analysis of banking system stability. *Journal of Financial Intermediation*, 19(3), 387–417.
- Delis, M. D., & Staikouras, P. K. (2011). Supervisory effectiveness and bank risk. *Review of Finance*, 15(3), 511–543.
- Demirgüç-Kunt, & Huizinga, H. (1999). Determinants of commercial bank interest margins and profitability: some international evidence. *The World Bank Economic Review*, 13(2), 379–408.
- Devereux, M., Johannesen, N., & Vella, J. (2015). Can Taxes Tame the Banks? Evidence from the European Bank Levies. *Saïd Business School, Research Papers*, (April).
- Devereux, M., Vella, J., Johannesen, N., Devereux, M. P., Johannesen, N., & Vella, J. (2013). Can taxes tame the banks? Evidence from European bank levies. *Working Paper Series-Oxford University Centre for Business Taxation*, WP 13/25.
- Diamond, D., & Rajan, R. (2009). The Credit Crisis: Conjectures about Causes and Remedies. *NBER Working Paper No. 14739*.
- Diemer, M. (2017). Bank levy and risk-taking. *Review of Financial Economics*, 34, 10–32.
<https://doi.org/10.1016/j.rfe.2017.06.001>
- Díaz, B. D., Olalla, M. G., & Azofra, S. S. (2004). Bank acquisitions and performance: evidence from a panel of European credit entities. *Journal of Economics and Business*, 56(5), 377–404.
- Edwards, F. R., & Mishkin, F. S. (1995). *The decline of traditional banking: Implications for financial stability and regulatory policy*. National Bureau of Economic Research.
- Haskamp, U. (2016). Spillovers of Banking Regulation: The Effect of the German Bank Levy on the Lending Rates of Regional Banks and Their Local Competitors. *Ruhr Economic Papers*, 664, 1884–1914. <https://doi.org/10.4419/86788859>
- Haskamp, U. (2018). Spillovers of banking regulation: the effect of the German bank levy on the lending rates of regional banks and their local competitors. *International Economics and Economic Policy*, 15(2), 449–466.
<https://doi.org/10.1007/s10368-017-0404-4>
- Hausman, J. A. (1978). Specification tests in econometrics. *Econometrica: Journal of the Econometric Society*, 46(6), 1251–1271.
- Havrylchyk, O. (2012). The effect of foreign bank presence on firm entry and exit in transition economies. *Journal of Banking & Finance*, 36(6), 1710–1721.
- Houston, J. F., Lin, C., Lin, P., & Ma, Y. (2010). Creditor rights, information sharing, and bank risk taking. *Journal of Financial Economics*, 96(3), 485–512.
- Hryckiewicz, A. (2014). What do we know about the impact of government interventions in the banking sector? An assessment of various bailout programs on bank behavior. *Journal of Banking & Finance*, 46, 246–265.
<https://doi.org/10.1016/j.jbankfin.2014.05.009>
- Hubbard, G. (2010). Financial Regulation: It's Not About More. Retrieved January 24, 2019, from
<https://hbr.org/2010/06/financial-regulation-its-not-a.html>
- Huizinga, H., Voget, J., & Wagner, W. (2012). International Taxation and Cross-Border Banking. *NBER Working Paper Series; National Bureau of Economic Research*, w18483.
- Jiang, W., Li, K., & Shao, P. (2010). When shareholders are creditors: Effects of the simultaneous holding of equity and debt by non-commercial banking institutions. *The Review of Financial Studies*, 23(10), 3595–3637.

- Kashyap, A. K., Rajan, R., & Stein, J. C. (2002). Banks as liquidity providers: An explanation for the coexistence of lending and deposit-taking. *The Journal of Finance*, 57(1), 33–73.
- Keen, M. (2011). The taxation and regulation of banks. *IMF Working Paper*, 11(206), 1–38.
- Köhler, M. (2012). Which banks are more risky? The impact of loan growth and business model on bank risk-taking. *Deutsche Bundesbank*, 33, 1–19.
- Kopecky, K. J., & VanHoose, D. (2006). Capital regulation, heterogeneous monitoring costs, and aggregate loan quality. *Journal of Banking & Finance*, 30(8), 2235–2255.
- KPMG. (2017). Special taxes in the financial sector. Retrieved March 4, 2018, from https://home.kpmg/content/dam/kpmg/fi/pdf/2017/11/Bank_levies_Nordic_comparison.pdf
- Kwan, S. (1997). Securities activities by commercial banking firms' section 20 subsidiaries: risk, return, and diversification benefits. In *Economic Research Federal Reserve Bank of San Francisco* (pp. 1–28). Citeseer.
- Laeven, L., & Levine, R. (2009). Bank governance, regulation and risk taking. *Journal of Financial Economics*, 93(2), 259–275.
- Lapteacru, I. (2016). risk On the consistency of the Z-score to measure the bank risk. *LAREFI Working Paper*, 05, 1–36.
- Louzis, D. P., Vouldis, A. T., & Metaxas, V. L. (2012). Macroeconomic and bank-specific determinants of non-performing loans in Greece: A comparative study of mortgage, business and consumer loan portfolios. *Journal of Banking & Finance*, 36(4), 1012–1027.
- Mauro, B. W. Di. (2010). *Taxing Systemic Risk: Proposal for a Systemic Risk Levy and a Systemic Risk Fund. Presented at the Deutsche Bundesbank*.
- Minami, S., & Wakatsuki, T. (2014). Save the Trading Costs: Simple and Intuitive Rule for Smart Beta Strategy. Retrieved April 14, 2018, from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2522817
- OECD. (2016). *Hungary*.
- Osborne, M., Fuertes, A., & Milne, A. (2012). Capital and profitability in banking: Evidence from US banks. In *3rd Emerging Scholars in Banking and Finance Conference, Cass Business School*. Retrieved from https://www.cass.city.ac.uk/__data/assets/pdf_file/0013/152122/Osborne_Matthew_Capital-and-earnings-in-banking-Emerging-Scholars.pdf
- Perotti, E., & Suarez, J. (2011). A Pigovian approach to liquidity regulation. *International Journal of Central Banking*, 7(4), 3–41.
- Petersen, M. A. (2009). Estimating standard errors in finance panel data sets: Comparing approaches. *The Review of Financial Studies*, 22(1), 435–480.
- Philippon, T. (2011). The Size of the US Finance Industry: A Puzzle? *Federal Reserve Bank of New York*, 11, 1–30. Retrieved from https://www.newyorkfed.org/medialibrary/media/research/conference/2011/NYAMP/Fed_Philippon_v1.pdf
- Podgórski, B. (2018). Impact of the January Effect on Return Rates in the Markets of the 2004 EU Enlargement. *Journal of Management and Business Administration. Central Europe*, 26(1), 27–48.
- PwC. (2013). Financial Transaction Taxes: Developing a strategic response. Retrieved January 16, 2019, from <https://www.pwc.com/gx/en/financial-services/financial-transaction-taxes/assets/pwc-financial-transactions-taxes.pdf>
- Reinhart, C. M., & Rogoff, K. S. (2013). Banking crises: An equal opportunity menace. *Journal of Banking & Finance*, 37(11), 4557–4573. <https://doi.org/10.1016/J.JBANKFIN.2013.03.005>

- Reiter, F. (2018). *Taxing Transmitters of Distress: Evidence from the German Bank Levy*. Working Paper. Retrieved from <https://www.ifo.de>
- Salas, V., & Saurina, J. (2002). Credit risk in two institutional regimes: Spanish commercial and savings banks. *Journal of Financial Services Research*, 22(3), 203–224.
- Schneider, M. (2001). *Borrowing constraints in a dynamic model of bank asset and liability management*. University of Rochester, Department of Economics. Mimeograph. Retrieved from https://pdfs.semanticscholar.org/3f6e/70a10e2e07a328f8ccc6890296b4e1db20a8.pdf?_ga=2.204461136.1172160923.1560528342-1305835172.1560528342
- Schweikhard, F. A., & Wahrenburg, M. (2013). The Internalization of Systemic Risk: An Analysis of Bank Levy Schemes. *SSRN Electronic Journal*. Retrieved from https://www.schweikhard.org/papers/Paper_GovInt_L.pdf
- Stiroh, K. J. (2004). Diversification in banking: Is noninterest income the answer? *Journal of Money, Credit, and Banking*, 36(5), 853–882.
- Sullivan & Cromwell. (2011). Bank Levies in the UK, France and Germany. Retrieved January 2, 2019, from https://www.sullcrom.com/siteFiles/Publications/SC_Publication_Bank_Levies_in_the_UK_France_and_Germany.pdf
- Szołno-Koguc, J., & Twarowska, M. (2015). Dodatkowe Daniny Publiczne Sektora Finansowego (Banków) – Przegląd Międzynarodowy. *ALTERUM Ośrodek Badań i Analiz Systemu Finansowego, December*, 1–87. Retrieved from http://alterum.pl/uploaded/Ekspertyza_-_dodatkowe_daniny_publiczne_sektora_finansowego.pdf
- Taylor, A. M. (2012). External imbalances and financial crises. *BER Working Papers*, 18606. Retrieved from <http://www.nber.org/papers/w18606.pdf>
- Trujillo-Ponce, A. (2013). What determines the profitability of banks? Evidence from Spain. *Accounting & Finance*, 53(2), 561–586.
- Uhde, A., & Heimeshoff, U. (2009). Consolidation in banking and financial stability in Europe: Empirical evidence. *Journal of Banking & Finance*, 33(7), 1299–1311.

Tables

TABLE 1 Summary of levy structures in some European countries.

<i>Country</i>	<i>Year of implementation</i>	<i>Tax base</i>	<i>Tax rate</i>	<i>Exclusion</i>	<i>Purpose</i>	<i>Tax Expense</i>
France	2011	Minimal amount of own funds required to comply with coverage ratio obligations determined by the regulator (risk-weighted assets)	0.5%	Requirement of minimal own funds amounting to EUR 500 m	Central Budget	YES
Germany	2011	Total liabilities and off-balance sheet derivatives	Progressive rates for 'relevant liabilities': ≤ 10 bn = 0.02%, > 10 bn ≤ 100 bn = 0.03%, > 100 bn < 200 bn = 0.04%, > 200 bn < 300 bn = 0.05%, > 300 bn = 0.06%, 0.0003% for off-balance sheet derivatives	Customers' deposits and non-bank equity capital	Stabilization fund	NO
Hungary	2010	Total assets	Progressive rates: ≤ HUF 50 bn = 0.15% > HUF 50 bn = 0.53%	Debt receivables from interbank loans, securities and shares issued by other credit institutions, financial enterprise or investment company loans, subordinated loans and supplementary subordinated loans granted to financial enterprises and investment companies (including reverse placement transactions, repurchase agreements and delivery repurchase agreements concluded with such institutions)	Central Budget	YES
Poland	2016	Total assets	0.0366% (monthly)	PLN 4 bn (banks); PLN 2 bn (insurance companies); government bonds	Central Budget	NO
United	2011	Total	0.036% for	GBP 20 bn tier-1 capital, Nominal capital	Central	YES

<i>Kingdom</i>	chargeable equity and liabilities	short-term liabilities; 0.071% for long-term liabilities	and assured bank deposits	Budget
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Source: Szolmo-Koguc & Twarowska, (2015); PwC, (2013); Capelle-Blancard & Havrylchyk, (2017); KPMG, (2017); Chaudhry, Mullineux, & Agarwal, (2015);

TABLE 2 Explanation and construction of all variables used.

Label	Explanation	Measurement
Dependent Variables		
Z-score	This ratio predicts the bankruptcy of financial institutions (Altman et al., 2013). A higher Z-score indicates that a financial institutions is farther from default and, therefore, more stable (Delis & Staikouras, 2011).	Z-score is defined as the ratio of the sum of the bank's average capitalization to the standard deviation of return on assets. Z-scores are estimated as four-year moving averages.
LLP	Loan Loss provisions are considered as the most important accrual from a bank' balance sheet. At the same time, financial institutions' managers have a significant discretionary power to manipulate loan Loss provisions.	The book value of loan Loss provisions to total assets as a percentage.
ROE-Volatility (robustness check)	ROE volatility ratio as a proxy of financial institutions' risky activities. The increase in ROE volatility increases the financial risk (Kwan, 1997). Moreover, higher volatility of ROE indicates a lower quality of earnings (Minami & Wakatsuki, 2014). Financial institutions that are more willing to take risk should, on average, experience more extreme outcomes. Assuming that levies reduce risk, financial institutions exposed to the levies should experience equity returns closer to reference level volatility (Devereux et al., 2013).	The absolute difference between the book value of return on equity of the financial institution itself and the median book value of return on equity within the reference group of the financial institution, with the same size decile and the same equity-asset decile.
Control variables		
BL	We assign a value of one for all years starting from the introduction year onwards, and a value of zero for all previous years. The inclusion of this variable is especially important, as it allows distinguishing between risk effects stemming from diversification and those of an associated amount of paid levy.	Dummy if a company j paid bank levy in a year of t, then equals to 1; otherwise zero.
BLpaid	Simulated amount of bank levy payments during each year.	Natural logarithm of amount calculated according to table 1.
Loan activity	This ratio measures bank's activity. This greater relative proportion of loans in the portfolio of the financial institutions is usually coupled with a greater liquidity risk arising from the financial institutions' inability to accommodate decreases in liabilities or to fund increases on the asset side of the balance sheet (Trujillo-Ponce, 2013).	Natural logarithm of total loans-to-total assets.
Size	FI size has been shown to be an important determinant of a bank's propensity for risk-taking. We use log transformation to allow for a possible nonlinear relation with risk. Large financial institutions have the ability to diversify risk across product lines and are more skilled in risk management than small entities (Salas & Saurina, 2002). On the other hand, larger financial institutions tend to be more willing to take risk due to the moral hazard problem (De Jonghe, 2010; Uhde & Heimeshoff, 2009).	Natural logarithm of total asset.
Efficiency	Existing research confirms that less efficient financial institutions are more willing to take on additional risk (Louzis et al., 2012) to improve their financial performance.	Cost to income ratio.
Loss	We control for the financial performance of the companies using the dummy variable indicating whether the company made a loss in the current year. We argue that declining profitability could tip the incentives of bank managers towards assuming greater risk in an effort to maintain former profit levels (Edwards & Mishkin, 1995).	Dummy if a company j has a loss in a year of t, then equals to 1; otherwise zero.
Liquidity	We use the liquidity ratio defined as the ability of a financial institution to fund increases in assets and meet obligations as they become due, without incurring unacceptable losses. Research shows that more liquid financial institutions behave less risky (Kashyap, Rajan & Stein, 2002)	Current assets to total assets.
Capital ratio	Capital ratio measures the institution's financial strength and should have an effect on the risk-taking behaviour of the financial institution (Tran, Lin, & Nguyen, 2016).	Equity to total assets ratio.
Inflation	Inflation creates pressure for financial institutions to modify their behaviour in competing for funds and make financial institutions more keenly aware of higher interest rates on money market instruments (Arpa, Giuliani, Ittner, and Pauer; 2001).	Value of Inflation in a given year.

TABLE 3 Summary statistics on unconsolidated financial statement of Hungarian and German financial institutions for the entire sample period (2005-2015).

VARIABLES	Hungarian credit institutions					German financial institutions				
	N	mean	sd	min	max	N	mean	sd	min	max
LLP (%)	157	0.800	2.200	-6.400	20.200	1,725	0.200	0.700	-4.100	8.200
Z-score	243	14.610	9.344	-4.937	49.640	1,725	6.506	9.004	-7.388	49.905
ROE volatility	243	13.982	18.623	0.000	147.176	1,725	0.870	16.62598	-179.883	170.775
Loan activity (%)	234	53.000	25.000	2.200	98.600	1,725	59.500	19.800	0.000	99.800
Total Asset, in EUR K	243	1,926,077	3,978,985	134.000	23,485,343	1,725	26,900,000	291,000,000	449.000	11,800,000,000
Efficiency	243	64.870	20.240	6.641	98.420	1,725	67.239	22.097	0.000	269.700
Loss	243	0.173	0.379	0.000	1.000	1,725	0.046	0.210	0.000	1.000
Liquidity ratio	242	0.357	0.252	0.001	0.939	1,725	0.162	0.155	0.000	0.995
Capital ratio	243	12.073	8.331	-2.964	48.124	1,725	0.072	0.050	0.000	0.644
Inflation (%)	243	2.991	2.398	-0.222	6.066	1,725	1.608	0.746	0.800	3.100
GDPgrowth (%)	243	0.888	2.985	-6.564	4.047	1,725	1.274	3.266	-5.619	4.080
ROA (%)	243	1.26	2.69	-7.666	14.987	1,725	3.753	12.706	-2.000	67.000
ROE (%)	242	9.29	23.54	-133.333	80.928	1,725	4.037	7.457	-93.722	99.000

TABLE 4 Summary statistics on unconsolidated financial statement of Hungarian and German financial institutions before the implementation of the BL (Hungary in 2005-2009 and Germany in 2005-2010).

VARIABLES	Hungarian credit institutions					German financial institutions				
	N	mean	sd	min	max	N	mean	sd	min	max
LLP (%)	28	1.000	3.880	-1.990	20.200	1,024	0.400	0.500	-4.000	8.200
Z-score	49	14.570	8.729	-4.937	40.910	1,024	6.976	9.447	-2.165	49.900
ROE volatility	49	7.667	7.980	0.000	40.215	1,024	1.338	17.02806	-149.856	170.7746
Loan activity (%)	47	52.300	24.700	6.790	95.300	1,024	58.300	19.300	0.000	81.730
Total Asset, in EUR K	49	1,860,797	3,692,996	27,949	17,942,739	1,024	23,840,000	119,200,000	100.000	1,783,000,000
Efficiency	49	63.880	21.030	6.641	94.950	1,024	66.239	19.431	0.000	269.700
Loss	49	0.102	0.306	0.000	1.000	1,024	0.045	0.207	0.000	1
Liquidity ratio	49	0.388	0.263	0.003	0.919	1,024	0.167	0.146	0.000	0.969
Capital ratio	49	12.170	8.314	-2.964	39.430	1,024	0.061	0.043	0.000	0.523
Inflation (%)	49	5.157	0.938	4.209	6.066	1,024	1.608	0.746	0.800	3.100
GDPgrowth (%)	49	-2.761	3.764	-6.564	0.889	1,024	1.274	3.266	-5.619	4.080
ROA (%)	49	1.261	2.007	-5.120	5.931	854	5.633	15.518	-2.000	67.000
ROE (%)	48	11.914	12.908	-29.222	40.494	854	4.214	7.218	-93.722	99.000

TABLE 5 Summary statistics on unconsolidated financial statements of Hungarian and German financial institutions after BL was implemented (Hungary in 2010- 2015 and Germany in 2011-2015).

Hungarian credit institutions						German financial institutions				
VARIABLES	N	mean	sd	min	max	N	mean	sd	min	max
LLP (%)	129	0.746	1.720	-6.370	10.000	701	-0.100	0.700	-4.100	4.200
Z-score	194	14.620	9.514	-0.405	49.640	701	5.009	7.732	-7.388	49.806
ROE volatility	194	15.577	20.158	0.000	147.176	701	0.185	16.008	-179.88	80.058
Paid BL in EUR K	194	979587	2060408	9.650	11,909,878	696	2117.221	15855.830	0.246	271,231
LoanActivity Ratio	187	53.200	25.200	2.240	98.600	701	56.500	22.200	0.000	98.900
Total Asset, in EUR K	194	1,942,553	4,056,700	0.067	23,491,915	701	31,400,000	437,000,000	362.000	11,800,000,000
Efficiency	194	65.120	20.090	10.800	98.420	701	69.149	25.370	0.100	161.326
Loss	194	0.191	0.394	0.000	1.000	701	0.047	0.212	0.000	1.000
Liquidity ratio	193	0.349	0.249	0.000	0.931	701	0.153	0.167	0.003	0.995
Capital ratio	194	12.049	8.358	0.990	48.124	701	0.085	0.056	0.000	0.643
Inflation (%)	194	2.444	2.346	-0.222	5.668	701	1.112	0.815	0.200	2.100
GDPgrowth (%)	194	1.810	1.848	-1.603	4.047	701	1.839	1.171	0.490	3.660
ROA (%)	194	1.265	2.840	-7.666	14.987	696	1.208	6.673	-0.870	65.000
ROE (%)	194	8.642	25.483	-133.333	80.928	665	3.805	7.421	-17.843	72.000

TABLE 6 Data presenting estimations based on a fixed effect estimator regarding all Hungarian credit institutions and all Hungarian commercial banks during the period between 2008 and 2015. Symbols *, **, *** represent statistical significance at the level of 10%, 5%, and 1%, respectively.

VARIABLES	All financial institutions		Commercial banks	
	LLP	Z-score	LLP	Z-score
BL	1.318***	-0.0918	1.347	-0.275
	(0.435)	(1.338)	(0.818)	(1.758)
Loan activity	-1.372*	-0.190	-1.060	-0.502
	(0.767)	(1.009)	(0.693)	(1.285)
Size	-0.422	-2.186	-0.950	-0.113
	(0.520)	(1.666)	(1.200)	(1.959)
Efficiency	-1.857**	-3.008***	-1.360*	-4.691***
	(0.727)	(1.006)	(0.714)	(1.513)
Loss	1.064**	-3.424***	1.111	-4.639***
	(0.493)	(0.769)	(0.966)	(0.759)
Liquidity	-1.192**	0.445	-1.368***	0.395
	(0.459)	(0.579)	(0.379)	(0.695)
Capital ratio	-1.966*	9.981***	-2.746	11.76***
	(1.144)	(1.632)	(2.562)	(2.220)
Inflation	0.102*	-0.0622	0.0927*	-0.00280
	(0.0515)	(0.135)	(0.0486)	(0.177)
GDPgrowth	-0.0139	0.0614	0.0275	0.123
	(0.0401)	(0.124)	(0.0474)	(0.169)
Constant	16.38	46.68	26.44	10.22
	(13.30)	(32.38)	(29.81)	(37.45)
Observations	157	243	109	165
R-squared	0.397	0.539	0.388	0.505
Instytution FE	YES	YES	YES	YES

TABLE 7 Data present estimations based on a fixed effect estimator regarding all Hungarian, commercial banks required to pay the levy at a lower rate and all Hungarian commercial banks that have to pay the levy at a higher late during the period between 2008 and 2015. Symbols *, **, *** represent statistical significance at the level of 10%, 5%, and 1%, respectively.

VARIABLES	Commercial banks with total assets below 50 billion forints		Commercial banks with total assets equal and above 50 billion forints	
	LLP	Z-score	LLP	Z-score
BL	2.597*** (0.0594)	-1.083 (0.906)	1.280 (0.914)	-0.338 (2.246)
Loan activity	2.053 (2.445)	-1.064 (0.817)	-0.362 (0.782)	0.387 (1.051)
Size	3.228*** (0.549)	-4.070 (2.567)	-0.839 (1.227)	0.895 (2.872)
Efficiency	0.330 (2.113)	-7.506*** (2.458)	-1.798** (0.778)	-5.193** (1.992)
Loss	2.651*** (0.245)	-4.281*** (1.163)	1.804 (1.196)	-5.522*** (0.899)
Liquidity	4.849*** (1.069)	2.133 (2.277)	-1.347*** (0.383)	0.440 (0.770)
Capital ratio	0.428 (1.563)	16.72*** (2.436)	-3.155 (2.720)	11.40*** (2.703)
Inflation	0.385*** (0.0910)	-0.526 (0.323)	0.098* (0.050)	0.059 (0.252)
GDPgrowth	-0.007 (0.041)	0.126 (0.123)	0.0167 (0.0421)	0.151 (0.254)
Constant	-51.62*** (9.241)	80.54 (48.50)	27.56 (31.23)	-6.121 (54.56)
Observations	23	38	86	127
R-squared	0.837	0.894	0.446	0.430
Instytution FE	YES	YES	YES	YES

TABLE 8 Data presenting estimations based on a fixed effect estimator regarding all non-commercial credit institutions in Hungary during the period between 2008 and 2015. Symbols *, **, *** represent statistical significance at the level of 10%, 5%, and 1%, respectively.

VARIABLES	Non-commercial credit institutions	
	LLP	Z-score
BL	1.152** (0.532)	0.987 (1.449)
Loan activity	-3.119 (2.527)	-3.498 (2.901)
Size	0.213 (0.525)	-6.230** (2.177)
Efficiency	-1.982** (0.719)	-0.923 (0.878)
Loss	0.885* (0.496)	-2.102* (1.180)
Liquidity	-0.452 (0.376)	0.302 (0.639)
Capital ratio	-1.231 (1.099)	8.838*** (2.239)
Inflation	0.121 (0.096)	-0.140 (0.170)
GDPgrowth	-0.026 (0.0576)	-0.149 (0.117)
Constant	2.679 (11.55)	114.2** (42.01)
Observations	48	78
R-squared	0.578	0.743
Instytution FE	YES	YES

TABLE 9 Data presenting estimations based on a fixed effect estimator regarding all credit institutions in Hungary during the period between 2008 and 2015. Symbols *, **, *** represent statistical significance at the level of 10%, 5%, and 1%, respectively.

VARIABLES	All financial institutions		Commercial banks	Non-commercial intitutions
	LLP	Z-score	LLP	LLP
BLpaid	0.0671***	0.00335	0.0642	0.0648**
	(0.0215)	(0.0730)	(0.0399)	(0.0268)
Loan activity	-1.282*	-0.189	-1.003	-3.121
	(0.753)	(1.015)	(0.706)	(2.526)
Size	-0.450	-2.174	-0.885	0.122
	(0.514)	(1.703)	(1.174)	(0.549)
Efficiency	-1.848**	-3.008***	-1.381*	-1.952**
	(0.718)	(1.004)	(0.726)	(0.715)
Loss	1.072**	-3.422***	1.142	0.843
	(0.485)	(0.781)	(0.945)	(0.505)
Liquidity	-1.179**	0.447	-1.364***	-0.472
	(0.448)	(0.581)	(0.367)	(0.359)
Capital ratio	-1.939*	9.988***	-2.582	-1.248
	(1.125)	(1.635)	(2.480)	(1.085)
Inflation	0.105**	-0.061	0.104**	0.122
	(0.051)	(0.136)	(0.046)	(0.095)
GDPgrowth	-0.0114	0.0633	0.0362	-0.0349
	(0.042)	(0.126)	(0.0503)	(0.0534)
Constant	16.97	46.46	25.03	4.322
	(13.27)	(33.03)	(29.35)	(12.08)
Observations	157	243	109	48
R-squared	0.393	0.539	0.381	0.588
Instytution FE	YES	YES	YES	YES

TABLE 10 Data presenting estimations based on a fixed effect estimator regarding all credit institutions in Hungary during the period between 2008 and 2015. Symbols *, **, *** represent statistical significance at the level of 10%, 5%, and 1%, respectively.

VARIABLES	ROE-Volatility			
	All financial institutions	Commercial banks	Commercial banks with total assets below 50 billion forints	Commercial banks with total assets equal and above 50 billion forints
BL	5.255*	2.645*	8.575**	3.509
	(3.509)	(2.766)	(2.870)	(3.403)
Loan activity	1.314	2.004	-5.982	5.807
	(2.528)	(2.037)	(4.503)	(4.160)
Size	-1.259	5.445	-13.56	6.160
	(6.643)	(5.006)	(8.813)	(8.266)
Efficiency	-1.003	-2.885	-16.69**	0.822
	(5.795)	(6.222)	(5.879)	(7.218)
Loss	21.46***	22.95***	3.741	27.04***
	(5.421)	(8.171)	(2.715)	(9.617)
Liquidity	4.761**	6.048***	-5.539**	7.892***
	(2.089)	(1.699)	(2.488)	(2.304)
Capital ratio	-8.310	0.934	-9.641	-1.748
	(9.744)	(4.515)	(7.381)	(5.781)
Inflation	0.0701	0.503	-1.103	0.749
	(0.628)	(0.716)	(1.021)	(0.779)
GDPgrowth	-0.413	-0.107	-0.689	-0.0129
	(0.363)	(0.329)	(0.496)	(0.335)
Constant	61.41	-78.06	322.9*	-99.89
	(136.8)	(100.5)	(179.6)	(161.8)
Observations	243	165	38	127
R-squared	0.236	0.242	0.493	0.283
Instytution FE	YES	YES	YES	YES

TABLE 11 Data presenting estimations based on a fixed effect estimator regarding all German financial institutions and all German commercial banks during the period between 2005 and 2015. Robust standard errors that control for clustering at the bank-level are reported in brackets. Symbols *, **, *** represent statistical significance at the level of 10%, 5%, and 1%, respectively.

VARIABLES	All financial institutions		Commercial banks	
	LLP	Zscore	LLP	z-score
BL	-0.648*** (0.0702)	0.965 (0.650)	-0.364*** (0.130)	1.166 (0.912)
Loan activity	-0.568*** (0.110)	4.948*** (1.429)	0.101 (0.0632)	3.098 (3.774)
Size	0.0796 (0.0602)	1.151** (0.537)	0.151 (0.359)	6.698*** (2.474)
Efficiency	0.0759*** (0.0179)	-0.0356 (0.180)	0.0962*** (0.0212)	0.0566 (0.201)
Loss	0.219** (0.0859)	-3.794*** (0.633)	0.198 (0.160)	-3.253*** (1.200)
Liquidity	-0.0201 (0.0266)	0.0981 (0.460)	0.0754 (0.0697)	-0.850 (0.698)
Capital ratio	-0.158 (0.109)	-0.0191 (0.362)	-0.183 (0.152)	2.836*** (0.897)
Inflation	-0.017 (0.013)	-0.143 (0.258)	0.0167 (0.0278)	-0.448 (0.415)
GDPgrowth	-0.0016 (0.003)	-0.182** (0.082)	0.019* (0.011)	-0.238 (0.249)
Constant	-1.204 (0.881)	-11.73 (8.101)	-2.473 (5.086)	-87.04** (35.41)
Observations	1,725	1,725	691	691
R-squared	0.279	0.029	0.201	0.052
Institution FE	YES	YES	YES	YES

TABLE 12 Data present estimations based on a fixed effect estimator regarding German commercial banks with contribution-relevant liabilities lower than EUR 10 billion and all German banks with contribution-relevant liabilities higher than EUR 10 billion during the period between 2005 and 2015. Symbols *, **, *** represent statistical significance at the level of 10%, 5%, and 1%, respectively.

VARIABLES	contribution-relevant liabilities below and equal to EUR 10 billion		contribution-relevant liabilities above EUR 10 billion	
	LLP	Z-score	LLP	Z-score
BL	-0.367** (0.143)	0.108 (1.647)	-0.180 (0.114)	-1.704 (1.809)
Loan activity	0.108* (0.0652)	0.154 (0.505)	0.232 (0.187)	7.958** (3.234)
Size	0.166 (0.408)	6.807*** (2.546)	-0.193 (0.240)	-3.137 (4.077)
Efficiency	0.104*** (0.0227)	0.118 (0.225)	0.00962 (0.0198)	-0.639 (0.377)
Loss	0.251 (0.199)	-3.325*** (0.888)	-0.0102 (0.208)	-1.456 (2.346)
Liquidity	0.0735 (0.071)	-0.965 (0.774)	0.228 (0.156)	3.351 (3.359)
Capital ratio	-0.225 (0.189)	2.770*** (0.934)	0.0121 (0.103)	2.382*** (0.743)
Inflation	0.018 (0.031)	-0.345 (0.428)	0.0479 (0.0545)	-0.365 (0.652)
GDPgrowth	0.020* (0.012)	-0.231 (0.259)	-0.004 (0.009)	0.142 (0.118)
Constant	-2.745 (5.626)	-86.12** (34.98)	4.304 (4.522)	85.48 (77.39)
Observations	638	638	53	53
R-squared	0.217	0.050	0.120	0.309
Institution FE	YES	YES	YES	YES

TABLE 13 Data presenting estimations based on fixed effect an estimator regarding German non-commercial banks during the period between 2005 and 2015. Robust standard errors that control for clustering at the bank-level are reported in brackets. Symbols *, **, *** represent statistical significance at the level of 10%, 5%, and 1%, respectively.

VARIABLES	FI other than commercial banks	
	LLP	Z-score
BL	-0.564***	0.747
	(0.0797)	(0.815)
Loan activity	-0.0859	0.282
	(0.0802)	(0.429)
Size	-0.294**	2.325
	(0.137)	(1.467)
Efficiency	0.0434	-0.301
	(0.0453)	(0.598)
Loss	0.141	-3.085***
	(0.111)	(0.759)
Liquidity	-0.0590	0.0102
	(0.0528)	(0.725)
Capital ratio	-1.031***	5.437***
	(0.257)	(1.940)
Inflation	-0.012	-0.836**
	(0.013)	(0.327)
GDPgrowth	-0.0028	-0.109
	(0.0031)	(0.088)
Constant	1.370	-7.925
	(1.757)	(19.21)
Observations	1,034	1,034
R-squared	0.401	0.035
Institution FE	YES	YES

TABLE 14 Data presenting estimations based on a fixed effect estimator regarding all German financial institutions during the period between 2005 and 2015. Symbols *, **, *** represent statistical significance at the level of 10%, 5%, and 1%, respectively.

VARIABLES	All financial institutions		Commercial bank	Non-commercial institutions
	LPP	Z-score	LLP	LLP
BLpaid	0.001	-0.234**	-0.010	-0.018**
	(0.006)	(0.103)	(0.013)	(0.008)
Loan activity	-0.0770	-0.928**	-0.011	-0.040
	(0.050)	(0.404)	(0.073)	(0.077)
size	-0.054	0.383	-0.044	-0.724***
	(0.117)	(0.488)	(0.385)	(0.175)
Efficiency	0.087***	-0.052	0.097***	0.040
	(0.017)	(0.186)	(0.021)	(0.044)
Loss	0.253***	-3.972***	0.137	0.137
	(0.086)	(0.668)	(0.172)	(0.118)
Liquidity	0.0203	-0.139	0.099	-0.070
	(0.031)	(0.477)	(0.072)	(0.068)
Capital ratio	-0.340*	-0.596	-0.252	-1.762***
	(0.185)	(0.437)	(0.184)	(0.322)
Inflation	-0.017	0.0350	0.004	-0.041***
	(0.017)	(0.260)	(0.032)	(0.014)
GDPgrowth	-0.018***	-0.168**	0.013	-0.011***
	(0.003)	(0.080)	(0.009)	(0.003)
Constant	-0.224	-0.452	-0.0346	5.594**
	(1.738)	(7.152)	(5.449)	(2.193)
Observations	1,725	1,725	691	1,034
R-squared	0.119	0.022	0.164	0.311
Institution FE	YES	YES	YES	YES

TABLE 15 Data presenting estimations based on a fixed effect estimator regarding all German financial institutions during the period between 2005 and 2015. Symbols *, **, *** represent statistical significance at the level of 10%, 5%, and 1%, respectively.

VARIABLES	ROE-Volatility			
	All financial institutions	Commercial banks	contribution-relevant liabilities below and equal to EUR 10 billion	contribution-relevant liabilities above EUR 10 billion
BL	-0.957	-6.773**	-7.000**	-8.365
	(0.841)	(2.725)	(2.888)	(6.682)
Loan activity	0.0933	-0.237	-0.435	-13.09
	(0.523)	(1.006)	(1.231)	(10.63)
size	-0.334	-9.957	-12.86*	-11.90
	(0.995)	(6.287)	(7.492)	(11.05)
Efficiency	0.127	-0.128	-0.274	1.076
	(0.238)	(0.211)	(0.226)	(0.811)
Loss	1.233	3.695	1.375	8.425
	(2.715)	(2.772)	(1.999)	(6.819)
Liquidity	-0.985	-2.594	-2.568	1.732
	(0.832)	(1.832)	(1.873)	(18.35)
Capital ratio	0.384	-4.777	-6.890	2.341
	(0.924)	(3.542)	(4.405)	(2.550)
Inflation	1.086*	2.121**	1.999*	4.148
	(0.561)	(1.055)	(1.102)	(3.650)
GDPgrowth	-0.0619	-0.0584	-0.0131	-0.567
	(0.152)	(0.298)	(0.318)	(1.096)
Constant	3.102	130.2	163.9*	224.8
	(13.69)	(81.18)	(93.95)	(214.4)
Observations	1,725	691	638	53
R-squared	0.060	0.062	0.069	0.154
Institution FE	YES	YES	YES	YES